Difi
Direktoratet for
forvaltning og ikt

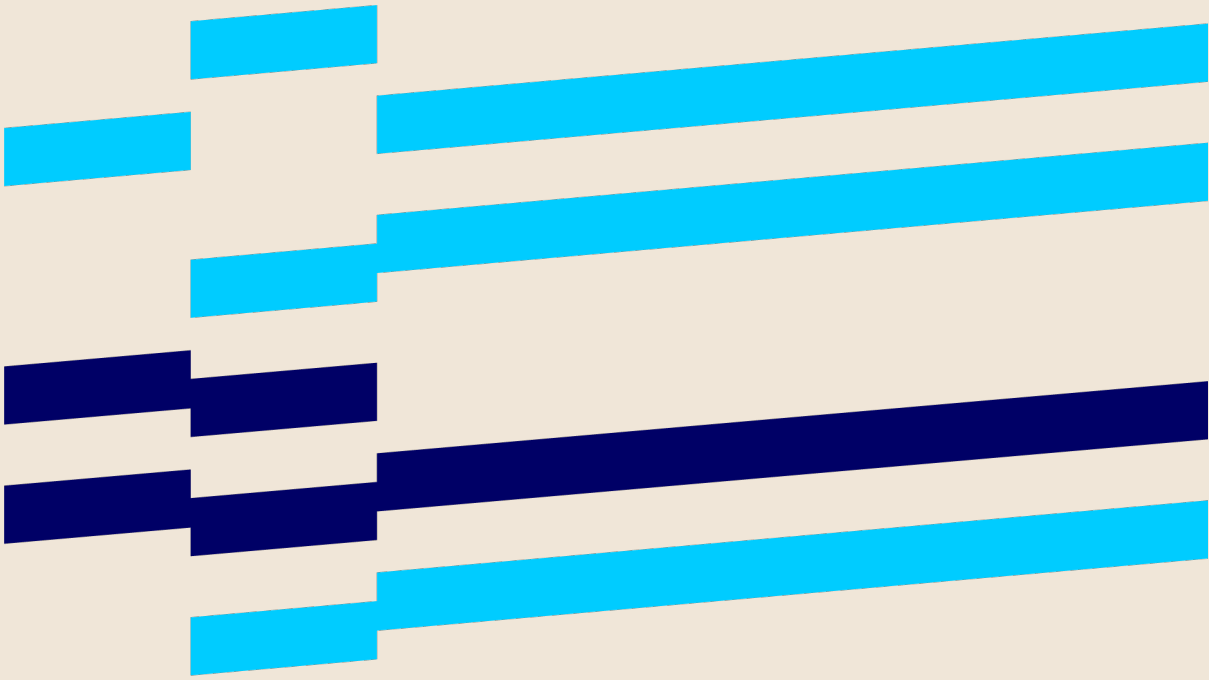
SSA-T 2018

Development and Customisation Agreement

Agreement governing the delivery of software that is developed or customised for the Customer

The Norwegian Government's Standard Terms and Conditions for IT Procurement

SSA-T



Agreement governing the delivery of software that is developed or customised for the Customer

An agreement concerning
[designation of the procurement]

has been concluded between:

[Write here]

_____
(hereinafter referred to as the Contractor)

and

[Write here]

_____

(hereinafter referred to as the Customer)

Place and date:

[Write place and date here]

_____

(NB: Concerning the duration of the Agreement, see clause 5.1.)

[The Customer's name here]	[The Contractor's name here]
_____	_____
Signature of the Customer	Signature of the Contractor

The Agreement is signed in two copies; one for each party.

Communications
Unless otherwise specified in Appendix 6, all communication concerning this Agreement shall be directed to:

On behalf of the Customer:	**On behalf of the Contractor:**
Name:	Name:
Position:	Position:
Telephone:	Telephone:
Email:	Email:

Contents

1. GENERAL PROVISIONS

1.1 SCOPE OF THE AGREEMENT

The Agreement governs the delivery of software that is developed or customised for the Customer, as well as configuration, the setting of parameters, integration work, and other services associated with the customisation of software for the Customer as described in Appendices 1 and 2 ("the deliverables").

The Agreement shall also apply to any delivery of equipment, training, etc.

The Customer has, based on its purposes and needs, specified its requirements in Appendix 1 (Customer requirements specification) and has described the software and the systems with which the software shall be compatible in Appendix 3. The Contractor has described its solution, based on the Customer requirements specification and the Contractor's assumptions in respect of the deliverables, in Appendix 2 (Contractor solution specification), including any requirements relating to the Customer's operating environment that must be satisfied in order to enable the Customer to utilize the deliverables. If the Contractor is of the view that there are obvious errors or ambiguities in the Customer requirements specification, the Contractor shall point this out in Appendix 2.

If Appendix 1 stipulates that the deliverables shall function together with the Customer's current technical platform, the Customer shall describe this in Appendix 3. If the Customer's technical platform needs to be upgraded in order to enable the Customer to utilize the deliverables, the Contractor shall point this out in Appendix 2.

The Contractor shall, in Appendix 2, inform the Customer of the likely consequences of the relevant customisations in terms of the complexity and price of any future maintenance of the standard system and customization.

If Customer participation is a requirement for the Contractor to be able to deliver according to the agreement, the Contractor must, in appendix 2, describe the Customer’s participation in sufficient detail as to enable the Customer to prepare and provide specified expertise at the specified time according to the agreement.

The scope and delivery of the deliverables are described in more detail in the Appendices included as part of the Agreement.

The "Agreement" means this general contractual wording, including Appendices.

1.2 APPENDICES TO THE AGREEMENT

All rows shall be ticked (Yes or No)	Yes	No
Appendix 1: Customer requirements specification		
Appendix 2: Contractor solution specification		
Appendix 3: Customer technical platform		
Appendix 4: Project and progress plan		
Appendix 5: Testing and approval		
Appendix 6: Administrative provisions		
Appendix 7: Total price and pricing provisions		
Appendix 8: Changes to the general contractual wording		
Appendix 9: Changes subsequent to the conclusion of the Agreement		
Appendix 10: Licence terms and conditions for standard software and free software		
Other Appendices:		

1.3 INTERPRETATION – RANKING

Changes to the general contractual wording shall be set out in Appendix 8, unless the general contractual wording refers such changes to a different Appendix.

The following principles of interpretation shall apply in the case of conflict:

1. The general contractual wording shall prevail over the Appendices.
2. Appendix 1 shall prevail over the other Appendices.
3. To the extent that the clause or clauses that have been changed, replaced or supplemented, are clearly and unequivocally specified, the following principles of precedence shall apply:
    a) Appendix 2 shall prevail over Appendix 1.
    b) Appendix 8 shall prevail over the general contractual wording.
    c) If the general contractual wording refers to changes to any other Appendix than Appendix 8, such changes shall prevail over the general contractual wording.
    d) Appendix 9 shall prevail over the other Appendices.

4. The standard licence terms and conditions (Appendix 10) shall apply between the producer of any standard software (licensor) and the Customer, but these shall not change the Contractor's obligations under this Agreement to an extent greater than that which is stipulated in clause 5.1 (The Contractor's responsibility for the deliverables) and chapter 10.7 (Free software). "Standard software" means software that is produced for delivery to multiple users, where a licence (right of disposal) may be acquired independent of services from the software producer.

1.4 THE REPRESENTATIVES OF THE PARTIES

Upon the conclusion of the Agreement, each of the parties shall appoint a representative who is authorized to act on behalf of such party in matters relating to the Agreement. The authorized representatives of the parties, as well as procedures and notice periods for any replacement thereof, shall be specified in more detail in Appendix 6.

1.5 THE PHASES AND MILESTONES OF THE AGREEMENT

The Agreement is split into five phases: the preparatory phase (chapter 2.1), the specification phase (chapter 2.2), the development phase (chapter 2.3), the acceptance test phase (chapter 2.4), and the approval period (chapter 2.5). The specification phase, development phase, acceptance test, and approval period may be repeated as often as is necessary to realize the deliverables, see clause 2.1.4 (Partial deliveries).

The main milestones in the Agreement are:

- Approval of the detailed specification (2.2.2)
- Solution ready for acceptance test (2.4.2)
- Acceptance test approved (2.4.6)
- Delivery date (2.5.3)

2. PERFORMANCE OF THE DELIVERABLES

2.1 PREPARATIONS AND ORGANIZATION

2.1.1 Project and progress plan

An overall project and progress plan for the delivery of the deliverables shall be included in Appendix 4.

During the planning phase, the Contractor shall, in cooperation with the Customer, prepare a detailed project and progress plan within the framework defined by the overall plan in Appendix 4. The detailed project and progress plan shall define activities under the milestones defined by the general plan and describe the scope of the Customer's contribution to the project, including resource and time estimates. Those parts of the plan that concern the Customer's participation shall be approved by the Customer. This shall not affect the responsibility of the Contractor for the delivery of the deliverables. If partial deliveries as described in clause 2.1.4 are used, this shall be stipulated in the plan.

The Contractor shall be responsible for keeping the plan updated in the case of changes. An updated version of the plan shall be available to both the Customer and the Contractor at any given time.

2.1.2 Project organisation

The project organisation, definition of roles, responsibilities and authorisations, management documents, reporting, meetings and frequency of meetings are described in Appendix 6.

2.1.3 Project documentation

The Contractor shall prepare and update, on an ongoing basis, the project documentation specified in Appendix 6.

The Contractor shall provide the Customer with status reports for the project in conformity with the procedures agreed in Appendix 6.

2.1.4 Partial deliveries

The deliverables may be split into partial deliveries that are introduced over time. An overall plan for this shall be set out in Appendix 4. The procedures in this Agreement's chapters 2.2-2.4 shall be repeated in connection with each partial delivery. If the partial deliveries shall be put into production on an ongoing basis as they are fully developed and tested, an approval period shall be conducted for each partial delivery, cf. chapter 2.5. Unless otherwise is stipulated in Appendix 4, an overall specification for all of the deliverables, which shows how the combination of the partial deliveries satisfies the overall scope of delivery pursuant to the Agreement, shall be prepared as part of the specification phase for the first partial delivery.

During the acceptance test and the approval period for each new partial delivery, a regression test shall be conducted to check that partial deliveries that have previously been made available or put into use continue to function as they did when they were approved earlier and that they fulfil the Agreement's requirements concerning the interaction between the various partial deliveries, performance, stability and scalability. Detailed provisions concerning the type and scope of the

acceptance test for each partial delivery and the overall acceptance test and approval period shall be stipulated in Appendix 5.

Unless otherwise is stipulated in Appendix 4, the approval period shall be one (1) month for each partial delivery and three (3) months in connection with the final partial delivery, cf. clause 2.5.1. If one or more partial deliveries shall be exempt from the combined testing, this shall be stipulated in Appendix 4.

2.2 DETAILED SPECIFICATION (THE SPECIFICATION PHASE)

2.2.1 Preparation of a detailed specification

During the specification phase, the Contractor shall prepare a detailed specification for the deliverables. Unless otherwise is stipulated in Appendix 4, the detailed specification shall contain an overall description of the deliverables (overall specification), a detailed description of the functionality of the solution (functional specification) and a specification of the interface, and any guidelines for the technical architecture, for those components of the deliverables that shall be developed, and for those components of the deliverables that the parties otherwise find it necessary to specify in more detail.

The specification work shall be carried out in close cooperation with the Customer, and in accordance with procedures and guidelines agreed in Appendix 4. Unless otherwise is stipulated in Appendix 4, the Customer shall be represented at meetings by people with the expertise necessary to discuss questions of significance concerning alternatives for the solution. The Contractor shall document clarifications concerning the solution and the proposed choices made for the solution and send them to the Customer for approval. The Contractor shall, after each working meeting, send out written minutes that describe the choices that were proposed, including the consequences the choices have for the detailed specification and, if relevant, for Appendices 1 and 2. Unless the Customer presents written objections to the proposed choices made for the solution within ten (10) working days, they shall be deemed to have been approved by the Customer. "Working days" means all days that are neither Saturdays, Sundays or public holidays, nor Christmas Eve or New Year's Eve. The Customer shall be responsible for any delays in respect of the deliverables if the Customer does not approve or present written objections to the proposed choices made for the solution by the agreed deadline.

The detailed specification shall set out the choices made for the solution in respect of the deliverables, including details and clarifications of the requirements, within the framework of Appendices 1 and 2. To the extent that changes are made to the Customer's requirements in Appendix 1 and the Contractor's proposed solution in Appendix 2, and these have consequences for the contract price, progress plan, Customer's participation, other requirements in Appendix 1, or other factors, a change order shall be issued. A joint change order shall be prepared for changes

that follow from the specification work, although it shall be clearly stated which requirements have been changed. The Customer may not waive requirements in any other manner than by issuing a change order.

The detailed specification shall form the basis for the development and delivery of the solution.

A plan for the conversion work shall also be prepared in the specification phase, cf. clause 2.3.8.

2.2.2 Delivery and approval of the detailed specification

A final detailed specification, cf. clause 2.2.1, and a complete project and progress plan for the deliverables, cf. clause 2.1.1, shall be handed over to the Customer, for final review and approval by the deadlines set out in Appendix 4.

Unless different deadlines are agreed between the parties, or are agreed in Appendix 4, the Customer shall, within ten (10) working days after they are handed over pursuant to the previous paragraph, consider the documents and provide the Contractor with a written response stating whether or not the documents are approved. If the Customer has not provided a response by the agreed deadlines, the specification shall be regarded as approved. If, in the opinion of the Customer, the documents do not conform with the requirements agreed in Appendices 1 and 2 as these are set out in detail and clarified pursuant to clause 2.2.1 or as changed through a change order, the Customer shall specify which factors it wants changed and notify the Contractor of these in writing. The Contractor shall rectify the documents in accordance with the Agreement and shall submit such documents to the Customer anew. The Customer shall then make a decision concerning the documents within ten (10) working days or the deadline stipulated in Appendix 4. Detailed terms and conditions for the approval of detailed specifications may be agreed in Appendix 5. If only minor components of the detailed specification are not approved by the Customer, the Contractor may start working on the deliverables for the approved components.

If the Customer rejects or requires changes to the detailed specification for any reason other than that it does not conform with what has been agreed (for example, because the Customer disagrees with some choices made for the solution and wants them changed, despite the fact that the choices would represent fulfilment of the requirements in Appendices 1 and 2, and are described in detail and clarified pursuant to clause 2.2.1) the Contractor shall be entitled to a change order.

2.3 PERFORMANCE OF THE DELIVERABLES

2.3.1 Development

The Contractor shall develop that which is described in the detailed specification, cf. clause 2.2, such that the software satisfies the requirements of the Agreement. The Contractor is in this regard responsible for carrying out design and development, as well as its own testing, of the software in accordance with the detailed project plan, cf. Appendix 4.

2.3.2 Interaction with equipment and other software

The Contractor shall execute the implementation work at the Customer, such that the software satisfies the requirements of the Agreement.

The Contractor shall be responsible for ensuring that the deliverables work together with those components of the Customer's current solution that the Customer has, in Appendix 3, informed the Contractor of and that the appendix states they shall work with, unless the Contractor has, in Appendix 2, stipulated that upgrading is required, cf. clause 1.1.

The Contractor shall be responsible for integrating the software with other software that the Customer has described in Appendix 3 pursuant to the requirements set out in Appendix 1, as well as the Contractor's proposed solution and assumptions in respect of the integration work in Appendix 2. Appendices 1 and 2 shall set out which integrations the Contractor shall bear responsibility for in respect of their results and progress, and which shall be delivered as additional services (contribution obligation). Integrations that are delivered as additional services, shall, unless otherwise is agreed, be paid for by the Customer on the basis of time spent charged at the Contractor's hourly rates in Appendix 7. Integrations that are delivered as additional services, shall, insofar as it is possible, be delivered pursuant to the progress plan in Appendix 4, but shall not provide a basis for rejecting the deliverables during the acceptance test or the approval period.

2.3.3 Implementation method

Appendix 2 shall describe the methods and tools that shall be used to implement the deliverables, as well as the environment in which they shall be implemented. Any special requirements on the part of the Customer as far as the methods, tools or environment are concerned are set out in Appendix 1.

2.3.4 Quality assurance

The Contractor shall have and maintain a quality plan based on documented work and quality assurance methods. The Contractor shall quality assure and test in a proper manner anything developed in accordance with the quality plan.

2.3.5 Audits

The Customer, or whomever it may authorise, shall, for its own account, be entitled to carry out quality and security audits and reviews of the development effort. The Customer shall also be entitled to conduct other audits to verify that the Contractor is complying with its other obligations under this Agreement. More detailed procedures and notification rules may be set out in Appendix 6. The Customer shall have the right to engage a third part to conduct the audit. The Contractor shall be notified of any third party selected by the Customer and may reject the assignment if the Contractor is able to demonstrate that this will entail a material commercial disadvantage to the Contractor.

2.3.6 Documentation

Documentation requirements shall be set out in Appendices 1 and 2. Unless otherwise is agreed, the Customer shall be granted access to the Contractor's standard documentation for the solution, as well as the documentation of the components of the solution that have been developed or customised especially for the Customer.

The documentation shall be delivered within the deadline or deadlines specified in Appendix 4. Unless otherwise specified therein, the documentation shall be delivered no later than the day before the Customer acceptance test shall commence, in order to enable testing of the documentation simultaneously with testing the other parts of the deliverables.

2.3.7 Training

If the Contractor shall assist with training, this shall be stipulated in Appendices 1 and 6, and priced separately in Appendix 7. The date for training shall be stipulated in Appendix 4.

2.3.8 Conversion

If the Contractor shall carry out the conversion of the Customer’s data, this is described in more detail in Appendix 1 and/or Appendix 2. Unless otherwise is agreed in Appendix 7, conversion shall be executed based on time spent charged at the Contractor's hourly rates in Appendix 7.

A detailed plan for the conversion work and a specification of the necessary conversion software shall be prepared and approved in the detailed specification phase, cf. clause 2.2. The plan shall also describe how personal data shall be processed in connection with conversion.

It is a prerequisite that the Customer has undertaken the necessary synchronisation and structuring of its own databases to ensure that the data quality of the Customer’s existing systems is sufficient for purposes of conversion to the software.

The Contractor shall, for example, by obtaining confirmation from the Customer, ensure that backup copies are made of the Customer's data before conversion takes place. The backup shall be stored until the Customer has confirmed that the conversion has been correctly executed.

Approval shall take place by the parties conducting one or more test conversions of data, as specified in detail in Appendix 5, whereupon the Customer shall verify that the test conversion has been correctly executed, including that the data have been transferred and are in the correct format.

Approval of the conversion shall otherwise take place pursuant to the provisions of Appendix 5, and within the deadlines specified in Appendix 4.

2.4 THE CUSTOMER ACCEPTANCE TEST

2.4.1 Preparations for acceptance tests

The duties of the Customer and the Contractor in connection with preparations for acceptance tests shall be stipulated in Appendix 5.

2.4.2 Solution ready for acceptance test

The Contractor shall inform the Customer in writing once the development and customisation of the software has been completed and it has been tested by the Contractor. The Contractor's test report, which shall include a list of known errors, shall be appended to the notice. The Customer may, in Appendix 5, stipulate requirements that limit the number of errors in various categories that the software may contain at the start of the acceptance test.

If, during the first ten (10) working days after the Customer has received notification from the Contractor, it becomes clear that the solution is so defective that it would entitle the Customer to halt the acceptance test pursuant to clause 2.4.5, paragraph five, the Customer may contest the notice and the milestone "Solution ready for acceptance test" shall be deemed not to have been achieved. Such complaints from the Customer shall be sent within ten (10) working days after the Customer received the notice from the Contractor. A corresponding procedure shall apply to any new notices.

2.4.3 Plan for the Customer acceptance test and the approval period

The Customer shall prepare and be responsible for a plan for the Customer's acceptance test; the Contractor shall contribute as set out in Appendix 5.

The Contractor shall make available to the Customer the material the Contractor will utilise as a basis for its testing of the solution, such that the Customer may use this as a basis for the Customer's work on the test plan.

The acceptance test plan shall describe how the Customer's acceptance test shall be conducted.

The Customer shall submit the test plan to the Contractor for its comments. This shall be set out in Appendix 5. The Contractor shall, as soon as possible, consider the test plan and provide a written response concerning whether or not it is deemed adequate to achieve the satisfactory testing of the solution by the deadline set out in Appendix 5.

2.4.4 Scope of the acceptance test

The Customer acceptance test shall comprise the software and the equipment that form part of the deliverables. The scope of the acceptance test is described in more detail in Appendix 5 and the test plan.

2.4.5 Performance of the Customer acceptance test

The acceptance test shall be commenced and completed in accordance with the deadlines set out in Appendix 4.

The Customer acceptance test shall be performed as described in Appendix 5, and in accordance with the acceptance test plan, cf. clause 2.4.3. The Customer is obliged to observe the progress plan for the test.

All errors reported during the Customer acceptance test shall be documented, in order that they may be reproduced. All reported errors shall be categorised as A, B or C errors by the Customer.

Unless Appendix 5 specifies otherwise, the following error definitions shall apply:

Level	Category	Description
A	Critical error	- Error that results in the stoppage of the software or equipment, a loss of data, or in other functions that, based on an objective assessment, are of critical importance to the Customer not being delivered or not working as agreed. - The documentation being so incomplete or misleading that the Customer is unable to use the software or the equipment, or material parts thereof.
B	Serious error	- Error that results in functions that, based on an objective assessment, are of importance to the Customer not working as described in the agreement, and which it is time-consuming and costly to work around. - The documentation being incomplete or misleading, and this resulting in the Customer being unable to use functions that, based on an objective assessment, are of importance to the Customer.

Level	Category	Description
C	Less serious error	- Error that results in individual functions not working as intended, but which can be worked around with relative ease by the Customer. - The documentation being incomplete or imprecise.

The Customer shall report errors to the Contractor on an ongoing basis, and the Contractor shall repair the errors without undue delay. Rectified errors shall be delivered for retesting as set out in Appendix 5.

If the Customer is prevented from executing the test because of inadequate error rectification, or if errors are discovered that prevent the effective execution of the entire test, or parts thereof, the affected component of the test shall be halted until the Contractor has performed the necessary rectifications. A period of time equal to the length of time for which the test was stopped plus the length of time the Customer needs to redo the test shall be added to the period for the Customer's acceptance test.

If previously rectified errors are reintroduced into the solution because the Contractor makes a version management mistake and inserts outdated code, the Customer's acceptance test shall be halted until the Contractor has performed the necessary rectifications. A period of time equal to the length of time for which the test was stopped plus the length of time the Customer needs to redo the test shall be added to the test period.

If the type or scope of the errors prevent all of the planned tests being conducted within the period of time set aside for the acceptance test, the Customer shall be entitled to extend the acceptance test by the period of time necessary.

2.4.6 Approval of the Customer acceptance test

If the Customer approves the acceptance test, the Customer shall give the Contractor written notice to such effect without undue delay. The acceptance test is under any circumstance deemed to be approved unless the Customer has notified the Contractor in writing, within ten (10) working days after the expiry of the acceptance test period, including any extensions because of matters as described in clause 2.4.5, stating that it is not approved. The acceptance test is also deemed to have been approved if the Customer opts to put the software into operation.

The Customer may not refuse to approve the test on the basis of matters that are immaterial for purposes of the Customer’s use of the deliverables. A and B errors are deemed to be individually material, with the exception of B errors that are not of material importance to the ability of the Customer to put the software into operation and commence the approval period. C errors are deemed to be immaterial, unless several C errors imply, in aggregate, that approval would be clearly unreasonable. Other, or more detailed, acceptance criteria may be described in Appendix 5.

Errors that have only occurred once, and which it has not been possible to reproduce during the acceptance test period, are not deemed to be errors for the purpose of approving the test. If the Customer refuses approval, the reasons for this shall be explained in writing with a statement of which errors are preventing approval. If the Contractor wishes to argue that the refusal is unjustified, including that the Contractor disagrees with the categorisation of errors, written notice shall be given to such effect, which notice shall be given within five (5) working days. If the Customer still refuses to approve the test, the dispute shall be resolved pursuant to chapter 16. The Contractor shall in all circumstances rectify the asserted errors as quickly as possible.

If the Contractor does not dispute the Customer's refusal, the Contractor shall within five (5) working days send the Customer a timetable for repairing the errors. The Contractor shall give written notice to the Customer when the repairs have been carried out. Repairs are not deemed to be performed until they have been properly tested by the Contractor and the acceptance test of the Customer. The Contractor's tests shall cover all parts of the deliverables that may be affected by the errors.

The Customer shall, as soon as the Contractor has given notice stating that the errors have been repaired and tested, resume its acceptance test. The Customer shall be entitled to a reasonable amount of additional time for purposes of carrying out such testing.

If, at the end of the acceptance test, the deliverables have errors and deviations that would entitle the Customer to reject the deliverables, the Customer may nevertheless choose to accept them with reservations. If the Customer chooses to accept with reservations and references to the agreed rectification plan, and the rectification plan is not complied with, the remedies shall apply as if the acceptance test was rejected (delay) from this point in time.

If the Customer, during the last five (5) working days of the acceptance test, reports an error to the Contractor for the first time that in principle prevents approval, the error shall be deemed to be covered by the agreed rectification plan. Such errors shall be rectified within ten (10) working days after the end of the acceptance test. The Customer shall then have five (5) working days to test the rectified errors. If the errors have not been rectified within the ten-day deadline, the remedies shall apply as if the acceptance test was extended (delay).

The approval period may only commence when the acceptance test has been approved.

The Customer's approval of the acceptance test shall not prevent the Customer from demanding, during the approval period, the rectification of errors or defects

that the Customer did not discover during the acceptance test, or errors that have not been rectified by the Contractor during the acceptance test period.

2.4.7 Commissioning

The software may be put into ordinary operation after the Customer's acceptance test has been successfully conducted and approved. The schedule for preparing for commissioning is set out in Appendix 4.

The duties of the parties in connection with commissioning are specified in Appendix 5.

2.5 APPROVAL PERIOD AND DELIVERY DATE

2.5.1 Duration

A three (3) month approval period commences on the date on which the deliverables are put into regular operation, unless a different duration has been agreed in Appendix 5.

If start-up of regular operations is delayed as the result of circumstances related to the Customer, the approval period shall nevertheless commence on the agreed date, unless the Customer requests a change to the progress plan pursuant to chapter 3.

2.5.2 Implementation of the approval period

The Customer shall carry out, during the approval period, checks as to whether the deliverables are in conformity with what has been agreed.

The checks carried out by the Customer during the approval period shall be performed on the basis of the ordinary, daily operational and other duties. A detailed specification of the content of the approval period, with a specific description of the checks to be carried out by the Customer, may be set out in Appendix 5 or in a separate plan for the approval period.

The Customer shall during the approval period give the Contractor written notice of any errors on an ongoing basis, including a description of the errors, in accordance with the same procedures for the acceptance test, unless otherwise is agreed in a separate plan for the approval period or in Appendix 5. The Contractor shall, as quickly as possible, rectify the errors and test the error rectifications before they are handed over to the Customer for retesting.

Unless otherwise agreed in Appendix 5, any errors shall be repaired, at the latest, by the end of the approval period, with the exception of:

1) errors that, pursuant to the agreed rectification plan, shall be rectified later, as well as
2) errors that are of only minor significance in respect of the Customer's use of the solution, and which will be rectified in a planned update of the software within a reasonable period of time and at the latest by the end of the warranty period, and which it would therefore be disproportionately resource-demanding for the Contractor to rectify during the approval period. Under any circumstances, the errors shall be rectified by no later than the end of the warranty period.

The basis for further examination during the approval period shall be regarded as having been rendered impossible if the Customer finds, and invokes in writing, A or B errors that on their own or combined would made further examination impossible, or very difficult, or that mean that the value of such an examination would be significantly reduced. The Customer may demand that the approval period be extended by a period of time equal to the time is takes to rectify the errors, as well as a reasonable period of time for retesting.

2.5.3 Final approval – delivery date

The Customer shall, prior to the end of the approval period, give the Contractor written notice of the extent to which of the deliverables are deemed to be in conformity with the agreed deliverables and, consequently, whether or not they can be approved. If such notice has not been sent by the end of the approval period, the deliverables shall nevertheless be deemed to be approved (through laches).

The Customer may not refuse to approve the deliverables on the basis of matters that are immaterial for the Customer’s use of the deliverables. Unless otherwise is agreed in Appendix 5, the following shall apply: A errors and three (3) B errors are deemed to be individually material. C errors are deemed to be immaterial, unless several C errors imply, in aggregate, that approval would be clearly unreasonable.

If the Customer refuses to approve the deliverables, such refusal shall be explained in writing. If the Contractor wishes to argue that the refusal is unjustified, including that the Contractor disagrees with the categorisation of errors, written notice shall be given to such effect no later than five (5) working days after the receipt of the Customer’s notice of refusal. If the Customer still refuses to approve the deliverables, the dispute shall be resolved pursuant to chapter 16. The Contractor shall in all circumstances rectify the asserted errors as quickly as possible.

If the Contractor does not dispute the Customer’s refusal, the Contractor shall within five (5) working days send the Customer a timetable for repairing the errors associated with the deliverables. The Contractor shall give written notice to the Customer when the repairs have been carried out. Repairs are not deemed to be performed until they have been properly tested by the Contractor and retested by

the Customer. The Contractor's tests shall cover all parts of the deliverables that may be affected by the errors. The Customer shall retest the rectification(s) within five (5) working days.

If the deliverables are not approved, the approval period shall be extended until the prerequisites for approval have been met.

If, at the end of the approval period, the deliverables have errors and deviations that would entitle the Customer to reject the deliverables, the Customer may nevertheless choose to approve them with the proviso that the errors be rectified in accordance with an agreed rectification plan. If the rectification plan is not complied with, the remedies shall apply as if the approval period was rejected (delay from the end of the original approval period).

If the Customer, during the last five (5) working days of the approval period, reports an error to the Contractor for the first time that in principle prevents approval, the error shall be deemed to be covered by the agreed rectification plan. Such errors shall be rectified within ten (10) working days after the end of the approval period. The Customer shall then have five (5) working days to test the rectified errors. If the errors have not been rectified within the ten-day deadline, the remedies shall apply as if the approval period was extended (delay).

The first working day after the deliverables are, or are deemed to be, approved, is referred to as the delivery date.

The Customer shall enjoy, as of the delivery date, the warranty described in chapter 4.

The Customer’s approval shall not prevent the Customer from demanding, during the warranty period, the rectification of errors and defects that the Customer did not discover and could not be expected to discover during the approval period, or errors that have not been rectified by the Contractor during the approval period.

2.6 CANCELLATION – TEMPORARY SUSPENSION

2.6.1 Cancellation in connection with the specification phase

Prior to the end of the specification phase as stipulated in clause 2.2, the Customer may cancel, in full or in part, the items contracted under this Agreement. Such cancellation shall be made in writing, and shall be received by the Contractor no more than ten (10) working days after the end of the specification phase.

In the event of such cancellation, the Customer shall pay the amount stipulated in Appendix 7 for cancellation during this phase, or if no such amount has been stipulated:

a) Any amount due to the Contractor in respect of such part of the project as

has already been completed.

b) The Contractor's necessary and documented direct costs in relation to the reassignment of personnel.
c) Other documented direct costs incurred by the Contractor as the result of the cancellation, including disbursements and costs that have been incurred by the Contractor prior to its receipt of the notice of cancellation, and which the Contractor is unable to make use of for other purposes.

The total cancellation fee for the specification phase may never exceed the consideration for the specification phase agreed in Appendix 7.

The consequences that partial cancellation has in respect of the remaining parts of the deliverables, including the effect on the contact price, shall be handled in accordance with the provisions in chapter 3.

2.6.2 Cancellation after the specification phase

After the specification phase as stipulated in clause 2.2, the Customer may cancel, in whole or in part, the items contracted under this Agreement on one (1) month's written notice.

In the event of such cancellation, the Customer shall pay:

a) Any amount due to the Contractor in respect of such part of the project as has already been completed.
b) The Contractor's necessary and documented direct costs in relation to the reassignment of personnel.
c) Other documented direct costs incurred by the Contractor as the result of the cancellation, including disbursements and costs that have been incurred by the Contractor prior to its receipt of the notice of cancellation, and which the Contractor is unable to make use of for other purposes.

In addition, the Customer shall pay a cancellation fee equal to the lower of:

- four (4) per cent of the contract price, or
- six (6) per cent of such part of the contract price as remains unpaid as per the cancellation date, and which has not been paid pursuant to letter a) above either.

A different cancellation fee may be agreed between the parties in Appendix 7.

In the case of partial cancellation, the cancellation fee shall be calculated on the basis of the share of the contract price accounted for by the cancelled items. The consequences that partial cancellation has in respect of the remaining parts of the deliverables, including the effect on the contact price, shall be handled in accordance with the provisions in chapter 3.

2.6.3 Temporary suspension of the deliverables

The Customer may request upon minimum 5 (five) working days' written notice to the Contractor, the temporary suspension of the delivery of the deliverables.

The Customer shall specify, in such notice, as from what date (milestone) the delivery of the deliverables shall be suspended, as well as from which date it is intended for the delivery of the deliverables to recommence.

The Contractor shall immediately, and no later than five (5) working days after notice has been received, send the Customer an overview of the functions and activities that need to be sustained during the suspension period.

The delivery of the deliverables shall recommence, without undue delay, upon written notice from the Customer.
The Customer shall reimburse the Contractor for its documented costs relating to the reassignment of personnel on the part of the Contractor and its subcontractors, as well as other direct costs incurred by the Contractor as the result of the suspension. If the Customer requests that personnel who participated in the delivery of the deliverables prior to the suspension shall recommence the work and complete the delivery of the deliverables, the Customer shall reimburse the costs of the Contractor in respect of such personnel, calculated on the basis of the lowest of the hourly rates for consultants set out in Appendix 7, but only to the extent that it has not been possible for the Contractor to use the resources for other income-generating work during the period of suspension of the delivery of the deliverables. Such a claim from the Customer shall be submitted no later than the notice referred to in paragraph two above.

If the suspension has consequences in terms of progress in the delivery of the deliverables or the contract price, cf. Appendices 4 and 7, such consequences shall be dealt with pursuant to the provisions in chapter 3 on changes.

If the delivery of the deliverables has been continuously suspended for more than one hundred and twenty (120) calendar days, the Contractor may terminate the Agreement without cause by written notice to the Customer. Unless the Customer renders written notice, within fourteen (14) calendar days of having received the notice, stating that the delivery of the deliverables shall recommence, the cancellation provisions of clauses 2.6.1 and 2.6.2 shall apply correspondingly.

2.6.4 Handover of specifications, etc.

Upon cancellation pursuant to clause 2.6.1 or 2.6.2, the Contractor shall hand over to the Customer all specifications and other materials prepared for the Customer up and until the cancellation date. This shall apply to both written and electronic materials.

3. CHANGES SUBSEQUENT TO THE CONCLUSION OF THE AGREEMENT

3.1 RIGHT TO CHANGE THE CONTENTS OF THE AGREEMENT (CHANGE TO THE DELIVERABLES)

The Customer has the right to order changes, in the form of increases or reductions in the scope, nature, type, quality or delivery of the deliverables, as well as changes to the progress plan, provided that such changes fall within the scope of what the parties could have reasonably expected upon the conclusion of the Agreement.

However, the Contractor shall not be obliged to carry out additional work that represents, in aggregate, a net addition of more than fifteen (15) per cent to the original contract price, other than in the case of a disputed change order pursuant to clause 3.8.

If the overall consideration of the Contractor, net of all reductions and additions, is reduced by more than fifteen (15) per cent of the original contract price, such reduction shall be dealt with as a partial cancellation, cf. clause 2.6.

3.2 CHANGE ESTIMATE

Unless otherwise is specified in Appendix 6 or the change order itself, the Contractor shall, within a maximum of ten (10) working days from receipt of a written request for a change, submit a study of potential risk and change consequences, as well as a price estimate. In the event of a request for major changes, the parties shall agree an extension of the deadline with such number of days as is deemed to be reasonable. In such circumstances, the Contractor may require an extension of the time-limit of up to ten (10) working days. The request for an extension of the deadline must be submitted before the end of the ten-day deadline in the first sentence.

At a minimum, the study shall include the following:

a) description of the change
b) description of the scope of work that needs to be carried out as a result of the change, and the time required for such work
c) implications for the requirement specification/solution specification and/or detailed specification
d) implications for the requirements applicable to the Customer's technical platform
e) implications for the contract price, with a detailed specification of the calculation basis, cf. clause 3.5
f) implications for the progress plan, cf. clause 3.5
g) changes to the Customer participation requirements
h) changes to test plans and test criteria

i) implications for the future maintenance of the standard system and the developed software, and the relation between these

Documented costs in connection with the preparation of change estimates are carried by the Customer in accordance with the prices and terms applicable to supplementary work, cf. Appendix 7. If standard prices for the preparation of change estimates are set out in Appendix 7, the Contractor shall not be entitled to the reimbursement of any costs in excess thereof, unless the Customer has given its prior written approval of a larger estimate.

If the preparation of a change estimate does in itself necessitate changes to the progress plan, the Contractor may request that the plan be adjusted.

3.3 CHANGE ORDERS

If the Customer accepts the study and the price submitted by the Contractor, the Customer shall inform the Contractor, by issuing a change order, that the Customer wishes the change to be implemented. The change order shall be signed by the Customer.

Thereafter, the Contractor shall, within ten (10) working days of the Contractor receiving the signed change order, ensure that the change order is incorporated into the Agreement, with changes to specifications, the progress plan, the technical platform, tests, required contributions from the Customer, as well as changes to the contract price, being set out in the Agreement.

The changes shall be presented to the Customer for its approval.

The terms and conditions of the Agreement shall apply to the change order as well, unless otherwise explicitly stated in the change order.

3.4 DOCUMENTATION OF THE CHANGE

Changes to the deliverables as referred to in chapter 3 shall be made in writing, and shall be signed by an authorised representative of the parties. The Contractor shall maintain a directory of the changes on an ongoing basis, which directory shall form Appendix 9, and shall without undue delay provide the Customer with an updated copy thereof.

3.5 CONSEQUENCES OF CHANGE ORDERS

If the Customer requires a change, the Contractor shall have the right to require adjustments to the contract price and progress plan or other matters, cf. clause 3.2, caused by the change requirement of the Customer.

Adjustments to the contract price shall be calculated on the basis of the hourly charges or other unit prices set out in Appendix 7, provided that the work occasioned by the change is, in the main, similar to work for which hourly charges or unit prices have been specified.

If it is not possible to calculate the change based on the hourly rates or unit prices in Appendix 7, the Contractor shall present a quote in respect of the addition or deduction for the changes. The offer shall reflect the general price level of this Agreement.

If any changes and/or additions requested would, as a general rule, have resulted in an adjustment to the agreed date on which the solution will be ready for the acceptance test or delivery date, the Contractor shall, to the extent practicable, seek to accelerate implementation in order that the agreed deadlines may nevertheless be observed. In such case, acceleration shall be deemed to constitute a change to be dealt with pursuant to the rules set out in chapter 3.

The change order shall be implemented without undue delay when received by the Contractor. This shall apply irrespective of whether the effect of the change order in terms of the contract price, the progress plan or other terms and conditions of the Agreement have been finally resolved, cf. clause 3.6.

3.6 DISPUTE CONCERNING THE CONSEQUENCES OF A CHANGE

If the parties agree that there is a change, but disagree on the effect of such change as far as the contract price is concerned, the Customer shall pay a preliminary consideration calculated pursuant to the rules set out in clause 3.5. If no ruling from an independent expert or mediator has been requested and no legal proceedings have been instituted in respect of the work occasioned by the change within six (6) months after the delivery date or the date on which notice of termination for breach or cancellation was received by the Contractor, the consideration paid shall be deemed to be final. The Contractor shall pledge security for the disputed part of the consideration, or alternatively choose to be paid half of the disputed part of the consideration, up to the date when the consideration is deemed to have been set with final effect.

3.7 DISAGREEMENT AS TO WHETHER THERE IS A CHANGE

If the Customer requests, in the form of written orders, specifications or otherwise from an authorised person, the performance of certain specific work that the Contractor believes to fall outside the scope of its obligations pursuant to the Agreement, the Contractor shall, in writing, request the Customer issue a change order.

Together with the change order request, the Contractor shall provide the Customer with a study of relevant risk and change consequences, as well as a price estimate (change estimate) pursuant to clause 3.2. The costs associated with the preparation of change estimates shall be paid by the Customer if the Contractor's request for a change order is accepted.

If the Contractor fails to make such request within a reasonable period of time, the work shall be deemed to form part of the Contractor's obligations pursuant to the Agreement, and the Contractor waives its right to invoke such work as grounds for extending deadlines, additional consideration or damages.

3.8 DISPUTED CHANGE ORDER

If the Contractor has requested the Customer to issue a change order pursuant to clause 3.7, the Customer shall, within a reasonable period of time, issue a change order pursuant to clause 3.3, or issue a written waiver of the request.

If the Customer deems the work to form part of the deliverables, it shall be explicitly stated that the change order is disputed (disputed change order). The change order shall include an explanation as to why the Customer deems the change order to be disputed.

Even if the change order is disputed, the Contractor shall perform what has been ordered in return for the Customer paying a provisional consideration corresponding to half of the amount to which the Contractor believes it is entitled. If the Contractor does not demand a decision concerning the disputed change pursuant to clause 3.9 of the Agreement within three (3) months after the consideration has been paid, or if the work is deemed to fall within the scope of the Agreement, the provisional consideration shall be set off against the consideration due upon the next payment milestone. If the work is deemed to be a change, the fixed consideration for the change, adjusted for the provisional consideration, shall be incorporated into the ordinary payment plan.

The Contractor may contest the duty to perform the work by requesting a ruling from an independent expert or mediator or institute legal proceedings or submit the dispute for arbitration in order to have its claim resolved with final effect, cf. chapter 16. Such a request must be submitted without undue delay after the Customer has provided notice that the change is disputed. The Contractor shall bear the risk associated with any delays that may occur due to the postponement of the work, if it is determined that the work falls within the scope of the Agreement.

3.9 DISPUTE RESOLUTION – DISPUTED CHANGE ORDER

If the Contractor has received a disputed change order, the Contractor shall, within six (6) months of having received the disputed change order, either request a ruling

from an independent expert or mediator or institute legal proceedings or submit the dispute for arbitration in order to have its claim resolved with final effect, cf. chapter 16. If the Contractor fails to do so, the work shall be deemed to fall within the scope of the Contractor's duties under the Agreement.

4. WARRANTY PERIOD

4.1 SCOPE OF THE WARRANTY

Unless otherwise agreed in Appendix 7, the warranty period shall be one (1) year for software and two (2) years for equipment after the delivery date, cf. clause 2.5.3.

Contingent upon normal, diligent use on the part of the Customer, the Contractor shall, at no additional cost, rectify errors and defects, replace defect parts of equipment and rectify errors in software governed by this Agreement and which the Customer has complained about before the expiry of the warranty period. No damages or other remedies for breach of contract may be claimed for defects that are rectified pursuant to the warranty.

Appendix 2 may specify detailed requirements for the maintenance of equipment that must be performed for the warranty to remain valid.

4.2 PERFORMANCE LEVEL

Any maintenance services beyond the warranted performance shall be specified and priced in a designated agreement.

If the parties have concluded a maintenance and service agreement, the performance level of such agreement shall also form the basis for the warranted performance.

If no maintenance agreement has been concluded, the performance level during the warranty period shall be specified in Appendices 1 and/or 2.

Moreover, all work involved in curing errors and defects shall be commenced and completed without undue delay after the Contractor has received notice of such errors or defects. The second to last paragraph of clause 5.1 shall apply correspondingly.

If the Contractor chooses to rectify errors during the warranty period by delivering a new version of the software, the Contractor shall not be entitled to any consideration in respect of the new version, even if it contains improvements. The Contractor may only rectify errors and defects by way of the delivery of a new

version if the Customer is able to utilise such new version on the Customer's existing technical platform.

4.3 ADDITIONAL CONSIDERATION

In the event of errors and defects that fall outside the scope of the warranty, the Contractor will perform the same service as agreed for the warranty period, but in the form of a chargeable service. The Contractor's list prices for such services shall apply, unless otherwise agreed.

5. THE DUTIES OF THE CONTRACTOR

5.1 THE RESPONSIBILITY OF THE CONTRACTOR FOR ITS PERFORMANCE

The Contractor is responsible for ensuring that the deliverables as a whole (the overall solution) provide the functions and satisfy the requirements specified in the Agreement.

The Contractor is responsible for ensuring that the deliverables are tailored to the technical platform specified in Appendices 2 and 3, cf. clause 1.1, and that the deliverables are compatible with other software specified in Appendices 1 and 2.

To the extent that standard software included in the deliverables must be delivered under standard licence terms and conditions and agreement terms and conditions (licence terms and conditions), this shall be explicitly stated in a separate chapter in Appendix 2, and copies of the licence terms and conditions shall be appended as Appendix 10.

The provisions of the licence terms and conditions governing right of disposal shall prevail over the provisions governing right of disposal in this Agreement, unless otherwise is explicitly stated in Appendix 8. The Contractor shall, however, ensure that standard software is offered under licence terms and conditions with a right of disposal that satisfy the requirements in respect of the deliverables and their area of use stipulated by the Customer in Appendix 1, and this Agreement's provisions governing right of disposal. To the extent that the provisions of licence terms and conditions governing right of disposal differ from this Agreement's provisions governing right of disposal, the Contractor shall describe this clearly in Appendix 7. In the event of defects in title, the Contractor shall not be liable for damages for defects in title associated with standard software beyond that which follows from licence terms and conditions included in Appendix 10 and the coverage of any liability for damages imposed on it in relation to a third party (the rightsholder(s)) pursuant to clause 13.4.

The deliverables shall be tested and approved pursuant to this Agreement's provisions governing testing and approval, independent of what may follow from the software's licence terms and conditions.

The Contractor shall be responsible for the deliverables (the overall solution) meeting the requirements under this Agreement, irrespective of the provisions of the particular licence terms and conditions.
If the deliverables deviate from what was agreed under this Agreement, it shall be the responsibility of the Contractor to rectify the deviation in such a way as to make the deliverables conform to what was agreed, even if such deviation is caused by factors in standard software that are subject to licence terms and conditions that include different provisions on the rectification of errors. The rectification of errors in, or errors caused by, standard software may be effected in any manner that makes the deliverables conform to the requirements under the Agreement.

If the Contractor documents that deviations in the deliverables are due to the behaviour of the standard software not matching the software producer's specifications, and that access to the standard software's source code is required in order rectify the errors, the Contractor's obligation to rectify the errors is limited to reporting the error to the software producer, seeking to the best of its ability to make rectification of the error a priority, keeping the Customer informed about the status of the error rectification, and making the rectified version available to the Customer once the error in the standard software has been rectified by the software producer. The Contractor shall assist with installation at the request of the Customer, without additional consideration. The Contractor shall make a reasonable effort to find a temporary solution while the software producer rectifies the error. A maximum financial limit for the Contractor's obligation to work out temporary solutions that work around errors in standard software can be agreed in Appendix 7.

Errors in standard software such as those mentioned in the second to last paragraph shall not be included in the assessment of whether or not the acceptance criteria or approval criteria have been fulfilled, unless the Contractor has failed to perform its duties in respect of following up the error rectification and installing the rectified version. As soon as the errors in the standard software have been rectified, the rectified version has been installed, and the Contractor has otherwise performed the tasks necessary for the deliverables to match that which has been agreed, the Customer shall be entitled to a reasonable period of time to retest the deliverables. If such errors as those mentioned in this paragraph result in the Customer deciding to postpone the start of the approval period, the Contractor may not demand consideration for this postponement, even if a change order is issued pursuant to clause 2.5.1, paragraph two. If the errors in the standard software are not rectified by the expiry of the warranty period, the Customer may demand a price reduction and possible damages pursuant to the Agreement's chapter 11.

5.2 REQUIREMENTS AS TO THE RESOURCES AND EXPERTISE OF THE CONTRACTOR

The Contractor warrants that the deliverables will be performed with sufficient qualitative and quantitative resources and expertise, given the requirements stipulated in the Agreement. The Contractor's project manager and other key personnel are specified in Appendix 6.

Persons designated as key personnel in Appendix 6 shall not, within the scope of the Contractor's managerial prerogative as employer, be replaced without the prior approval of the Customer. Such approval shall not be unreasonably withheld. The actual participation of the key personnel in the provision of the deliverables shall not be scaled back without the prior approval of the Customer.

Personnel that the Customer, for justifiable reasons, does not wish to use, or wishes to have replaced, shall as soon as possible be replaced by alternative personnel with at least corresponding expertise.

Personnel replacements shall not affect the progress of the project or impose additional costs on the Customer.

5.3 USE OF SUBCONTRACTORS

The Contractor's use and replacement of subcontractors that directly participate in the performance of the deliverables must be approved in writing by the Customer. Approval shall not be unreasonably withheld.

Subcontractors that are approved shall be specified in Appendix 6.

5.4 COOPERATION WITH THIRD PARTIES

The Contractor undertakes to cooperate with third parties to the extent that the Customer deems this necessary for the purposes of performing the duties stipulated in this Agreement. The scope of such assistance shall be specified in Appendix 6. Any consideration for such assistance shall be specified in Appendix 7. The Contractor shall in such cases adopt an independent position, and act in consultation with the Customer.

However, the Contractor shall be released from the duties mentioned in this clause if the Contractor substantiates that such cooperation will be of material disadvantage for the Contractor's relationship to its existing subcontractors or other business contacts.

5.5 WAGES AND WORKING CONDITIONS

The following shall apply to agreements governed by the Regulations No. 112 of 8 February 2008 relating to Wages and Working Conditions under Government Contracts:

In respect of areas covered by the Regulations relating to Generalised Collective Wage Agreements, the Contractor shall ensure that its and any subcontractors' employees who contribute directly to the performance of the Contractor's obligations under the Agreement do not receive wages or have working conditions that are inferior to those stipulated in the Regulations relating to Generalised Collective Wage Agreements. In areas not covered by generalised collective wage agreements, the Contractor shall ensure that the same employees do not receive wages or have working conditions that are inferior to those stipulated in any applicable nationwide collective wage agreements relating to the relevant trade. This applies to work performed in Norway.

All agreements that are entered into by the Contractor and that involve the performance of work that contributes directly to the performance of the Contractor's obligations under the Agreement shall include corresponding terms and conditions.

If the Contractor fails to meet this obligation, the Customer shall be entitled to retain part of the contract price, corresponding to approximately two (2) times the savings of the Contractor, until it has been documented that compliance has been achieved.

The Contractor's obligations as mentioned above shall be documented in Appendix 6 by means of either a self-declaration or a third-party declaration showing conformity between the relevant collective wage agreement and the actual wages and working conditions relating to compliance with the Contractor's and any subcontractors' obligations.

The Contractor shall, at the request of the Customer, disclose documentation relating to the wages and working conditions which are used. Each of the Customer and the Contractor may request that the information be submitted to an independent third party appointed by the Customer to examine whether the requirements of this provision have been complied with. The Contractor may require the third party to sign a declaration that the information will not be used for any purpose other than to ensure fulfilment of the Contractor's obligations pursuant to this provision. The disclosure obligation shall also apply to subcontractors.

Further clarification concerning the implementation of this clause 5.5 may be agreed in Appendix 6.

6. THE DUTIES OF THE CUSTOMER

6.1 RESPONSIBILITIES OF AND CONTRIBUTIONS BY THE CUSTOMER

The Customer is responsible for having described the purpose of the procurement and its requirements and needs, in Appendix 1, in a clear manner, as a basis for the performance of the Contractor. If it is stated in Appendix 2 that the technical platform of the Customer needs to be upgraded, cf. clause 1.1, the Customer shall itself ensure such upgrading, unless otherwise stipulated in Appendices 1 and/or 2.

The Customer shall contribute to facilitating the Contractor's performance of its duties under this Agreement.

The Customer shall contribute to the delivery of the deliverables in the manner specified in Appendix 2, in accordance with the deadlines stipulated in Appendix 4.

6.2 USE OF A THIRD PARTY BY THE CUSTOMER

The Customer may freely appoint a third party to assist it in connection with its duties under the Agreement. Such third parties shall be specified in Appendix 6. The Contractor shall be notified of any third party selected by the Customer, and may reject the assignment if the Contractor is able to demonstrate that this will entail a material commercial disadvantage to the Contractor.

7. DUTIES OF THE CUSTOMER AND THE CONTRACTOR

7.1 MEETINGS

A party may, if deemed necessary by it, convene, with no less than three (3) working days' notice, a meeting with the other party to discuss the contractual relationship and how the contractual relationship is being handled.

Other deadlines and procedures for the meetings may be agreed in Appendix 6.

7.2 RESPONSIBILITY FOR SUBCONTRACTORS AND THIRD PARTIES

If the Contractor appoints a subcontractor or the Customer appoints a third party to perform work occasioned by this Agreement, the relevant party shall remain fully responsible for the performance of such work in the same manner as if said party was performing the work itself.

7.3 CONFIDENTIALITY OBLIGATION

Information that comes into the possession of the parties in connection with the Agreement and the implementation of the Agreement shall be kept confidential, and shall not be disclosed to any third party without the consent of the other party.

If the Customer is a public body, the scope of the confidentiality obligation under this provision shall not go beyond that laid down by the Act of 10 February 1967 relating to Procedure in Cases concerning the Public Administration (Public Administration Act) or corresponding sector-specific regulations.

The confidentiality obligation pursuant to this provision shall not prevent the disclosure of information if such disclosure is demanded pursuant to laws or regulations, including any disclosure or right of access pursuant to the Act of 19 May 2006 relating to the Right of Access to Documents in the Public Administration (Freedom of Information Act). The other party shall, if possible, be notified prior to the disclosure of such information.

The confidentiality obligation shall not prevent the information from being used when there is no legitimate interest in keeping it confidential, for example when it is in the public domain or is accessible to the public elsewhere.

The parties shall take all necessary precautions to prevent unauthorised persons from gaining access to, or knowledge of, confidential information.

The confidentiality obligation shall apply to the parties' employees, subcontractors and other third parties who act on behalf of the parties in connection with the implementation of the Agreement. The parties may only transmit confidential information to such subcontractors and third parties to the extent necessary for the implementation of the Agreement, and provided that they are subjected to a confidentiality obligation corresponding to that stipulated in this clause 7.3.

The confidentiality obligation shall not prevent the parties from utilising experience and expertise developed in connection with the implementation of the Agreement.

The confidentiality obligation shall continue to apply after the expiry of the Agreement. Employees or others who resign from their positions with one of the parties shall be subjected to a confidentiality obligation following their resignation as well, as far as factors mentioned above are concerned. The confidentiality obligation shall lapse five (5) years after the delivery date, unless otherwise stipulated by law or regulation.

7.4 FORM OF COMMUNICATION - IN WRITING

All notices, demands or other communications relating to the Agreement shall be submitted in writing to the postal address or electronic address stated on the first

page of the Agreement, unless the parties have agreed a different procedure in Appendix 6 for this type of enquiry.

8. CONSIDERATION AND PAYMENT TERMS

8.1 CONSIDERATION

All prices and the detailed terms governing the consideration to be paid by the Customer for the deliverables provided by the Contractor are set out in Appendix 7.

Disbursements, including travel and subsistence costs, shall only be reimbursed to the extent agreed. Travel and subsistence costs shall be specified separately, and shall be paid pursuant to the Government Travel Allowance Scale applicable at any given time, unless otherwise agreed. Travel time shall only be invoiced if this is agreed in Appendix 7.

Unless otherwise specified in Appendix 7, all prices are quoted exclusive of Value Added Tax, but include customs duties and any other indirect taxes.

All prices are quoted in Norwegian kroner unless the Customer has, in Appendix 7, agreed that prices for components that are delivered from abroad may be stated in a foreign currency.

8.2 INVOICING

Payment shall be made within thirty (30) calendar days of the invoice date. The invoices of the Contractor shall be specified and documented so that the Customer can easily check whether the invoice conforms to the agreed consideration. All invoices relating to hours recorded on an ongoing basis shall be accompanied by a detailed specification of the hours accrued. Disbursements shall be specified separately.

When the Customer has made arrangements for such, the Contractor shall submit invoices, credit notes and reminders in accordance with the Electronic Trading Format (EHF) that has been determined.

The payment schedule and other payment terms, and any terms and conditions relating to the use of EHF, are set out in Appendix 7.

The Contractor shall be responsible for paying any costs that it incurs in respect of submitting electronic invoices.

8.3 LATE PAYMENT INTEREST

If the Customer fails to make payment by the agreed time, the Contractor shall be entitled to claim interest on any overdue amount, pursuant to the Act No. 100 of 17 December 1976 relating to Interest on Overdue Payments, etc. (Late Payment Interest Act).

8.4 PAYMENT DEFAULT

If overdue consideration, with the addition of late payment interest, has not been paid within thirty (30) calendar days of the due date, the Contractor may send a written notice to the Customer, stating that the Agreement will be terminated for breach, unless settlement has taken place within sixty (60) calendar days of receipt of such notice.

Termination for breach may not take place if the Customer settles the overdue consideration, with the addition of late payment interest, by the expiry of the deadline.

8.5 PRICE ADJUSTMENTS

Hourly rates charges for services may be adjusted at the beginning of every calendar year by an amount equivalent to the increase in the retail price index (the main index) of Statistics Norway, with the initial reference index value being the index value for the month in which the Agreement was formed, unless a different index value is agreed in Appendix 7.

The prices may be adjusted to the extent that rules or administrative decisions pertaining to indirect taxes are amended in a way that affects the consideration or costs of the Contractor.

Any other provisions pertaining to price adjustments are set out in Appendix 7.

9. EXTERNAL LEGAL REQUIREMENTS, DATA PROTECTION AND SECURITY

9.1 GENERAL EXTERNAL LEGAL REQUIREMENTS AND MEASURES

The Customer shall identify, in Appendix 1, which legal requirements, or requirements that are specific to the party in question, are of relevance to the conclusion and implementation of this Agreement. The Customer shall be responsible for specifying, in Appendix 1, any relevant functional and security requirements that are applicable to the deliverables.

The Contractor shall in Appendix 2 describe how the Contractor takes account of these requirements through its solution.

Each party is responsible for the follow-up of its own duties pursuant to such legal requirements.

Each party shall, as a general rule, pay the costs of complying with legal requirements applicable to the party and its activities. In the event of amendments to legal requirements or official requirements that affect the activities of the Customer that occasion a need for changes to the deliverables subsequent to the conclusion of the Agreement, the Customer shall cover the costs associated with such changes and any additional work, cf. chapter 3.

9.2 INFORMATION SECURITY

The Contractor will take appropriate measures to address the information security requirements associated with the performance of the Service.

This entails that the Contractor will take appropriate measures to ensure the confidentiality of the Customer's data, as well as measures to ensure that data does not fall into the hands of unauthorised persons. Furthermore, the Contractor will take appropriate measures to protect against the unintended modification and deletion of data, and against virus and other malware attacks.

If the Customer has specific requirements for how information security is to be safeguarded by the Contractor, the Customer must state this in Appendix 1.

If the Contractor handles the Customer's data, the Contractor will be obliged to keep the Customer's data separate from the data of any third parties, in order to reduce the risk of impairment of data and/or access to data. By separate is meant that necessary technical measures to secure data against unintended change or access are implemented and maintained. Unintended changes or access also include access by the employees of the Contractor or others who do not need the information in their work for the Customer.

If the Customer has specific requirements for how the Contractor is to fulfil the requirement of separation of data, the Customer must specify this in Appendix 1.

The Contractor must ensure that Contractors of third-party deliverables undertake sufficient and necessary assurance of the Customer's data.

If the Customer has specific requirements for how the Contractor is to ensure that the Contractor(s) of third-party deliverables undertake adequate and necessary safeguarding of the Customer's data, the Customer must state this in Appendix 1.

9.3 PERSONAL DATA

If the Contractor is to process personal data during the performance of the service, the Contractor must describe in Appendix 2 how satisfactory processing in line with the personal data protection regulations will be achieved and performed. This includes privacy shield requirements. This applies irrespective of whether the Customer has set this requirement in Appendix 1.

If the Customer has any further requirements relating to the Contractor's information security measures, the Customer must state this in Appendix 1.

The Contractor must document that the information system and security measures are satisfactory. Such documentation shall be made available, upon request, to the Customer and its auditors, as well as the Norwegian Data Protection Authority and the Privacy Appeals Board. If the Customer has any further documentation requirements relating to the information system and security measures, the Customer must state this in Appendix 1. If the Customer requests information to perform Data Protection Impact Assessments, the Contractor must assist in providing such information.

The Contractor may not entrust personal data to other parties for storage, reworking or deletion without prior special or general written permission for this from the Customer. The Contractor must ensure that any subcontractors used by the Contractor, and which process personal data, assume the same obligations as those set out in clause 9.3 of the Agreement. If special or general written permission has been obtained, the Contractor must notify the Customer of any plans to use other data processors or to replace data processors, and thereby give the Customer the opportunity to oppose such changes. Subcontractors that are approved by the Customer must be stated in Appendix 6.

Personal data may not be transferred to countries outside the EEA without any transfer basis and documentation demonstrating that the terms for use of the transfer basis are fulfilled. In such case, the Contractor will document this in Appendix 2.

If the assignment concerns the processing of personal data on behalf of the Customer, the Customer and the Contractor will be obliged to enter into a data processor agreement in accordance with the personal data protection legislation. If the Customer has not prepared a draft data processor agreement, the Contractor will attach a draft as an attachment to Appendix 2. The data processor agreement must be entered into before the processing of personal data begins.

If the parties have entered into a data processor agreement, this data processor agreement will take precedence in the event of any conflict with the Agreement's provisions relating to the processing of personal data.

The parties' liability for damage suffered by a data subject or other natural persons which is due to a violation of the General Data Protection Act (Regulation 2016/679), the General Data Act with regulations or other regulations that implement the General Data Protection Act, will follow the provisions of article 82 of the General Data Protection Act.

The limitation of liability in section 11.5.6 does not apply to liability arising from article 82 of the General Data Protection Act.

The parties are individually liable for administrative fees imposed pursuant to article 83 of the General Data Protection Act.

10. RIGHT OF OWNERSHIP AND RIGHT OF DISPOSAL

10.1 RIGHT OF OWNERSHIP OF EQUIPMENT, ETC.

Equipment that is delivered pursuant to the Agreement becomes the property of the Customer upon such delivery. The transfer of title implies that the Customer is granted complete physical and legal right of use of the equipment, subject to the limitations set out in this Agreement with appendices, or in a maintenance and software service agreement.

Any purchase-money security interest may be agreed in Appendix 7.

10.2 RIGHT OF DISPOSAL OF STANDARD SOFTWARE

10.2.1 Limited right of disposal

The Customer is granted a limited right of disposal of the standard software that forms part of the deliverables. The right of disposal comprises the rights that are necessary for the Customer to be able to utilise the deliverables as agreed, including a right to make such number of copies of the software as follows from ordinary operational and safety procedures.

The Contractor shall be responsible for the Customer being granted the agreed right of disposal in respect of the software, and for the Customer being able to utilise it without being restricted by the copyright or other rights of third parties.

Consideration for the right of disposal in respect of the software, including any prerequisites and limitations, for example, in relation to the number of users or the

place where the right of disposal is exercised/the equipment used to do so, is described in Appendix 7.

10.2.2 Security for access to source code, etc.

The Customer may, in Appendix 1, stipulate a requirement that the Contractor shall offer the Customer an agreement concerning access to source code or some other solution (for example, a performance bond from its parent company or an associated company) that satisfactorily secures the Customer's interests should the Contractor go bankrupt or for some other reason be unable, or cease, to deliver its services pursuant to this Agreement or an associated maintenance agreement. In those circumstances where the Customer is entitled to access to the source code pursuant to this provision or have arrangements put in place to fulfil this provision, the Customer shall have an expanded right of disposal that covers the right to use, copy, modify and develop the deliverables itself, or with the aid of a third party, to the extent necessary to achieve the purpose of the procurement.

10.2.3 Maintainability

If the Contractor chooses to deliver customer customisations in the form of developing the source code of software that provides the basis for the deliverables, the Contractor shall ensure that the customer customisations are also addressed in subsequent versions of the software.

10.3 RIGHTS TO DEVELOPMENT AND CUSTOMISATIONS

10.3.1 The rights of the Contractor

The Contractor shall retain the copyright to software that are developed specifically for the Customer unless otherwise agreed in the particular case.

10.3.2 The rights of the Customer

The Customer is granted, free of charge, an indefinite and non-exclusive right to utilise the various parts of the software developed or customised specifically for the Customer (expanded right of disposal). The expanded right of disposal includes the right to use, copy, modify and develop the customisations, either on its own or with the assistance of a third party. The Customer is entitled to confer a corresponding expanded right of disposal on any other public body.

Source code and associated specifications and documentation of the development and customisations shall be handed over to the Customer within ten (10) working days after the delivery date, unless otherwise agreed in the particular case.

10.4 RIGHT OF DISPOSAL OF DOCUMENTATION

10.4.1 Making of copies (copying)

The Contractor shall make available such number of copies of the documentation as is desired by the Customer, at the prices listed in Appendix 7.

If the Contractor is unable to make available the necessary number of copies, the Customer may make such copies itself for its own use. No consideration shall be payable in respect of such copies.

10.4.2 Changes to the documentation

The Customer may, at its own risk, make such changes, additions, etc., to the documentation for its own use as are deemed appropriate by the Customer.

10.4.3 Documentation of development and customisations

The Customer is granted a corresponding right of disposal of documentation prepared in connection with development and customisations, cf. clause 10.2, as the Customer is granted in relation to the development and customisations. This shall also cover training materials.

10.4.4 Utilisation of the detailed specification

Each of the parties may utilise the detailed specification without hindrance in respect of the other party's possible copyright. The right of utilisation includes the right to reuse the detailed specification in other assignments and to make it available to others, including for their reuse. This provision does not provide a right to distribute information that is covered by a confidentiality obligation pursuant to clause 7.3.

10.5 JOINT PROVISIONS APPLICABLE TO SOFTWARE AND DOCUMENTATION

10.5.1 Marking of software and documentation

If the original copy of the software or documentation made available by the Contractor for the Customer is marked with a "copyright notice", the Customer shall add corresponding marking to all the copies made by the Customer pursuant to the Agreement.

10.5.2 Duration of the right of disposal

The right of disposal shall apply as from signing of the Agreement, without any deadline or right of termination, unless otherwise agreed in Appendix 7.
If a right of disposal has been agreed in return for the payment of ongoing consideration, the right of disposal may be terminated by the Customer by giving three (3) months' notice, unless otherwise is agreed in Appendix 7. The right of

disposal shall lapse as per the end of the relevant calendar month. Upon termination, a proportional consideration shall be paid for the right of disposal up to the expiry of the period of notice. Further provisions may be stipulated concerning this in Appendix 7.

10.5.3 Return or destruction upon termination of the right of disposal

The Customer undertakes to return or delete, upon the termination of an agreed right of disposal of software, all copies of the software that fall within the scope of the agreement and are located on the premises of the Customer. The same shall apply to copies of documentation.

10.6 THE TOOLS AND METHODOLOGICAL BASIS OF THE CONTRACTOR

Unless otherwise specified in Appendix 1 and/or Appendix 2, the Contractor, the subcontractors, and any third party from whom the Contractor or the subcontractors derive their rights, shall retain the right to their own tools and to the methodological basis used by the Contractor in respect of the deliverables. This includes any customisations that the Contractor has developed independently of the Customer, and has reused for purposes of these deliverables.

10.7 FREE SOFTWARE

10.7.1 General provisions pertaining to free software

Free software means software that is offered under what are generally recognised to be free software licences.

A free software licence permits, for example, the Customer to use the software for any purpose and on any scale, and grants access to the source code of and documentation on the software, the right to examine and change the software, to make copies of the software and to make changes and improvements to the software available to the general public.

If free software is to be used in connection with the deliverables, the Contractor shall prepare an overview of the relevant free software. The overview shall be included as a separate chapter in Appendix 2. Copies of the applicable licence terms and conditions for the relevant free software shall be appended in Appendix 10.

The Contractor shall ensure that no free software is being used under licence terms that are incompatible with the requirements applicable to the deliverables, or incompatible with the licence terms governing other software that forms part of the deliverables.

The general terms and conditions of the Agreement shall also govern those parts of the deliverables that consist of free software, subject to the clarifications and exceptions set out below.

10.7.2 The Contractor's responsibility for the overall functionality of the deliverables when using free software

The Contractor shall be responsible for the deliverables (the overall solution) meeting the requirements under the Agreement, cf. clause 5.1, irrespective of the provisions of any particular free software licence.

If errors in free software result in the deliverables deviating from what was agreed under this Agreement, it shall be the responsibility of the Contractor to rectify the error in such a way as to make the deliverables conform to what was agreed, even if such free software might be subject to separate licence terms and conditions that include different provisions on the rectification of errors. The rectification of errors in free software may be effected in any manner that makes the deliverables conform to the requirements under the Agreement.

10.7.3 The Customer's rights in relation to the parts of the deliverables that are based on free software

As regards the parts of the deliverables that are based on free software, including customisations and further developments of the free software, the Customer shall be granted the rights that are necessary for compliance with the terms of the relevant free software licence.

The rights include access to source code, with associated specifications and documentation.

10.7.4 Effects of distributing free software to others

If the deliverables are to be distributed to others, the terms of the relevant free software licence shall apply. If distribution to others, or other ways of making the deliverables available, implies that also other parts of the deliverables than those that originally were free software will be governed by the terms of a free software licence, this shall be specified by the Contractor in Appendix 2.

10.7.5 The Contractor's responsibility for defects in title to free software

The Contractor shall only use free software that is offered under generally recognised free software licences, and that does not, based on a sound assessment on the part of the Contractor, infringe third-party rights. The assessment shall take into consideration, inter alia, how well-established the relevant free software is in the market, the Contractor's knowledge, if any, of the history and origins of the software, and whether it is known in the relevant market that someone is arguing

that the software infringes their rights. The Contractor shall describe its assessment in Appendix 2.

If free software used by the Contractor in connection with the delivery infringes third-party rights, the Contractor shall, within the limitations laid down by clause 10.7.6, remedy the defects in title as specified in clause 13.2.

The Contractor shall indemnify the Customer in respect of any liability for damages imposed as a result of defects in title in respect of free software that the Contractor has offered or independently chosen to use in connection with the deliverables, cf. clause 13.4.

10.7.6 Liability of the Customer if it requires the use of free software

If the Customer requires the use of specific free software as part of the deliverables, the Customer shall itself pay any costs resulting from inadequate functionality caused by errors or defects in the free software.

The Customer shall itself carry the risk of defects in title relating to free software that the Customer has requested be used as part of the deliverables. The Customer shall indemnify the Contractor in respect of any liability for damages imposed as a result of defects in title in respect of free software that the Customer has chosen, cf. clause 13.4 of the Agreement.

To the extent that the Contractor is aware that free software that the Customer has requested be used as part of the deliverables, is unsuited to satisfying the Customer's requirements or, infringes, or is alleged by anyone to infringe, third party copyrights, the Contractor shall point this out in Appendix 2, cf. clause 1.1 of the Agreement.

The Contractor shall, as a supplementary and chargeable service, assist the Customer with the remediation of any defects or defects in title in free software that is chosen by the Customer as mentioned above. The Contractor's standard hourly rate for consultancy services under this Agreement shall apply, unless otherwise agreed in Appendix 7. The Contractor may request a change to the Agreement pursuant to chapter 3 if the effort to remedy such defects has implications for the other obligations of the Contractor under the Agreement.

11. BREACH OF CONTRACT ON THE PART OF THE CONTRACTOR

11.1 WHAT IS DEEMED TO CONSTITUTE BREACH OF CONTRACT

There is a breach of contract on the part of the Contractor if the deliverables do not conform to the agreed functions, requirements or deadlines. There is also a breach of contract if the Contractor fails to perform other duties under the Agreement.

Nevertheless, there is no breach of contract if the situation is caused by circumstances related to the Customer or by force majeure.

The Customer shall submit a written complaint without undue delay after the breach of contract has been discovered or ought to have been discovered.

11.2 NOTIFICATION OBLIGATION

If the Contractor's deliverables cannot be delivered as agreed, the Contractor shall give the Customer written notice thereof as soon as possible. The notice shall specify the reason for the problem and, insofar as it is possible, when performance can take place. A corresponding obligation shall apply if additional delays are to be expected after the first notice has been given.

No damages or other remedies for breach of contract may be claimed for circumstances that have not been notified at the latest prior to the expiry of the warranty period. Nevertheless, this shall not apply to any liability for damages imposed in relation to a third party in respect of defects in title pursuant to clause 13.4.

11.3 EXTENSIONS OF DEADLINES

The Contractor may request an extension of the deadline, which extension must have the written approval of the Customer in order to apply.

The Customer shall not be entitled to claim liquidated damages, ordinary damages or other remedies for breach of contract in respect of the period comprised by an extension of the deadline.

An extension of the deadline shall have no impact on the entitlement of the Customer to any liquidated damages or ordinary damages that accrue prior to the extension of the deadline.

11.4 CURE

The Contractor shall commence and complete the effort of curing the breach of contract without undue delay.

The aim of the cure shall be for the deliverables to satisfy the agreed requirements and specifications, and for the deliverables to work as agreed. Cure may, for example, take the form of repair, redelivery or supplementary delivery.

To the extent that no cure is provided, the Customer may request a proportional price reduction or terminate the Agreement for breach if the conditions for this in clause 11.5.3 or clause 11.5.4 are met.

If the Contractor has failed to cure the breach of contract within the stipulated or agreed deadline, or if the conditions for termination for breach are met, the Contractor shall pay all expenses incurred by the Customer in obtaining a cure from a third party. Nevertheless, the Customer may not allow a third party to cure the defect until any extended deadline has expired.

The Customer shall give written notice to the Contractor prior to appointing a third party.

11.5 REMEDIES FOR BREACH OF CONTRACT

11.5.1 Withheld payment

In the event of breach of contract, the Customer may withhold payment, although the amount withheld shall not be obviously higher than what is necessary to secure the Customer's claim resulting from the breach of contract.

11.5.2 Liquidated damages in the case of delay

If the agreed detailed specification approval date, solution ready for acceptance test date, acceptance test approval date, delivery date, or some other deadline in respect of which the parties have stipulated liquidated damages in Appendix 4 is not complied with, and this is not caused by force majeure or circumstances related to the Customer, there is a delay on the part of the Contractor that triggers liquidated damages.

If the Contractor is delayed with regard to the detailed specification approval milestone or later milestones for which the parties have stipulated liquidated damages, later deadlines shall be extended corresponding to the number of calendar days of the liquidated damages. If the Contractor, through acceleration, manages to meet the milestone *solution ready for acceptance testing* at the originally agreed time, the previously accrued liquidated damages shall be cancelled.

The liquidated damages shall accumulate automatically. The liquidated damages amount to 0.15 per cent of the total consideration payable for the deliverables (the contract price), excluding Value Added Tax, for each calendar day of delay, but albeit limited to a maximum of one hundred (100) calendar days. If the delay pertains to a partial delivery, the liquidated damages shall amount to 0.15 per cent of the total consideration (exclusive of Value Added Tax) for the partial delivery in question for each calendar day the delay lasts, but limited to a maximum of one hundred (100) calendar days. If no price has been quoted for the partial delivery in

Appendix 7, the liquidated damages shall be calculated based on the partial delivery's relative share of the consideration for the total delivery. In the case of the final, comprehensive acceptance test, liquidated damages shall be calculated based on the total consideration for the deliverables. The sum of previously accumulated liquidated damages for the partial deliveries and the comprehensive acceptance test may not exceed 15 per cent of the total consideration for the deliverables.

Other rates for liquidated damages, a different calculation basis and other periods for liquidated damages may be agreed in Appendix 4. Unless otherwise is explicitly stated in Appendix 4, total liquidated damages shall not exceed 15 per cent of the total consideration for the deliverables.

The Customer shall not have the right to terminate the Agreement for breach for as long as the liquidated damages continue to accumulate. However, this time restriction shall not apply in the case of wilful misconduct or gross negligence on the part of the Contractor or anyone for whom it is responsible.

If only parts of the agreed deliverables are delayed, the Contractor may request a reduction in the liquidated damages proportional to the ability of the Customer to utilise the part of the deliverables that has been delivered.

11.5.3 Price reduction

If the Contractor has not succeeded, despite repeated attempts, in curing a defect, the Customer may claim a proportional reduction in the contract price. The price reduction shall compensate for the reduced value of what has been delivered, and shall be independent of any damages.

11.5.4 Termination for breach

If there is a material breach of contract, the Customer may, after having given the Contractor a written notice and granted it a reasonable deadline for remedying the situation, terminate all or part of the Agreement for breach with immediate effect.

The Customer may terminate all or part of the Agreement for breach with immediate effect if the deliverables are materially delayed. There is a material delay if delivery has not taken place by the time liquidated damages reach their maximum limit, or by the expiry of an extended deadline, if this expires later.

The Customer may terminate the Agreement for breach for a partial delivery when the period for the liquidated damages for the specific partial delivery has expired. If the delay is of such a type that the delivery as a whole must be deemed to be substantially delayed, for example, because that which is already delivered or which shall be delivered later cannot be used without that which is covered by the right to terminate for breach, the Customer may terminate the total delivery for breach.

11.5.5 Damages

The Customer may claim damages in respect of any direct loss, including additional costs the Customer incurs due to substitute purchases, any loss caused by additional work and other direct costs in connection with delays, deficiencies or other breaches of contract pursuant to clause 11.1, unless the Contractor demonstrates that the Contractor did not cause the breach of contract or the reason for the breach of contract.

Liquidated damages shall be deducted from any other damages in respect of the same delay.

11.5.6 Limitation of damages

No damages may be claimed in respect of indirect loss. Indirect loss includes, but is not limited to, lost earnings of any kind, lost savings, loss of data, and claims from third parties, with the exception of liability for damages pursuant to clause 13.4.

Overall damages over the term of the Agreement are limited to an amount corresponding to the contract price exclusive of Value Added Tax. Overall damages in the specification phase are limited to an amount corresponding to the consideration for the specification phase.

The said limitations of damages shall not apply in the case of gross negligence or wilful misconduct on the part of the Contractor or anyone for whom the Contractor is responsible.

12. BREACH OF CONTRACT ON THE PART OF THE CUSTOMER

12.1 WHAT IS DEEMED TO CONSTITUTE BREACH OF CONTRACT

There is breach of contract on the part of the Customer if the Customer fails to perform its duties under the Agreement.

Nevertheless, there is no breach of contract if the situation is caused by circumstances related to the Contractor, or by circumstances deemed to constitute force majeure.

The Contractor shall submit a complaint without undue delay after the breach of contract has been discovered or ought to have been discovered.

12.2 NOTIFICATION OBLIGATION

If the Customer is unable to perform its duties under the Agreement, including observing any deadlines, the Customer shall notify the Contractor in writing

accordingly as soon as possible. The notice shall specify the reason for the problem and, to the extent possible, when the Customer will again be able to perform the agreed duty.

12.3 CURTAILMENT OF THE RIGHT OF RETENTION ON THE PART OF THE CONTRACTOR

The Contractor shall not suspend any performance as the result of breach of contract on the part of the Customer, unless the breach is material, cf. clause 12.4.

12.4 TERMINATION FOR BREACH

In the event of payment default, the Contractor may terminate the Agreement for breach if the Customer has failed to settle overdue payments within sixty (60) calendar days of the Customer having received the Contractor's written notice pursuant to clause 8.4.

In the event of other material breach of contract, the Contractor may send the Customer a written notice stating that the Agreement will be terminated for breach unless the Customer has discontinued or cured the breach of contract within sixty (60) calendar days after the Customer received the notice. Termination for breach shall not take place if the Customer has discontinued the breach of contract situation before the expiry of the deadline.

12.5 DAMAGES

The Contractor may claim damages in respect of any direct loss that arises from breach of contract pursuant to clause 12.1, unless the Customer demonstrates that the breach of contract or the cause of the breach of contract is not attributable to the Customer. If the Customer's performance of its duties under the Agreement is delayed, and this results in the Contractor spending more time implementing its part of the deliverables, the Contractor shall have the right to adjust the agreed consideration by an amount corresponding to the number of hours of additional work the Contractor has been caused due to the breach on the part of the Customer.

The limitation of damages provision of the Agreement, cf. clause 11.5.6, shall apply correspondingly.

13. INFRINGEMENT OF THE INTELLECTUAL PROPERTY RIGHTS OF THIRD PARTIES (DEFECT IN TITLE)

13.1 THE RISKS AND RESPONSIBILITIES OF THE PARTIES IN RELATION TO DEFECTS IN TITLE

Each party shall be responsible for ensuring that its deliverables do not infringe the copyrights or other intellectual property rights of third parties, and shall carry all risks in this respect. There is a defect in title if the deliverable entails such infringement.

13.2 THIRD-PARTY CLAIMS

If a third party asserts to one of the parties that the deliverables entail a defect in title, the other party shall be informed thereof in writing as soon as possible.

The responsible party shall deal with the claim at its own expense. The other party shall assist the relevant party with this task to a reasonable extent.

The relevant party shall commence and complete the effort of curing defects in title without undue delay, by

a) ensuring that the other party is able to use the deliverable as before, without infringing any third-party rights, or
b) providing a corresponding deliverable that does not infringe any third-party rights

If the defect in title cannot be resolved as stipulated in paragraph three, the Customer shall stop any further use of the solution and delete the relevant software component.

13.3 TERMINATION FOR BREACH

A defect in title that is not cured, and that is of such a nature as to be of material importance to the other party, shall give the other party the right to terminate the Agreement for breach.

13.4 INDEMNIFICATION OF LOSS RESULTING FROM A DEFECT IN TITLE

A party shall be fully indemnified in respect of any liability for damages imposed on it in relation to a third party and any legal costs incurred, including the party's own costs connected to dealing with the case, in connection with a defect in title. The party may also claim damages in respect of other loss pursuant to the provisions of clauses 11.5.5, 11.5.6 and 12.5.

14. SETTLEMENT UPON TERMINATION FOR BREACH

Upon termination for breach, the Customer shall have the rights stipulated in chapter 10 to what has been produced and made available to the Customer, and the Customer shall pay the agreed consideration for the deliverables that were performed prior to the date of the termination for breach with the deduction of a price reduction in accordance with clause 11.5.3. Clause 2.6.4 concerning the handover of material shall apply correspondingly.

If the deliverables rendered prior to the termination date are of such a nature that the Customer has gained little or no benefit from the deliverables rendered on the termination date and cannot reasonably expect to complete the deliverables with the assistance of another contractor, the Customer may, in connection with termination for breach, choose to demand the repayment of consideration received by the Contractor under the Agreement, with the addition of interest, at the rate of NIBOR plus one (1) per cent, as from the date on which payment was made. In this circumstance, chapter 10 shall not apply.

When the rights of the Customer in relation to what has been made available to the Customer lapse, and if requested by the Contractor, equipment and software and all other materials, whether in an electronic or other format, and irrespective of the medium, shall be handed back or deleted or destroyed in a proper manner. The Contractor may request confirmation from an impartial auditor stating that this has been done. In the event of termination for breach by the Customer, the fee of the auditor shall be paid by the Customer, otherwise it shall be paid by the Contractor.

15. OTHER PROVISIONS

15.1 RISK

The risk of damage to equipment and delivered software copies, etc., due to an accidental occurrence, shall pass to the Customer on the date they are physically handed over to, or downloaded at, the Customer. The Contractor is responsible for maintaining insurance cover for the period up to this date.

If delivered software copies are destroyed after the risk has passed to the Customer, the Customer shall nevertheless be entitled to new software copies in return for payment of the direct costs incurred by the Contractor in making these available.

15.2 INSURANCE POLICIES

If the Customer is a public body, the Customer shall be self-insured. If the Customer is not self-insured, the Customer will be under an obligation to have insurance policies that are sufficient to cover any claims the Contractor may bring on the basis

of the risks or responsibilities assumed by the Customer pursuant to this Agreement, within the limits defined by ordinary insurance terms and conditions.

The Contractor shall hold insurance policies that are sufficient, within the limits defined by ordinary insurance terms and conditions, to meet such claims from the Customer as may arise on the basis of the risks and responsibilities assumed by the Contractor pursuant to this Agreement. This obligation shall be deemed to be met if the Contractor takes out third-party and business insurance on terms and conditions that are deemed to be ordinary within the Norwegian insurance industry.

The Contractor shall, at the request of the Customer, explain and document those of the insurance policies of the Contractor that are of relevance to compliance with this provision.

15.3 ASSIGNMENT OF RIGHTS AND OBLIGATIONS

To the extent that the Customer is a public body, the Customer may assign its rights and obligations under this Agreement to another public body. The entity to which the rights and obligations are assigned shall be entitled to corresponding terms and conditions, provided that the rights and obligations under the Agreement are assigned jointly.

The Contractor may only assign its rights and obligations under the Agreement with the written consent of the Customer. The same shall apply if the Contractor is de-merged into several companies or in the case of assignment to a subsidiary or another company within the same group, but not if the Contractor is merged with another company. Consent shall not be unreasonably withheld.

The right to assignment in the paragraph above shall only apply if the new contractor meets the original qualification requirements, no other material changes are made to the contract, and the assignment is not made to circumvent the regulations concerning public procurement.

The right to consideration under this Agreement may be assigned freely. Such assignment shall not release the relevant party from its obligations and responsibilities.

15.4 BANKRUPTCY, COMPOSITION WITH CREDITORS, ETC.

In the case of debt rescheduling proceedings, composition with creditors, bankruptcy, or any other form of creditor intervention, in respect of the business of the Contractor, the Customer shall be entitled to terminate the Agreement for breach with immediate effect, unless otherwise is stipulated by mandatory law.

15.5 DUTY OF CARE IN RELATION TO EXPORTS

If any products, including spare parts, software and technology, delivered by the Contractor are subject to requirements for authorisation from the authorities in the country of origin and/or other countries, the Customer is responsible for obtaining such authorisations in the case of export or re-export of such products.

15.6 FORCE MAJEURE

If an extraordinary situation should arise which is outside the control of the parties which makes performance of the duties under this Agreement impossible, and which under Norwegian law must be classified as force majeure, the other party shall be notified of this as soon as possible. The obligations of the affected party shall be suspended for as long as the extraordinary situation prevails. The corresponding obligations of the other party shall be suspended for the same period.

In force majeure situations, the other party may only end the Agreement with the consent of the affected party, or if the situation prevails or is expected to prevail for more than ninety (90) calendar days as of the date on which the situation arose, and in such case only with fifteen (15) calendar days' notice. Each of the parties shall cover their own costs associated with the ending of the contractual relationship. The Customer shall pay the agreed price for the part of the deliverables that was performed prior to the Agreement coming to an end. The parties may not present other claims against each other due to the Agreement coming to an end pursuant to this provision.

The parties shall, in connection with force majeure situations, have a mutual disclosure obligation towards each other concerning all matters that must be deemed relevant to the other party. Such information shall be disclosed as soon as possible.

16. DISPUTES

16.1 GOVERNING LAW

The rights and obligations of the parties under this Agreement shall in their entirety be governed by Norwegian law.

16.2 NEGOTIATIONS

Should a dispute arise between the parties as to the interpretation or the legal effects of the Agreement, the parties shall seek to resolve such dispute through negotiations.

If such negotiations do not succeed within ten (10) working days, or a different period agreed by the parties, each of the parties may request that the dispute be brought before an independent expert or submitted for mediation.

16.3 INDEPENDENT EXPERT

The parties shall in connection with the conclusion of the Agreement appoint an independent expert, whose name shall be specified in Appendix 6, and who shall hold such qualifications as the parties believe to be the most appropriate in the light of the Agreement. If this has not been done, the parties may agree on the appointment of an independent expert at the time of a dispute.

The parties shall in advance choose either to

a) comply with the solution proposed by the expert (binding), or
b) use the solution proposed by the expert as a basis for reaching a solution themselves (advisory).

The detailed approach to these efforts shall be determined by the independent expert, in consultation with the parties.

16.4 MEDIATION

If a dispute related to this Agreement has not been resolved after negotiations or by using an independent expert, the parties may attempt to resolve the dispute through mediation.

Mediation may also be used without the prior use of an independent expert.

The parties may elect to adopt the rules of the Norwegian Bar Association for mediation by advocate, modified, if applicable, to suit the preferences of the parties. The parties should agree on a mediator and who shall hold such qualifications as the parties believe to be the most appropriate in relation to the nature of the dispute.

The detailed approach to the mediation shall be determined by the mediator, in consultation with the parties.

16.5 JOINT RULES FOR INDEPENDENT EXPERT AND MEDIATION

The independent expert and/or mediator shall act impartially and independently in the performance of his or her duties. Prior to accepting an assignment, the expert/mediator shall notify the parties of any potential circumstances that are likely to give rise to a suspicion of insufficient impartially or independence on his or her part. The expert/mediator shall also give the parties such notice during the

assignment if the parties have not previously received such information, or if the relevant circumstances arise during the assignment.

At the start of mediation, the expert/mediator shall inform the parties of the basis on which his or her remuneration will be calculated. Unless otherwise agreed, each party shall pay its own costs and half of the costs of the expert/mediator. The expert/mediator has the right to request the parties to pay a sufficient advance to cover the costs and remuneration of the mediator/expert, or to request the parties to provide sufficient security.

The assignment of the independent expert or mediator shall be concluded in one of the following ways:

a) through a proposed solution from the expert in accordance with clause 16.3, second paragraph,
b) through a written settlement or agreement between the parties, based on the solution proposed by the expert/mediator,
c) through the expert/mediator informing the parties that he or she does not deem it appropriate to continue the assignment, or
d) through a party informing the expert or the mediator that such party wishes to conclude the assignment

16.6 LITIGATION OR ARBITRATION

If a dispute is not resolved through negotiations, through mediation or by an independent expert, each party may require such dispute to be resolved with final effect before the Norwegian courts of law.

The venue shall be the court of domicile of the Customer.

The parties may alternatively agree that the dispute shall be resolved with final effect through arbitration.

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Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 1 – Customer requirement specification

[Contractor name]

[Contractor logo]

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Attachment 4 - Checklist transfer to third countries

1. INTRODUCTION

1.1. ABOUT THIS APPENDIX

This Appendix describes background for and scope of the procurement and the Customer's objectives, needs and requirements for a solution for new ingest system of media assets (hereinafter referred to as "the Solution") The needs and requirements must be answered in subsequent appendices as indicated, where an overall description of the Solution must be provided as well as a detailed description of how the Contractor's objectives, needs and requirements will be fulfilled.

The list below provides an overview of this document:

- Chapter 2 summarizes the background and main objectives of the project.
- Chapter 3 describes the scope of the Solution, including options.
- Chapter 4 contains instructions for the documentation of the Contractor's high-level solution proposal.
- Chapter 5 describes the Customer's needs for workflows and automation.
- Chapter 6 describes the Customer's needs and requirements related to the solution architecture.
- Chapter 7 and 8 describes the Customer's technical needs and requirements, also related to integrations and API.
- Chapter 9 describes the Customer's requirements and preferences regarding climate environmental requirements.
- Chapters 10-12 describe needs and requirements related to other deliveries and performances; including processing and storage of personal data, implementation methods, documentation; training and administrative and legal requirements.

Attachments according to the table of contents.

Further, this Appendix contains a combination of textual descriptions of objectives, needs, cases, and requirements as well as tabulatory listings of requirements of a more technical character.

The specified needs and requirements must be understood on the basis of descriptions of the background, as well as the Customer's purpose and needs in chapters 2 and 3. By answering all requirements and describing how the requirements are met in the offered solution, the Contractor is expected to present its best proposed solution based on the described needs that fulfils the objectives in a best possible manner.

For practical purposes "the Customer" may also be referred to as "NRK".

Any reference to "clause" refers to a section in the General Contract Terms (SSA-T).

1.2. EXPLANATION TO THE REQUIREMENTS SPECIFICATION

The requirement specification table consists of the columns shown below. Light gray shaded columns in Appendix 2 only and to be filled out by the Contractor.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	

#: Requirement ID - Consecutive numbering of needs/requirements within each section.

Requirement: Textual description of the need/requirement.

"Requirement fulfilment:

- **STD**: the requirement is fulfilled through default standard functionality "preconfigured out of the box".
- **CON**: the requirement is fulfilled through configuration, e.g. screen/GUI config, reports, etc.
- **DEV**: the requirement is fulfilled through custom development (changes to the source code of the standard solution or custom extensions/add-ons to the standard solution).
- **3RD INT**: the requirement is fulfilled through third-party software with built-in integrations as part of the standard solution.
- **3RD**: the requirement is fulfilled through third-party software.
- **FUT**: the requirement is fulfilled through future software release. Future software release refers to versions that are released after the Solution is put into operation for the Customer. The Contractor must comment on which future version will fulfil the requirement and the estimated time for when this version will be available to the Customer.
- **WA**: the requirement is **not** fulfilled as intended by the Customer's requirement description, but the Contractor has a workaround solution (describe workaround solution).
- **NO**: the requirement is **not** fulfilled.

The Contractor's Solution Description: The Contractor's detailed description of *how* the need/requirement is fulfilled as well as which parts of the requirement are possibly not fulfilled according to the applied fulfilment code. Please also refer to section 1.3 below.

1.3. INSTRUCTIONS FOR COMPLETING APPENDIX 2

The Contractor is required to document degree of fulfilment of and compliance with the specified objectives, needs and requirements in Appendix 1 by completing the corresponding Appendix 2 Contractor's solution description.

In Appendix 2 the Contractor shall:

- provide a high-level solution overview, cf. chapter 4
- document fulfilment of requirements as specified in chapters 5 through 12.

The Contractor must in Appendix 2, provide for each case and requirement, an exhaustive elaboration of how the Solution addresses the Customer's needs and requirements. The Contractor is encouraged to add illustrations and screenshots whenever this may help the Customer to a better understanding of how the Solution addresses the requirement. References to general materials such as sales and/or product brochures, product magazines and web content is not sufficient. Any relevant supplementary information may be provided as attachment(s) to Appendix 2 with clear and unambiguous reference.

Where requirement tables are used the Contractor must answer each requirement with a confirmation by marking an "X" in the relevant column(s) under the heading "Requirement fulfilment":

If the Contractor marks either one of columns "STD", "CON", "DEV", "3RD INT", "3RD" or "FUT", the requirement is accepted as fulfilled.
If the Contractor has any reservations to the requirement, this must be explained in the "Solution Description"-column.

If the Contractor will fulfil part of the requirement with one of the categories and another part with another category, then the Contractor may mark more than one category. In that case, the Contractor must be very explicit in his description in Appendix 2 about how each part of the requirement is fulfilled.

The Contractor shall, inform the Customer of the likely consequences of any customizations in terms of the complexity and price of any future maintenance of the standard system and customization.

If the Contractor does not fulfil the requirement as intended by the Customer's requirement description, but the Contractor has a workaround solution, the Contractor must put a mark in the "WA"-column and describe the workaround solution in the "Workaround solution"-column.

If the Contractor does not fulfil the requirement, the Contractor must mark the "No"-column.

The Contractor's Solution Description must be sufficiently exhaustive for the Customer to assess whether the solution meets the requirement and otherwise may be considered suitable, possibly adding value, and thus form a sufficient framework for any detail specification. If the column "The Contractor's Solution Description" in the opinion of the Contractor does not contain sufficient space for text and possible illustrations for certain requirements the description may be included under each requirements table with clear and unambiguous reference to the applicable requirement number.

Although alternative proposals are not allowed as such, this does not prevent the Customer from accepting a fulfilment of individual requirements that are not necessarily "according to the letter of the requirement" if the Customer has justified this in terms of increased performance, value, efficiency, safety, gain etc., or reduced risk and cost. Similarly, if the Contractor considers certain requirements to be particularly complex or cost-driving the Contractor may justify this and propose and describe an alternative fulfilment.

It is the responsibility of the Contractor to ensure that all requirements are sufficiently addressed. If requirements are left unanswered or uncommented – they are to be considered as fulfilled unless otherwise explicitly stated by the Contractor.

Any limitations, demarcations, assumptions, or deviations must be clearly described in connection with the individual goal/need/requirement in Appendix 2 order to be invoked.

1.4. INSTRUCTIONS FOR COMPLETING OTHER APPENDICES

ID	Instructions
1	The Contractor shall in Appendix 4, in accordance with the structure and instructions provided in the Appendix, describe their overall project and progress plan for the delivery of the Solution, based on the Contractor's applied project methodology as described in Appendix 2. In this Appendix the Contractor shall also provide a plan for establishing the support and maintenance service.
2	The Contractor shall in Appendix 5, in accordance with the structure and instructions provided in the Appendix, describe how testing and approval shall be conducted.
3	In Appendix 6, the Contractor shall, in accordance with the structure and instructions provided in the Appendix, describe its organisation, staff and interaction with the Customer as instructed.
4	The Contractor shall specify prices and the principles for pricing in Appendix 7.
5	If the Contractor has any reservations to the general terms in the agreement these shall be set forth in Appendix 8, except for cases where the General Contract Terms refer to other documents.
6	Any licence terms and conditions for standard software and free software shall be included in Appendix 10.

2. BACKGROUND AND PURPOSE

2.1. BACKGROUND AND PURPOSE

As an incumbent and mature broadcasting organisation we have a long history of ingesting content into our media-production and media asset systems. Times are changing and so are

technology. **Hence, we need to upgrade our production to be future proof** and more in line with future demands. NRK aims to transition from dedicated AV infrastructure to an IT-centric, IP-based media infrastructure. NRKs vision is being actualised through the Modernised Production Platform (MPP) programme, which is briefly described in the next chapter.

NRKs current ingest solution is nearing its end of life/support. The current system is decentralised, with ingest servers located across Norway. Often, the same content is ingested multiple times at different locations. **NRK aims to substitute the old solution and implement a new centralised ingest solution**, housed in data centres and provide remote accessible distributable to production capacities throughout the country.

NRK is also relocating the head office in Oslo and several regional offices, including a large regional centre in Trondheim. **This move urges NRK to adapt to new production, technical, and workflow capabilities**.

The main purpose – in bold – also needs to support our strategic commitment to reduce our carbon footprint by 1. **Pooling resources** which are currently distributed across Norway to **increase** overall utilisation. 2. **Reducing duplication** of ingest jobs. 3. **Upgrading old hardware** for modern, more energy efficient and compact systems. 4. Placing the **servers in energy efficient colocation datacentres.**

Furthermore, MPP provides an opportunity to create a cost-effective, modernised ingest system that promotes collaboration. This can be achieved by centralising the system into the two new data centres and removing the ingest hardware and servers from our offices. In this model, ingest channels will be selected from a shared pool, preventing duplicate captures of identical content.

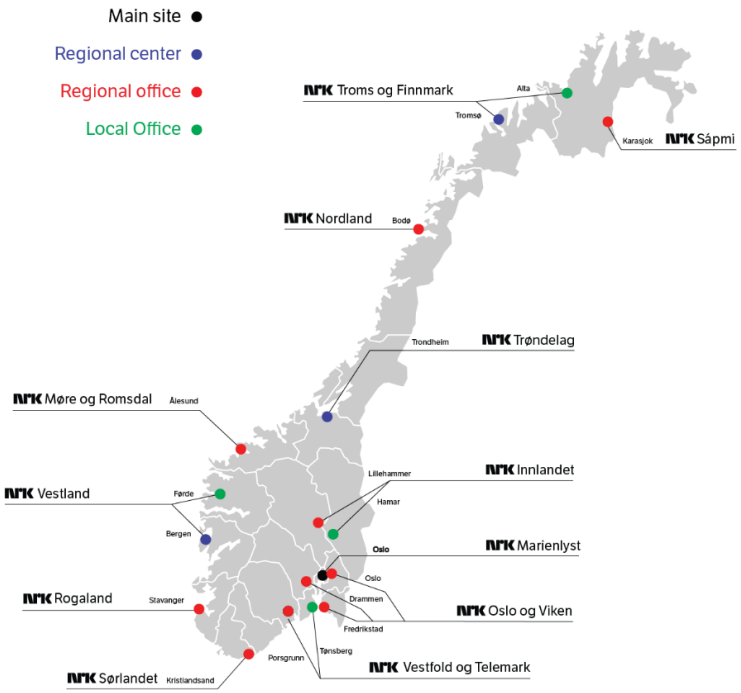


Figure 1. NRK office locations

The new solution will be compatible with MPP technologies (e.g. ST 2110, AMWA NMOS), formats (e.g. 1080i/25 SDR, 1080p50 HDR, 2160p50 HDR), encoding formats (e.g. MXF, AVC, HEVC, ProRes 422) and should be deployable both on premises and on public cloud infrastructure.

2.2.MODERNISED PRODUCTION PLATFORM BRIEF (MPP)

Fuelled by several factors, NRK is currently in the process of performing a business transformation from SDI and AES3 broadcast technologies to native AV over IP services

(AVoIP). The AVoIP model will form the standard model for real-time broadcast activities at all sites.

This business transformation is being co-ordinated by a company-wide programme, referred to as MPP – Modernisation of the Production Platform (MPP). In addition to the transformation to AVoIP, the MPP programme aims to centralise production processing resources in external datacentres, and to lay the groundwork for integrating public cloud services into broadcast workflows.

The MPP high level technical vision encompass the following principles:

- Business transformation from SDI and AES3 broadcast technologies to native AV over IP services (AVoIP).
- Centralize production processing resources in secure, resilient, synchronized external datacenters (DC) as private cloud and to integrate public cloud services into broadcast workflows.
- Applications and workloads will be hosted on public clouds when and where appropriate.
- All suitable technical production resources not requiring direct physical interaction (ingest servers being a good example) will be centralized within the DC locations.
- Utilize general purpose, commercial off the shelf (COTS) network and server hardware.
- Replace hardwiring system components by logically defined "soft" wiring, and "soft coupled" components.
- High-speed, diverse WAN network links will provide connectivity between the datacenters and office locations across Norway. QoS markers will be used to prioritize traffic and ensure service quality.
- Remote access to a subset of platform services and applications will be possible via the Internet.
- Technical workspaces (control rooms, studios, edit suites etc.) located within NRKs offices will access platform applications and services via Wide Area Network (WAN) links.

Figure 2 provides a very high-level, geographical representation of the technical vision for the MPP.

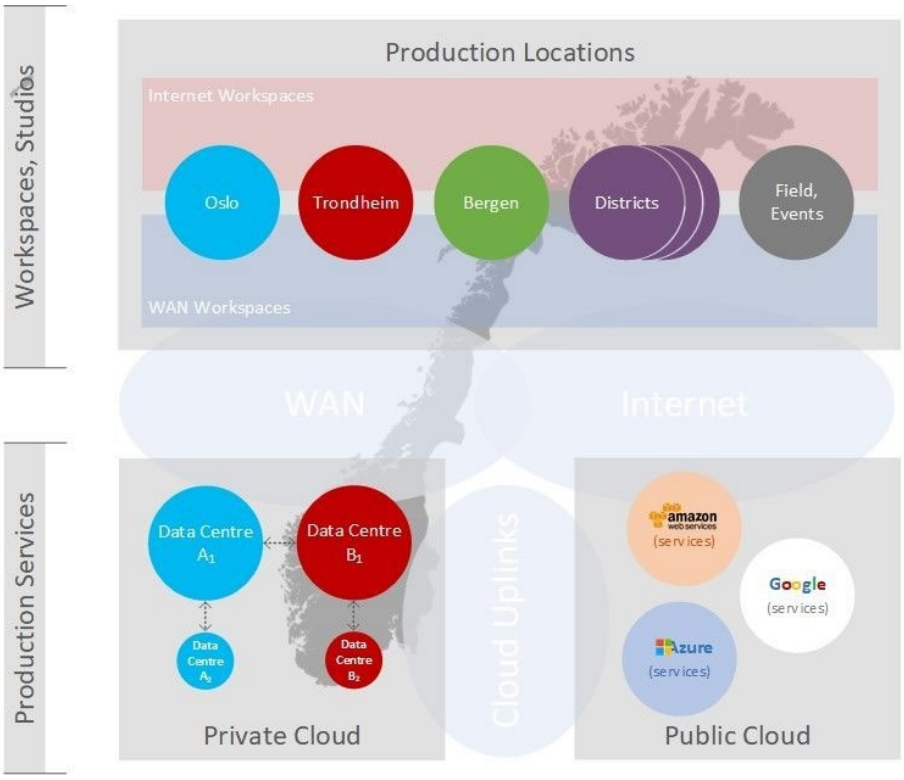


Figure 2. Very-high level context diagram. The working assumption is that one DC will be in southern Norway (A1/A2), in or around Oslo, the other in central Norway, in or around Trondheim (B1/ B2).

2.3. PHASING AND MILESTONES OF THE MPP SCOPE

MPP scope will be delivered in phases, which are described here below. Time plan indicated is tentative. Hence, the new Ingest Solution is part of MPP and will need to be aligned with the "global" timeline and the objectives of MPP.

V0.5 release

The programme phase leading to release v0.5 is in progress. The v0.5 environment is ready for deployments in temporary data centers from Q3 2024 with target to have completed testing in Q4 2024. This phase establishes foundation functionality for use at a minimum viable scale for live services. The goal of V.0.5 is a functional modernized platform in Marienlyst (HQ in Oslo). To achieve this goal, an initial deployment of the ingest system should be delivered. In scope for v0.5 phase and relevant to the Ingest solution is:

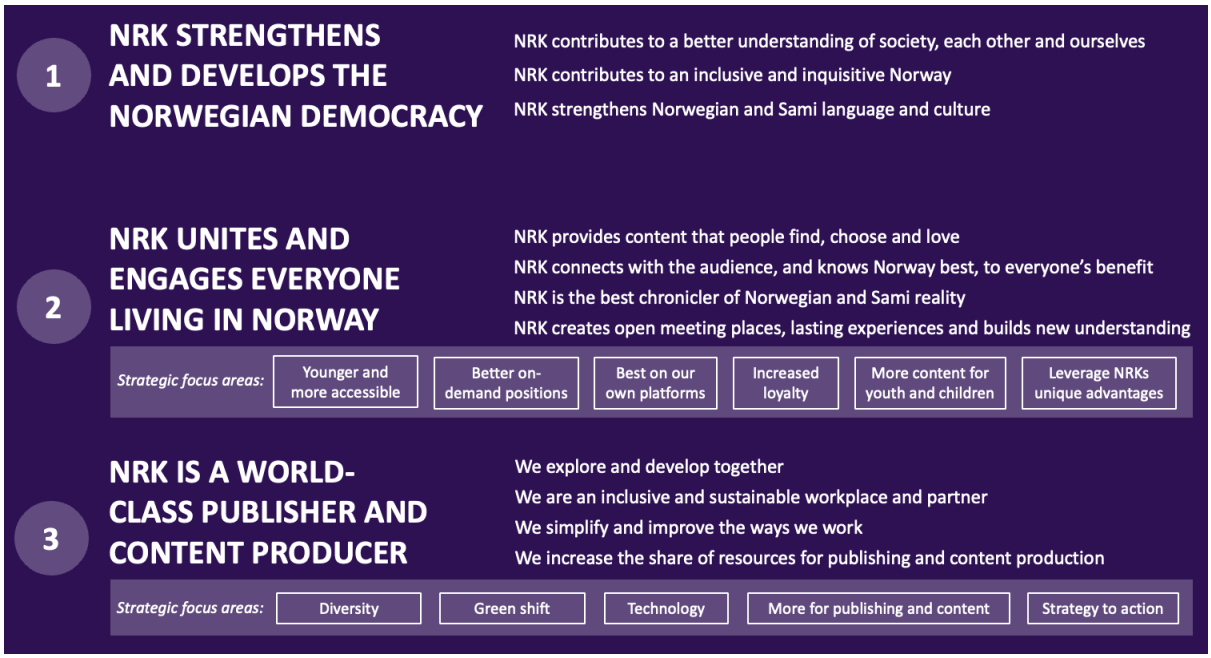
- Implementation of a Broadcast Control System (BCS)
- WAN rollout and networks.
- Compute and NAS.
- Initial deployment of ingest capability.

V1.0 release

Following v0.5 release in Q4 2024, this phase runs for one year to support the new Trondheim facility launch (v1.0) planned for Q4 2025. The v1.0 environment will be ready for deployments in permanent data centers by Q2 2025 with a target to have testing completed by Q4 2025. Scope should be deployed incrementally throughout the stage. v1.0 widens the scope to include all live production and post-production workflows needed for new Trondheim. The new NRK Trondheim facility will launch using this functionality, which will evolve to inform NRKs new headquarter at Ensjø in Oslo. All remaining product integrations are introduced for this phase. This includes an expanded ingest deployment.

2.4.OBJECTIVES

The objective of this RFP and the subsequent negotiations is to provide NRK with a general purpose ingest system that will fulfil NRKs live ingest requirements which will contribute to NRKs long-term strategic goals shown below.



The Ingest system is an essential component in a broadcast production platform. There is an ongoing, long-running project at NRK where the main focus is to provide a modern, automation driven integrated platform for the acquisition, production and management of content.

Apart from the basic tasks an Ingest-system must be able to perform, these are the main objectives that are sought realised through the solution as described below.

2.4.1. TECHNOLOGICAL RENEWAL AND MODERNIZATION

Technological shift from SDI to AVoIP
NRK aims to safely transition from dedicated AV infrastructure to an IT-centric, IP-based media infrastructure. Editorial staff from all offices in NRK should be able to schedule, record, preview, and work on ingested assets regardless of location and physical distance to the resources and data centres.

Modern software development and operation methodologies
Infrastructure as code, version-controlled configuration, continuous integration/delivery and automatic deployment of software and servers.

Scalability and flexibility
Resource requirements will shift over time. We might need to scale up the system for i.e. event purposes. The ability to deploy solutions in private or public data centers is an important park of NRKs technological strategy. A high degree of flexibility is appreciated to meet future requirements for technical standards and formats.

Environmental responsibility
Reduce the carbon footprint by pooling geographically spread resources, increase overall utilization, and choose modern hardware for more energy efficient and compact systems.

2.4.2. INTEGRATION, AUTOMATION, AND EFFICIENCY

API driven
The ingest system will be part of an ecosystem and integrate with other third-party and in-house developed systems. Use of modern API-interfaces and other modern techniques will enhance integrations with up- and down streams systems.

Increase level of automation and performance
Manual operations are time-consuming and prone to errors. Reducing manual operations across multiple systems in the scheduling and ingest workflows will improve efficiency. In progress recordings should be made available for preview and editing to support fast and efficient workflows.

2.4.3. SECURE SERVICE AVAILABILITY

High availability and resilience
Highly available design and components to secure normal operations in case of disruptions in order to maintain NRKs responsibilities as a public broadcaster. Maintainable in service, reduce need for disruptive maintenance windows.

Secure by design, not as an afterthought
High public trust is essential for NRK, and safeguarding the content production chain is vital. Therefore, NRK should always follow security best practices to help ensure the confidentiality, integrity, and accessibility of NRK's data and information technology environment.

3. SCOPE OF THE INGEST SOLUTION PROCUREMENT

The Customer shall procure a new ingest solution (hardware and software) during design (customization) and implementation.

The project aims to deliver a high degree of continuous value to the organization by actively planning for an incremental introduction of the new systems and features.

Combined with a clear Separation of Concern (SoC) and co-developed integrations (cf. section 8) this should enable the responsible teams at NRK a higher change-rate and ability to implement new workflows faster and more reliably.

The Contractor should assume overall responsibility for the deliveries within this contract and use the Customer's resources as far as possible.

Delivery scope 1: In this scope we shall implement the ingest solution in two temporary data centers located within the NRK offices in Trondheim and Oslo. The solution will be limited in both functionality and scale, with a minimal physical footprint of hardware in each data center. The objective of this scope is to assess and test basic functionality including;

- 3G and UHD ingest.
- Playout of media streams capabilities.
- Integration to the MAM-system for registering video assets.
- Integration to the BCS for routing of signals

The ingest solution will not be live and in real production in delivery scope 1.

Delivery scope 2: In this scope we shall implement the ingest solution in the two permanent data centers. At the time being, the location of the data centers is unknown. The objective of this scope is to have a fully functional ingest solution:

- Move ingest servers from temporary to permanent data centers.
- Scaled for production.
- Integrations to up- and downstream systems.

The ingest solution is planned to be incrementally rolled out in Q3/4 2025.

3.1. TECHNICAL SCOPE

The following figure shows a high-level overview of the technical scope illustrated and framed in “as-is” and “to-be”.

The procurement includes an ingest solution with associated hardware, integrated with current and future Media Asset Management (MAM) (cf. section 8.1.1), that supports the reference architecture requirements (cf. section 6) and being compatible with MPP technologies (e.g. ST 2110, AMWA NMOS), formats (e.g. 1080i/25 SDR, 1080p50 HDR, 2160p50 HDR), encoding formats (e.g. MXF, AVC, HEVC, ProRes 422) and should be deployable both on premises and on public cloud infrastructure.

For the purpose of this specification, the scope is as follows:

In scope for Ingest system delivery:

- General purpose ingest
- District and regional news ingest
- Studio / multi-cam ingest
- Visual radio
- Ingest servers and software
- Ingest scheduling software
- Playback of hi-res content

Initially out of scope for Ingest system delivery:

- National news - replay/ingest/edit
- Sports - replay/ingest/edit
- Playout – main transmission playout system
- File ingest/upload

However, although the above functional areas are initially out of scope, NRK reserves the right to consider these items as options for possibly future investigation and implementation if deemed necessary and appropriate to maintain the high-level objective for the new Ingest solution.

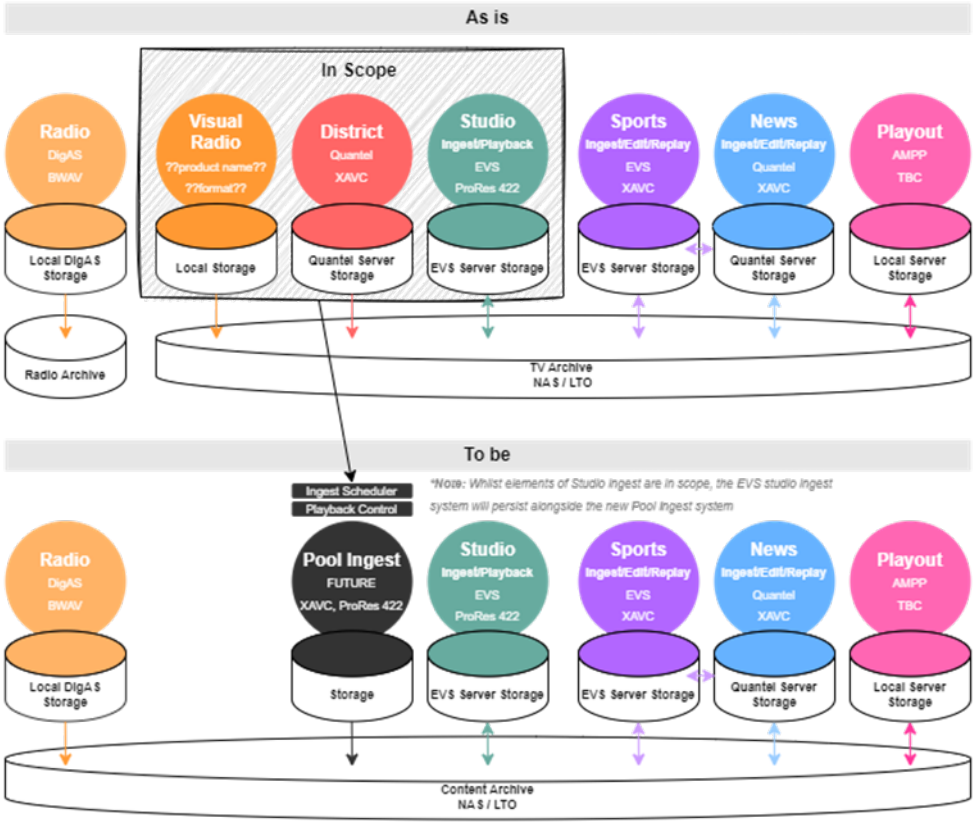


Figure 3. Ingest Scope

3.2. VOLUMES

The ingest system must at least handle the following volumes of concurrent inputs for Delivery Scope 2. In Delivery Scope 1, NRK requires a minimum footprint of hardware that allows us to achieve the objectives described.

Delivery Scope 1:
For Delivery Scope 1, we would like to test 3G ingest, UHD ingest and replay capability with MAM / BCS integration, ideally with the minimum footprint possible in each data centre. We would like the Contractor to suggest a minimum viable product that allows NRK to meet the objectives of this scope.

Delivery scope 2:
For Delivery Scope 2, we would expect the remaining capacity to be delivered. Please note that the capacity described below is the total capacity required in the production environment.

- Datacenter A
  - 38 inputs
    - 32 x 1080p50 inputs
    - 6 x 2160p50 inputs
- Datacenter B
  - 38 inputs
    - 32 x 1080p50 inputs
    - 6 x 2160p50 inputs

Staging environment
NRK requires a cost-efficient staging environment that needs to mirror the production environment in functionality, but not scale. The staging environment is intended to follow the same principles and design as the production environment (cf. section 5). We would like the Contractor to suggest how a cost-efficient staging environment can be set up that meets the requirements of mirroring the production environment.

3.3. OPTIONS

In addition to the volumes described above, the following options shall be briefly described in Appendix 2 and priced in Appendix 7. See detailed descriptions of options in section 12.4 in this Appendix.

4. HIGH-LEVEL SOLUTION OVERVIEW

The Contractor shall provide a comprehensive high-level overview of their Solution based on the objectives and needs described in chapter 2 and 3 and the accompanying cases, user stories and requirements in the following chapters. A high-level technical description/illustration of the Solution should be included.

The Contractor must provide clear and unambiguous statements about which of the Customer needs and requirements they do not support or cannot deliver.

The high-level overview and documentation should emphasise:

a) **Performance**: How the offered Solution contributes to achieve the main objectives of this procurement (cf. chapter 2.4). Please make unambiguous references to the relevant sections in Appendix 2 that contribute to the achievement of the Customer's objectives.

b) **Risk**: How the Contractor will help the Customer to reduce principal risk related to this Solution. Both in establishing the service and running it. Please make unambiguous references to the relevant sections in Appendix 2 where the offered measures provide effect.

c) **Additional Value**: How the Contractor can offer additional value to the Customer in addition to the listed requirements and relative to the competing Contractors. Please make unambiguous references to the relevant sections in Appendix 2 that shows how the offered Solution provides added value and better goal achievement for the Customer.

5. HIGH-LEVEL WORKFLOW DESCRIPTION

This section contains the description of a target workflow and functional needs.

5.1. BASIC WORKFLOW

The following description is intended to provide guidance about the target workflow of the ingest system in its ecosystem. To allow scope for different approaches which achieve a similar result, the description is deliberately high-level.

The purple-coloured parts are the ingest system (in-scope for this procurement), the red, green and blue parts are existing NRK systems to be integrated with the ingest system. Requirements regarding integrations and APIs are stated in section 8 below. The existing NRK systems are described in Appendix 3 – Customer Technical Platform.

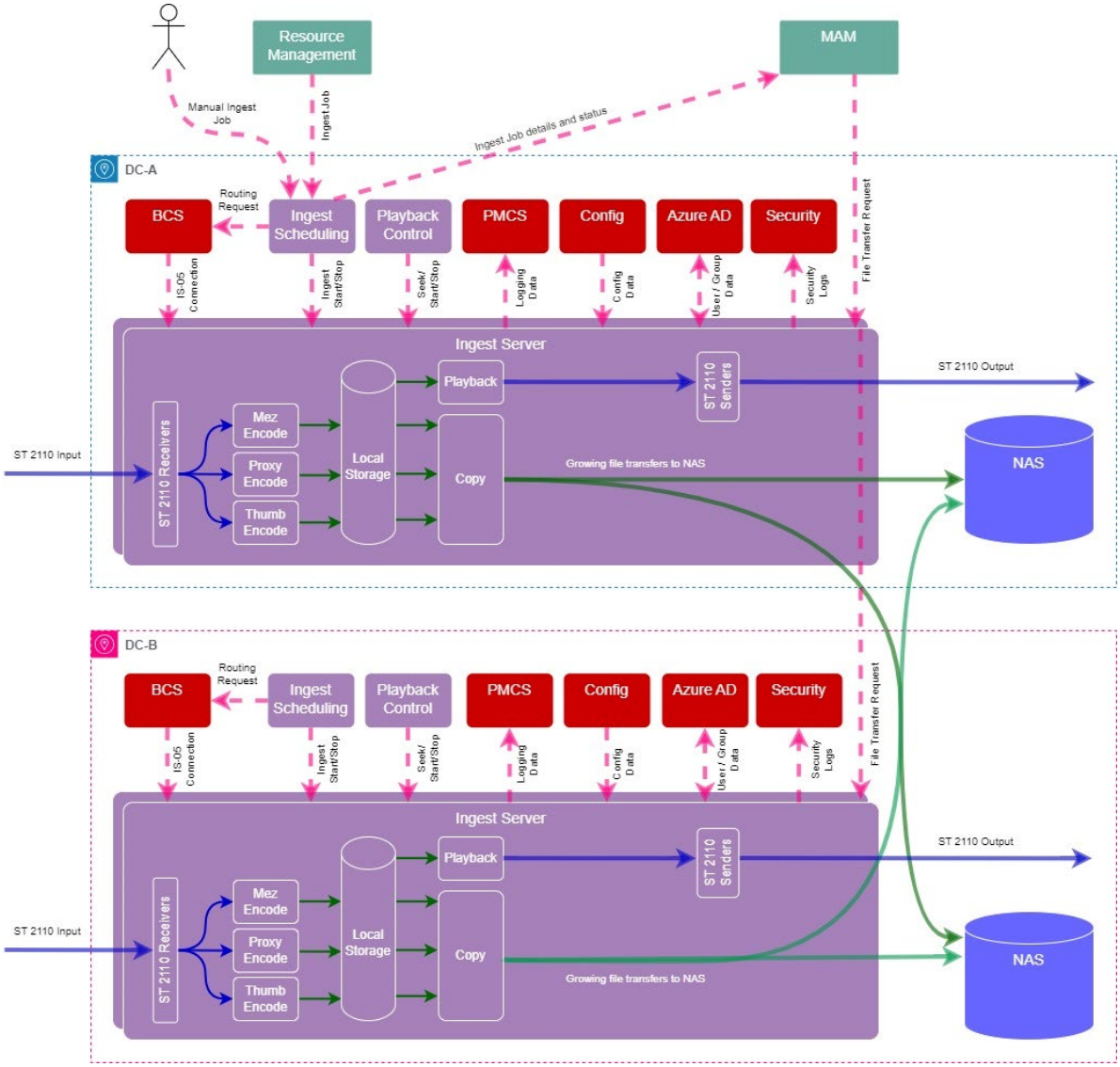


Figure 3. Ingest System Overview

The ingest server ports are a shared resource that can be scheduled either via a Resource Management system or via operators entering jobs directly into an ingest scheduling tool.

1. A Resource Management system issues ingest job information to the DC-A/DC-B Ingest Scheduling systems. The ingest job will include: file name, start time, duration, format, server, server channel, as well as various other metadata fields. The request may be issued days or weeks ahead of the ingest job start time. Users may also create jobs directly within the Ingest Scheduling system.

   Various options exist for content capture, which will be based on the importance of the content. Examples include:
   a) Capture of a live feed to a single server within one datacentre
   b) Concurrent capture of a live feed to two servers within one datacentre
   c) Concurrent capture of a live feed to a single server within both datacentres
   d) Concurrent capture of a live feed to two servers within both datacentres

   NRK anticipate that scenario “c” will be the most common.

2. The Ingest Scheduling system creates corresponding content placeholders within the MAM.
3. Shortly before the ingest job start time, each Ingest Scheduling system issues a routing request to the Broadcast Control System (BCS) to present the required live content to the server.

4. The BCS system in DC-A/B issues IS-05 connection requests to the ingest server channel which has been scheduled to encode the event. The IS-05 connection request will use the "bulk" attribute so that all audio, video and data connections for the ingest job can be communicated in a single request. The BCS also communicates to the AVoIP network to ensure the source media flows are transferred across the network to the network switch the ingest server is attached to.
5. Each ingest server subscribes to the audio, video and data flows associated with the ingest job.
6. Each Ingest Scheduling system issues the job request to the ingest server shortly before it is due to start.
7. Each ingest server encodes and writes Mezzanine, Proxy, and Thumbnail files to local server storage.
8. The MAM initiates parallel growing file copies from the local storage of the primary server to the NAS storage in both DC-A and DC-B. No copies are initiated from the Guard server unless the encode job on the Primary server fails.

Within this workflow, various possibilities exist to resolve failures (e.g. encode failure, file transfer failure, failure to create MAM placeholders).

Please note that whilst the ST 2110 inputs and outputs are illustrated, the solution should support a variety of other transports and codecs such as NDI, TS, SRT, RIST, AES67 (please refer to requirements tables for details).

The "Config" block in Figure 4 refers to NRK's configuration automation environment. The MPP platform is an IT platform for media production. It will be operated based on DevOps practices. Configuration will be managed within a Git repository and CI/CD tools such as GitHub Actions and Ansible will be used to automate the process of deploying devices and configuration.

The "PMCS" block in Figure 4 refers to the Platform Monitoring and Control System. The PMCS will collect log and event data from applications, services, networks, and devices within the modernised production platform. Aggregated log data will be reported on in a variety of ways to provide relevant insights to different user communities (Figure 5).

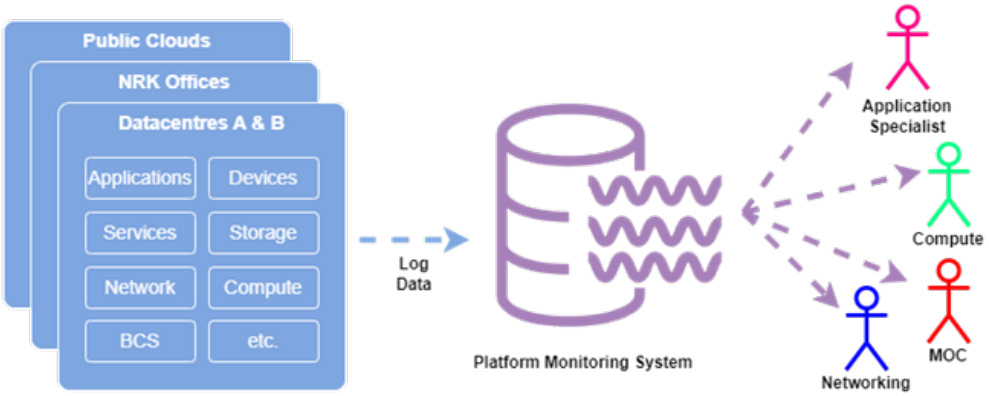


Figure 4. Platform Monitoring Context

Platform monitoring will be based on modern, IT-centric tools (Figure 6), which are aligned with existing tools in use at NRK. The architecture caters both for real-time event processing and alerting, as well was log data analysis, to provide deeper platform insights. The chosen solution will be integrated with this system.

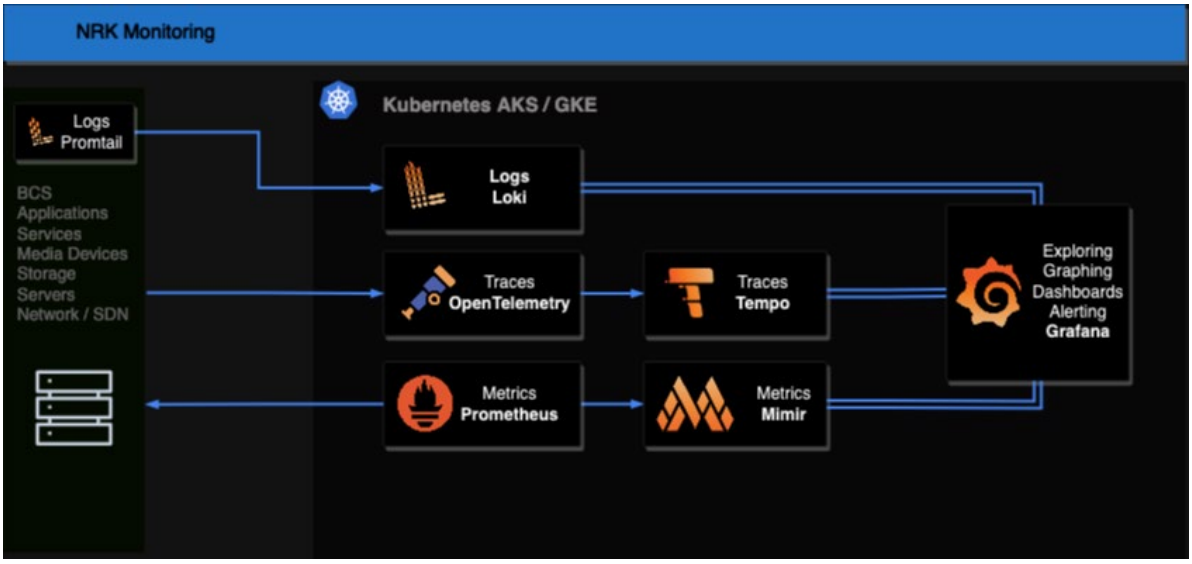


Figure 5. Platform Monitoring Stack

#	Requirement
1	With reference to the diagrams and text above, please describe how the Contractor will meet NRKs workflow objectives with specific reference to the encoding to local server storage and dual data centre model.
2	In the workflow, various possibilities exist to resolve failures (e.g. encode failure, file transfer failure, failure to create MAM placeholders). Please summarise worst case scenarios and how they would be managed within the proposed solution.

5.2.EXAMPLES OF INGEST SOLUTION USAGE

This chapter contains a few examples of the ways in which the current ingest solution is being used including pain points. In addition, the chapter includes future use cases for how we envision the new ingest solution to used.

The wording of these examples cannot be considered literally exhaustive, they are only meant to show functional and technical challenges and requirements in a richer context. While NRK's operating model is yet to be finalised, these examples demonstrate likely ways in which the solution might be employed.

5.2.1. CURRENT USE CASE 1: MANUAL INGEST TASK

This example covers a current scenario in which an unscheduled recording must be triggered manually by an operator, for example for a news event or a press conference.

A request is made by an editorial or operational team for an ad hoc recording with little or no advance notice. This request may come by email, phone or in person.

The operator will get the source from either the staff requesting the recording, or by calling the Master Control Room for any additional information.

The operator selects the source in the ingest scheduling tool, which has the ability to display all sources from the BCS. A human readable clip name is given, in addition to the start time and duration of the recording. The ingest tool will automatically select which input to use and assign a random GUID which is used as a unique identifier in the MAM. The ingest tool will trigger workflows in the MAM, i.e. ingest as growing file and proxy generation once the recording is finalised.

Pain points from the above workflow:

- It is not possible to preview the ingest in the MAM while the recording is ongoing, proxies are generated once the ingest is finished.
- Editing a growing file in Premiere is challenging due to bad performance. There is a delay which prevents real time editing and playback close to “now”.
- It is not practical to play back/playout the high res recording while the ingest is ongoing, for example for time shifting.
- The workflows for making the ingest available as audio only are slow.

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs and pain points described above

5.2.2. CURRENT USE CASE 2: INGESTS OF REGIONAL TRANSMISSIONS BASED ON RULESET

This example covers ingests of daily transmissions in the regional offices. These are used for archival purposes and are also transcoded to be published to NRK’s on demand service.

An operator will create a series of recurring ingests based on a ruleset that contains a clip name, start time, duration and interval. The interval can for example be daily at 19:45:00. A source is selected in the ingest system, and an input is automatically selected.

NRK has created a service that polls all scheduled ingests. If a clip name matches a clip name from a placeholder in the MAM, the service will change the GUID to match the ID from the placeholder. This will force a merge to the placeholder once the recording is ingested to the MAM.

Pain points from the above workflow:

- Limited automation.
- Manual creation of schedules in each regional site.
- These schedules can’t be set to recur indefinitely, forcing the operators to constantly extend the ruleset.
- Manual intervention is required for changes to the schedule, i.e. last-minute change to start of recording.
- The ingest will start at a set time, not when the transmission is actually starting . This can lead to an empty/black head and tail on the on-demand program.
- 20 minutes / four times a week all regional sites have simultaneous transmissions. In this period, port usage is nearly 3 x times higher than baseline. This implies that the ingest system is inefficiently used and scaled with ports to cover peaks for 80 minutes a week.

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs and pain points described above

5.2.3. CURRENT EXAMPLE 3: RECURRING 24/7 SCHEDULES

Some regional news offices record at least 2 x agency feeds per day. These recordings are sometimes duplicated across sites.

Pain points from the above workflow:

- Recordings must be separated into 3-hour chunks for usability
- Inefficient port usage due to lack of capability to overlap recordings – requires two alternating ports to do a single long running schedule.
- Schedules and ruleset must be maintained in the ingest scheduling tool. Cannot be scheduled indefinitely.

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs and pain points described above

5.2.4. CURRENT EXAMPLE 4: PLANNED EVENT FROM AN EXTERNAL SOURCE

This example covers the recordings of a live sports event for use in sports news coverage. The requirement is to record a sporting event and create highlights at a later time.

The sports news producer goes to an external website which provides information on sporting events of the day. The producer finds the most interesting / relevant event based on editorial needs. They make a note of the event details. The producer will then go to an internal website where they have the ability to make a request for a recording. They need to add a clip title, the channel from which the content originates, the start time and end time.

This request is then added to a task list seen by MCR operators. MCR will set up the route from the source and enter the relevant details in the task list.

The ingest operator will copy / past the clip name to the ingest tool, add the start and end times and find the sources specified by MCR and initiates the recording. The request's status is then manually updated by the ingest operator. This status will be visible to the editorial staff.

Pain points from the above workflow:

- Lack of automation
- Manual operations from multiple teams (Production, MCR, Ingest)

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs and pain points described above

5.2.5. FUTURE EXAMPLE 5: RESOURCE MANAGEMENT MODEL

This example is typical of a planned event such as for a transmission directly to a VOD platform. This example assumes integrations with other systems which will not be provided by the ingest solution Contractor.

Recordings are requested by editorial or operational units. These recordings are booked (named, start / end time specified) by operators using a resource management system.

The booking triggers a series of automated actions involving the broadcast control, media management and Ingest systems.

In this example, at the appointed time, the ingest scheduling tool makes a call to BCS to set up the route to the input. The scheduling tool makes a placeholder visible for the operators. The recording stars, either exactly at the scheduled time, or in some cases, this might be frames / seconds / minutes later based on an external trigger. The idea is to make the recording with as little headroom as possible, e.g. for publishing directly to VOD through additional automation.

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs described above

5.2.6. USER INTERFACES DESIGN PRINCIPLES

All functionality within the Ingest system must be available through the Ingest system user interfaces and give the users the ability to interact with the system based on their production role and their login privileges.

The user experience should be recognisable and consistent across user interfaces, e.g., across desktop interfaces, touch screens. The industry best practice to achieve this, is to build user interfaces using a design system – a shared design and code collection of reusable components, guided by clear standards. An international (and best practice) example is Google's open-source design system Material Design.

The Ingest system interfaces should be possible to use by "as many as possible". Ingest system user interfaces and components should be built with accessibility in mind, trying to be as inclusive as possible, using Web Content Accessibility Guidelines (WCAG).

#	Requirement
1	Please describe how the proposed ingest system adheres to these user interface design principles
2	The Ingest system user interface must be accessible as a responsive web interface.
3	The Ingest system user web interface should follow proper HTML semantics (e.g., not using table for visual layout)
4	The Ingest system web interface should support the common browser versions from Edge, Chrome, Firefox, and Safari
5	The user interfaces should have full UTF-8 or UTF-16 support in order to support all characters required for Norwegian, North Sami, South Sami and Lule Sami
6	The Ingest system user interface should support role-based access control
7	The users should have the ability to personalize the user interface for their needs in a flexible way based on their privileges or roles
8	The Ingest system should meet the latest Web Content Accessibility Guidelines (WCAG) at levels A and AA. Currently, the latest version is WCAG 2.1
9	Contractor should use the check list W3Cs WCAG-EM or a similar Accessibility Conformance Report (ACR) to document how the Ingest system matches the WCAG 2.1 requirements on levels A and AA

5.3.INGEST SCHEDULING

Ingest Scheduling features will be an integral feature of the Ingest system or an external system with integration to the Ingest system using northbound APIs. Currently there is limited automated resource management of ingest in NRK, however it will be desirable to have this functionality in the future. Additionally, the ingest system must support manual scheduling of recordings either via a crash record method or integral system for scheduling a future event. In this section these functionalities will be discussed.

5.3.1. CRASH RECORD

While a high level of automation is the objective, there will still be a need to do a crash record, i.e. that an operator manually programs an ingest as that starts immediately (Cf. section 5.2.1).

#	Requirement
1	An operator must be able to manually trigger a recording event through the user interface. In this scenario, the crash record is triggered immediately.
2	The operator is responsible for the metadata input and the integral ingest scheduling system should be able to register the asset in the MAM
3	The integral ingest scheduling system should be able to either be routed manually using the BCS, or trigger a BCS route while crash recording
4	The integral ingest scheduling system should provide the ability to follow the crash record in a nearfield monitor.

5.3.2. SCHEDULE AN EVENT IN THE INGEST SYSTEM

Sometimes an operator would need to schedule an impending ingest in the near future without going through an Enterprise Resource Management System (cf. sections 5.2.2, 5.2.4).

#	Requirement
1	An operator must be able to manually schedule a single event through the user interface. In this scenario, the recording is triggered at the time desired by the user.
2	The user interface must provide customisable fields to support metadata entry. The operator is responsible for the metadata input and the integral ingest scheduling system will register the asset in the MAM.
3	Scheduled recordings should be generated and be visible on a port and time frame user interface
4	The integral ingest scheduling system should support manually routed inputs (where an operator uses the BCS to route a source to an ingest server input), and automated routing (where the ingest system triggers a BCS route when a recording starts).
5	The system should allow an operator to manually schedule a recurring event through the user interface. In this scenario, the recordings are triggered at a user specified date/time and repeat interval and will continue until a user specified end date or indefinitely.
6	The system should support the creation of templates with pre-defined metadata for different events, which can be easily recalled. For example, following a naming convention.

5.3.3. SCHEDULE AN EVENT IN THE RESOURCE MANAGEMENT SYSTEM

An integration with the Resource Management System is a key part of reducing the number of manual tasks and automate ingest (cf. section 8.2.2 and 8.2.3).

#	Requirement
1	The ingest solution must provide a northbound API to enable ingest jobs to be created/updated/deleted by an upstream resource management system in which bookings are created and managed.
2	The northbound API should allow the format of incoming flows to be set. The format may differ between jobs for example 1080i/25 SDR, 1080p50 HDR, 2160p50 HDR.

5.3.4. CLIP PLAYBACK

Sometimes there is a requirement to quickly playout ongoing ingests, for example a live event with a time delay, or in scenarios where it would be impractical and slow to first do an edit and then transcode to a new file (cf. section 5.2.1).

#	Requirement
1	The system should provide functionality to playout ingested files and ongoing ingests.
2	The system should support a pass-through mode, which it can delay a feed by a user defined time offset.
3	The system should provide the ability for a user to review growing files, create, replay and publish sub-clips.

4	The system should provide tools to review and annotate growing files. It should be possible to publish the captured data.
5	The system should provide tools to create and play a basic playlist from clips and subclips.
6	The system should provide the ability to overlay static graphics over content being played out.

5.3.5. INGEST SCHEDULING USER INTERFACE

Please refer to section 5.2.6 User interface design principles for technical requirements for the user interface.

#	Requirement
1	The system should support both graphical and text-based display formats. In either format: • previous, current, and new schedules should be represented and be visually distinct. • current and future schedules will appear as indefinite unless/until an end time is added, or the scheduled event is manually ended. • current schedules should be visually distinguishable from future and past schedules. • individual schedules in a concurrent series of the same connection must be distinguishable. • failed schedules must be visibly distinguishable from successful schedules. • the current time should be graphically displayed via a progress bar or similar.
2	The UI should provide a list-based view (vertical view of ingest jobs associated with an ingest channel).
3	The graphical display should be in the form of linear timelines relating to ingest resources. The current time should be indicated on the timelines. It should be possible to: • filter the visible ingest resources by type (user defined) • filter the visible ingest resources by upcoming events. • zoom the visible time frame in and out. • scroll the visible time frame forward and backward. • Search for a given event on the timeline. • Search for a given port on a timeline. • Show the source for a given event on the timeline.
4	There should be customizable metadata fields that would allow for metadata from the scheduling interface to be mapped to other systems (i.e. MAM/PAM)
5	The system should allow for 3rd party web components to be available in the scheduler, i.e. to allow for searching MAM for placeholders or adding metadata.
6	The ingest UI should provide a thumbnail view of active ingest feeds.
7	The ingest UI should provide audio metering for ingest feeds.
8	The ingest UI must allow a user to manually create/update/delete jobs.
9	The ingest UI should provide users with an overview of system, ingest server, ingest channel health.
10	The ingest UI should allow users to play back and preview ingested files.
11	The ingest UI should enable active ingest jobs to be shortened or lengthened.

6. SOLUTION ARCHITECTURE REQUIREMENTS

Being an important component in NRK's live production infrastructure, the Ingest system must be fully resilient and fault tolerant. Each Ingest system instance must also be able to operate autonomously, so that for instance if one data center is cut off, NRK can still produce and distribute content using the remaining data centers and locations.

The architecture requires that the ingest solution should support ganging of ports to enable resilient feed capture. The basic architecture requires that a farm of ingest servers is located within two datacentres (DCs). The DCs are loosely coupled. A major systems outage in one DC must not prevent the other DC from functioning. Contribution feeds can be dual presented to the two datacentres and ingested in a variety of ways depending on the value of an incoming feed and availability of technical resources.

Dual DC, single server 1:0|1:0 - A feed is presented to both DCs simultaneously and encoded by ingest servers located in each DC. This is considered the default mode.

Other modes are also possible, and the solution should not prevent them from being implemented:

- **Single DC, single server 1:0|0:0 -** A feed is presented to one DC and ingested be a single ingest server.
- **Single DC, dual server 1:1|0:0 -** A feed is dual presented to one DC. The feeds encoded by ingest channels hosted on different ingest servers within that DC.
- **Dual DC Dual Server 1:1|1:1 -** A feed is dual presented to both DCs. The feeds within each DC are encoded by ingest channels hosted on different ingest servers within that DC.

As a general principle, a contribution feed received in one DC should be encoded by an ingest server within the same DC. To maximise platform resilience, NRK want to minimise the incidence of feeds crossing between DCs.

#	Requirement
1	The Ingest system must have no single point of failure in the system core.
2	The Ingest system must not rely on a single instance of a database.
3	The Ingest system should be able to merge configuration changes which will be applied without disrupting existing operation and ongoing ingests. For example, adding/removing/reconfiguring ingest servers and inputs/outputs.
4	The ingest system should have a persistent store for scheduled ingest jobs, such that in the event of an outage, system state can be recovered.
5	Each Ingest system instance must be able to function autonomously.
6	The ingest system must support setup of SMTPE 2022-7 redundant streams across two networks fabrics.
7	System must support automatic re-establishing of connections after an error on underlying infrastructure such as network or storage.
8	Ingest servers must have separate network interfaces for control (x2 interfaces) and ST 2110 flow exchange (x2 interfaces).
9	Control (e.g. IS-05 subscription requests) and monitoring communication (e.g. ST 2110 endpoint status) should not be conveyed to a device by the media exclusive (AVoIP) network, even if the communication involves routing of signals to/from that device, unless there is no alternative.
10	Supplier to describe how solution can deliver resilient feed capture within a datacentre and between data centres. Example include: a) Concurrent capture of a live feed to two servers within one datacentre b) Concurrent capture of a live feed to a single server within both datacentres c) Concurrent capture of a live feed to two servers within both datacentres The description should highlight any integration requirements for external systems (e.g. Resource Management, BCS, MAM).
11	Please state if there are parts of the system that has quorum requirements – i.e., if there are a minimum number of nodes that need to be healthy for a cluster to be available, and how this may affect deployment strategies and requirements.
12	Please make sure that it is clearly stated what parts of the system hold local (and authoritative) state – i.e., what part of the system holds data that has to survive a re-installation/re-deployment, and thus needs traditional backup.
13	Please describe suggested backup strategies (database backups, snapshots etc) for the stateful instances, and any if any operational considerations must be taken (downtime, failover etc) for backing up or restoring the system to a previous state.
14	Please describe other solution resilience strategies both within a datacenter and across datacenters.

7. TECHNICAL REQUIREMENTS

This section contains the Customers' technical requirements for the Ingest system. In order of essence, the security requirements (personal data and technical security) have been extracted to a separate chapter below (cf. section 11)

7.1. PHYSICAL INTERFACES

All equipment shall be installed in NRKs data centers and must comply with the hardware requirements as specified below.

#	Requirement
1	The equipment should be mountable in 19in racks.
2	The Contractor should specify the dimensions of the equipment (WxDxH).
3	The Contractor must specify the total physical space in terms of rack units
4	The Contractor must specify the total maximum and average power consumptions of the system (excluding client pc's).
5	The Contractor must specify the required cooling capacity to cool the entire system (excluding client pc's).
6	Specify any operational environmental requirements (temperature/humidity) for the equipment
7	Due to various requirements from our data center providers, NRK needs to know how you require airflow and any special needs regarding mounting and cooling.
8	All equipment must bear the CE marking for declaration of conformity and meet the current applicable EU directives.
9	All hardware delivered with the system should have hot-swappable dual power supplies (where applicable).
10	All equipment must be operating at nominal 230 VAC, 50Hz.
11	All hardware with network connectivity should have dual network ports for redundancy.
12	All network connectivity over 1Gb should be presented as SFP or QSFP cages to enable patching to ToR switches using copper DAC or fibre MPO cables. Please list supported optics and DAC cables. Please also highlight any limitations (e.g. unsupported brands).
13	All 1Gb or below network connectivity should be presented on RJ45 connectors.
14	All equipment must meet the current RoHS directive.
15	Provided hardware should have a suitable cable management solution
16	Provided hardware should come with an out of band management module (iLO, iDRAC, IPMI or similar)

7.2. CONTROL STANDARDS

NRK endeavours to be a driving force in the utilization of a standards driven IT-centric production platform. To support this strategy the Ingest system should prioritise standards over vendor specific solutions.

#	Requirement
1	The Ingest system must support NMOS IS-04 for device registration
2	The Ingest system must support NMOS IS-05 for connection management
3	The Ingest system should support NMOS IS-07 for event and tally
4	The Ingest system should support NMOS IS-08 for audio channel mapping
5	The Ingest system should support NMOS IS-09 for system parameters
6	The Ingest system should support NMOS IS-10 for authorization
7	The ingest system must provide an open API for control of ingest and player ports

7.3.PLATFORM AND OPERATIONAL ENVIRONMENT

As part of the transition to an IT and standard driven approach for media production, all the systems used for the media production, including the Ingest system must adhere to common operational best practices.

We see many benefits from deploying applications on containers and using a container orchestration and runtime environment such as Kubernetes. We would like to see that also parts of the Ingest system, where appropriate, moves in the same direction for the flexibility this

#	Requirement
1	The Ingest system must support one or more of these runtime environments in preferred order: Running as a container Running as a Linux service Running as a Windows service Running as a Windows Gui application is not an acceptable runtime environment
2	It should be possible to deploy the ingest system software on virtual machines where applicable
3	The ingest system should be deployable on virtual machines or the public cloud (e.g. to support the capture of NDI or ARQ based formats such as SRT and RIST).
4	The Ingest system should support the following log configurations based on the runtime environment: When running as a container, writes logs to standard out/standard error When running as a Linux service, writes logs either to standard out/standard error or directly to journal When running as a Windows service, writes logs to the Windows event log
5	The Ingest system should support providing runtime metrics using Prometheus. If Prometheus is not supported, describe the supported runtime metrics system(s).
6	The Ingest system should support OpenTelemetry.
7	The Ingest system should support patching and upgrades without downtime when run in a HA configuration.
8	NRK has standardized on preferred HP and Dell servers. If the ingest system is running on COTS hardware, please list hardware manufacturers.

7.4.CONFIGURATION

Through its many internal development teams and in-house developed services, NRK has learned the huge benefits of automated deployments – both for reducing risk, documenting installation procedures, ensure repeatability, increase development and deployment speed - and ultimately making higher-quality services available for both users and viewers.

It is therefore expected that all virtual server instances may be automatically provisioned based on pre-created images, or preferably be created completely from scratch on-demand by leveraging technologies like HashiCorps Packer or similar.

In the same vein, it is expected to be able to automatically configure and set up both infrastructure, servers, and software using terraform, ansible, salt or other provisioning and configuration technology enabling a version-controlled environment.

NRK has local experience and resources for working in collaboration with the Contractors to set up such deployment strategies. Still, it requires that the software, hardware, and infrastructure is capable of being configured and installed this way.

#	Requirement
1	Please describe what deployment technologies and strategies the system may support, including both initial installation and subsequent updates and upgrades.
2	The Ingest system should have a complete REST or GraphQL API for configuration, providing at a minimum: • Adding, removing, and modifying ingest channels • Modifying software components

#	Requirement
3	The Ingest system should have support for configuration using Ansible or Terraform with an Ansible module or Terraform provider supported by the Contractor.
4	The Ingest system should support administrator-configurable webhooks to interact with other generic APIs (e.g., on status updates).

7.5.MEDIA FORMATS

The Ingest System should generate the NRK house standard in mezzanine and proxy formats as specified below. Additionally, the Ingest System should support a wide range of professional formats and codecs including but not limited to those described below.

7.5.1. LIVE CAPTURE FORMATS

Whilst ST 2110 will be the primary capture format, wider input format support will enable NRK to utilise the solution in a wider range of use cases with a large degree of flexibility. We envisage that not all ingests have to be equal, and that we could have lower quality tiers using less demanding formats for easier deployment and scaling to virtual machines and the public cloud.

Please refer to “III-a-NRK-2024-295_Ingest_Solution_SSA-T_App 01-1-Attachment 1-2 NRK Device ST2110 ST2059 NMOS Conformance - v3.5” for detailed ST 2110 conformance requirements.

#	Requirement
1	Must support the frame-accurate capture of live feeds, based on timing information in an ingest job
2	Audio and video must be synchronous
3	Should support the capture of SRT encapsulated flows
4	Should support the capture of RIST encapsulated flows
5	Should support the capture of NDI flows
6	Should support the capture of SDI flows
7	Must support the capture of SMPTE ST 2110-20/30/40 flows
8	Should support the capture of SMPTE ST 2110-22 flows (JPEG-XS encoded video)
9	Should support audio only capture of SMPTE ST 2110-30 flows
10	Must support the capture of up to 16 audio channels per ST 2110 video flow
11	Should support the capture of up to 32 audio channels per ST 2110 video flow
12	Should support ST 2110-30 Conformance Level C (support for 125uS packet timing)
13	Must support the capture of up to 4 x ST 2110-30 audio flows per ST 2110 video flow
14	Should support different channel counts and packet timing per ST 2110-30 flow. (Future Dolby Atmos requirements are driving this)

7.5.2. RESOLUTION AND FRAMERATE

#	Requirement
1	Must support the input and encoding of 1080i25 SDR
2	Must support the input and encoding of 1080p25 SDR
3	Must support the input and encoding of 1080p25 HDR

#	Requirement
4	Must support the input and encoding of 1080p50 SDR
5	Must support the input and encoding of 1080p50 HDR
6	Must support the input and encoding of 2160p50 HDR
7	Please attach an overview of supported resolutions, framerates, audio and video formats and wrappers

7.5.3. WRAPPERS, CODING AND AUDIO

#	Requirement
1	Must support capture to MXF OP1a
2	Must support capture to MXF OP Atom
3	Must support capture to Quicktime
4	Must support capture to MPEG
8	Must support AVC Intra encoding
9	Must support XAVC Intra encoding
10	Must support ProRes 422 encoding
11	Must write frame accurate timestamp into wrapper, where this is supported by the wrapper
12	Must write accurate media format information into wrappers
13	Must support the capture of uncompressed audio as linear PCM 48kHz, 24bit as an AES3 stream, within an MXF wrapper
14	Must support the capture of uncompressed audio as linear PCM 48kHz, 24bit as a BWAV file
15	Must support AAC audio

7.5.4. PROXIES AND THUMBNAILS

The MAM is generating proxies and thumbnails for preview purposes. Currently any ongoing ingest will have to be finished before the previews and proxies can be generated.

Preview images are generated are downscaled and compressed to a format like jpeg.

There is currently a limited number of workflows utilizing editing on proxy files. A future PAM solution might include a web editor which make use of growing proxies.

#	Requirement
1	Should support capture of a thumbnail image at a customizable resolution and offset. Please specify which formats are supported.
2	Should support capture of multiple images at a customizable time interval to enable an NRK's service to create a preview of the stream (filmstrip).
3	Proxy encoding must output discrete audio and video files.
4	Must support capture of proxy files with the native resolution and framerate.
5	Must support h.264 with AAC audio and mp4 wrapper for low bitrate proxy files.
6	Should support h.265 with AAC audio and mp4 wrapper for low bitrate proxy files.
7	Must update mp4 moov atom as the file grows to facilitate browse of growing proxy files

7.6.DEVELOPMENT ENVIRONMENTS

The Solution must be delivered with a staging-environment for testing changes, installation, patching and features before they are put into production.

NRK requires a cost-efficient staging environment that needs to mirror the production environment in functionality, but not scale. The staging environment is intended to follow the same principles and design as the production environment (cf. section 5).

We would like the Contractor to suggest how a cost-efficient staging environment can be set up that meets the requirements of mirroring the production environment.

Additional developer-software-licenses for running the software on developer machines and/or in build/test-chains (if applicable) should also be provided.

7.7.CHANGES TO THE TECHNICAL PLATFORM

The Contractor shall describe how the offered Solution will cooperate with the Customer's technical platform described in appendix 3. Any assumptions/prerequisites or required changes in the customer's technical platform must be explicitly described in Appendix 2 in order to apply.

The Customer will itself ensure such upgrading and reserves the right to purchase the necessary equipment and software required by its own agreements.

8. API'S AND INTEGRATIONS

Most of NRKs critical productions systems are thoroughly integrated into our production platform. Hence, we will be reliant on robust APIs for our new ingest solution.

This chapter covers general API requirements, followed by integrations needed between the Ingest system and adjacent systems at NRK.

Please also revisit the relevant paragraphs in section 5.1 to fully understand NRKs need regarding integrations.

8.1.API

NRK has a strong developer community, and being able to create new workflows, automate operations and adjust integrations between in-house built software and third-party systems is an important principle for NRK.

We value well-defined, documented APIs with a hight degree of functionality coverage, and has come to expect this as an essential part of any new system or software delivery.

#	Requirement description
1	The system must provide access to all vital functionality in the business layer like record scheduling and media handling through a public API.
2	The APIs must be thoroughly documented.
3	The data model in use by the API should be documented and include formal schema definitions.
4	Usage of the API must be covered by the support level agreements.
5	The API and documentation must be kept up to date when new features are added to the system so that requirements #2 and #3 are always fulfilled.
6	If the API is exposed through one or more HTTP REST-like endpoints, they should use proper HTTP methods and response codes (i.e. errors should be in the 400-500 range etc).

#	Requirement description
7	Access to the API should at a minimum be controlled by the same authorization and authentication mechanisms (built-in/LDAP/Azure AD etc) as present in the user interface.
8	The API authentication should offer single sign on through Azure AD supported authentication protocols.
9	The API should allow external systems to subscribe to events affecting assets in the system (like creation, modification, etc) through persistent callbacks, message queues or other event systems. I.e. messages should be guaranteed to be delivered at least once on a persistent level.
10	The system-provided user interfaces should rely on publicly exposed and documented APIs
11	Responsiveness of the API should not be linked to the responsiveness or availability of the ingest/workflow/playout-capabilities; it should not be possible to affect the stability of ingest or playout due to excessive use of the API by an ill-behaving client.
12	The Ingest system must provide a northbound API, preferably using modern REST-like interfaces.
13	Please describe which standards are in use by the API for date, time and duration, i.e. ISO8601.
14	Please provide API documentation if it is publicly available.

8.2. INTEGRATIONS

Where there are well known and/or well-defined protocols and transports with little technical, business- or data-modelling ambiguity (like router-control), NRK prefers and expects the offered automation system to include proper integrations to the external system in question (integration type A below).

However, NRK has a strong developer community, and especially in areas where NRK has very bespoke needs or expects frequent changing business or user requirements, there is a policy of (co)developing and owning these integration-services or -modules in-house rather than asking the involved vendors to deliver a bespoke integration on their own. This is based on prior experience where the most complicated and difficult part of many integrations are not the technical implementation or development, but the business and data model impedance and the need to be able to adjust and adapt the mapping and logic over time (integration type B/C below).

If an integration is missing or inadequate, NRK would prefer that work and effort is put into providing proper, public APIs and/or SDKs or stand-alone modules over writing a black-box integration as an internal part of the provided system/software.

In Appendix 7, the Contractor shall price the integration or facilitation of integration with the listed systems/applications in this chapter by means of at least one of

A. An existing, already working and documented integration that covers the required integration.
   If only minor adaptations or adjustments are needed this may still be a viable option.

B. Existing APIs/SDKs.
   Well documented interfaces, module SDKs, extension-points and/or event-based integrations that enable NRK to do the integration described.

C. New APIs/SDKs developed to facilitate the requirements.
   In the case that an integration is not currently supported, or the supported integration deviates in vital areas from what is requested, please provide price estimates for enabling the integration in question through creation of public APIs as described in section 8.2. NRK emphasizes that the estimate must be a starting point for further detailing together with the Customer in the specification stage of the project. Please see the requirements below for expected details in the descriptions.

The following sections describe the adjacent systems / applications at NRK with which the new ingest system must interact.

The Contractor shall as attachment to Appendix 2 include the descriptions of their available APIs.

Please summarize in the table below how the Contractor will propose the needed integrations:

#	Integration	Integration proposed: A, B or C
1	Media Asset Management (MAM)	
2	Broadcast Control System (BCS)	
3	Enterprise Resource Management system	
4	Platform Monitoring and Control System (PMCS)	
5	Security Incident and Event Management system (SIEM)	
6	Configuration Deployment Pipeline (CDP)	
7	NAS Storage	
8	AVoIP Device Integration Standards	

8.2.1. MEDIA ASSET MANAGEMENT (MAM)

The involvement of the in-house development teams will especially be important for the MAM-integration. The MAM-installation is a part of a larger file-based production platform developed by NRK ("The Program Bank"), with a host of integrations with both third-party software and services, and NRK-developed systems and applications.

The Program Bank APIs may provide endpoints and events for:

- Querying technical metadata (formats, codecs, preview urls ++)
- Querying availability of media
- Querying media status (placeholder)
- Media conversion/transcoding
- By further agreement, other requests the ingest system needs to fulfill its media flows

Finalizing the specs for the needed operations and APIs will be done in collaboration with NRK-developers, including a possible small integration-service owning the interfacing between the Program Bank and the ingest system.

#	Requirement description
1	Please describe what type of hooks, callbacks, events and APIs are available to handle automatic query, fetch or push of media files and technical metadata from the Ingest system to the MAM system.

8.2.2. BROADCAST CONTROL SYSTEM (BCS)

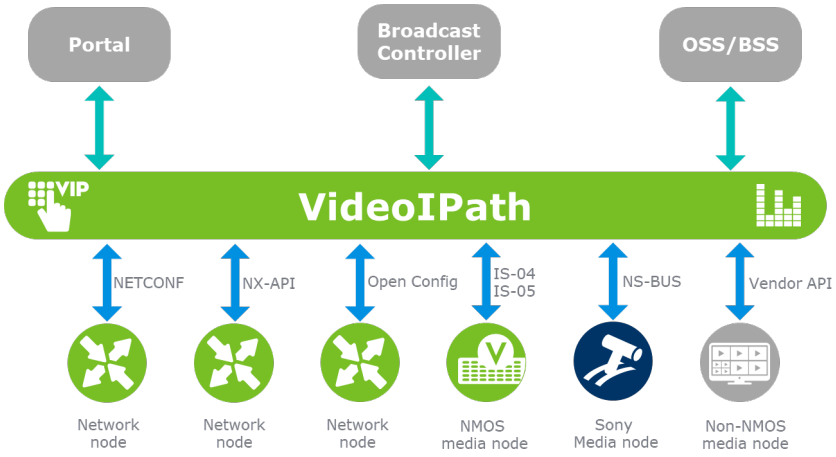
NRK has chosen Nevion Video iPath to provide broadcast control system functionality. The expectation is that all contractors will implement some level of integration with this critical platform component. This section details two different approaches to integration with the BCS and the chosen resource management system, VimBiz from VimSoft (cf. 8.2.3).

Integration of 3rd party Controllers and Devices

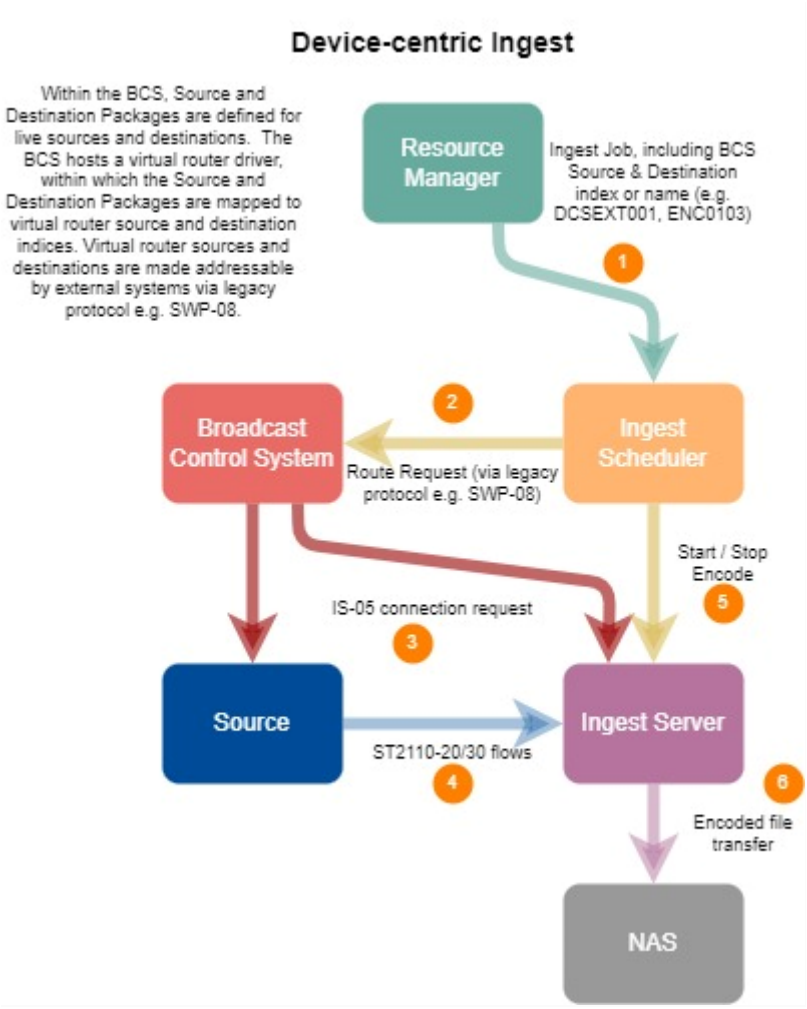
VideoIPath is designed as an open product that can interface with any external system. This is facilitated using an industry standard REST interface that exposes all data within the system and allows external systems to access the functionality and to modify the data provided by the system. The REST interface is already used for integration with a range of existing 3rd party systems. Full API documentation is available under NDA with Nevion.

VideoIPath also supports the following traditional routing protocols when being controlled by and 3rd party system: Nevion MRP, Sony NS-bus, Probel SW-P-08, Lawo Ember+, Imagine LRC and Evertz Quartz.

The figure below illustrates how the orchestrator typically interfaces with other systems and devices.



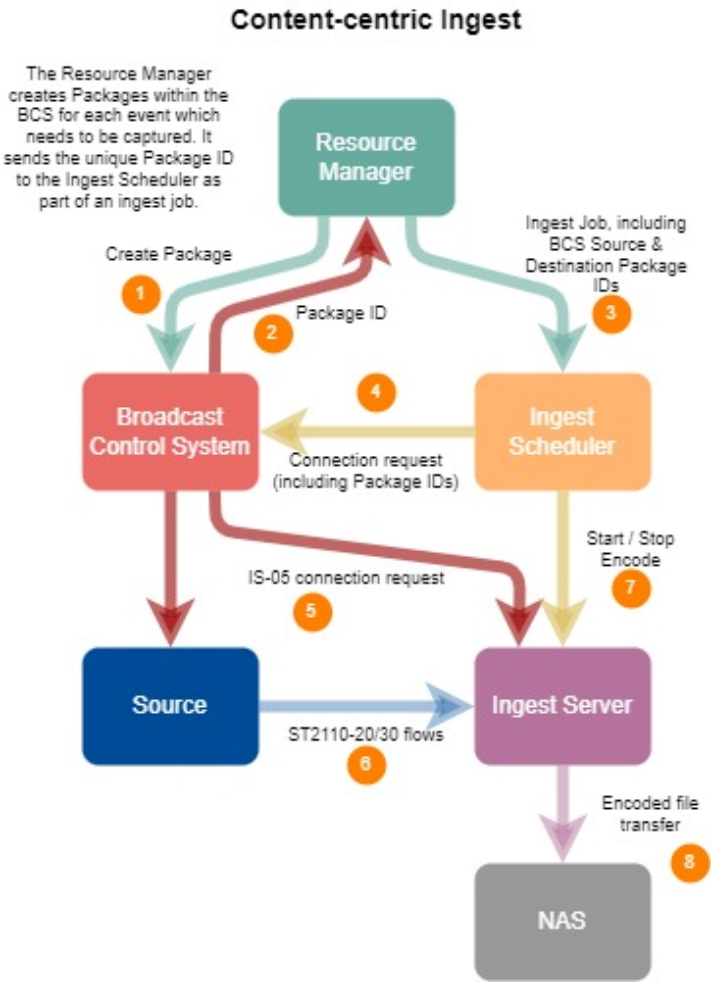
NRK hasn't finalized the resource management and routing model for MPP and invites the suppliers to discuss the following approaches.



Device-centric ingest

In the above diagram, the BCS defines Source and Destination Packages for live sources and destinations. The BCS hosts a virtual router driver, within which the Source and Destination Packages are mapped to virtual router source and destination indices. Virtual router sources

and destinations are made addressable by external NMOS systems such as an Ingest Scheduler via legacy protocol e.g. SW-P-08. The BCS would then create routes from source to destination and the Ingest Scheduler instructs the Ingest Server to record the 2110 flows, encoding and writing the files to NAS storage.



Content-centric ingest

The Resource Manager creates Packages within the BCS for each event which needs to be captured. It sends the unique Package ID to the Ingest Scheduler as part of an ingest job. The Ingest Scheduler makes a call (including the package IDs) to the BCS to create the route from the source to the destination. The ingest Server starts and stops the recording based on the job information.

#	Requirement
1	With reference to the diagram above, please describe the way in which the Contractor would implement an integration with the Nevion BCS / VimBiz resource management system in a 'Device-centric' model.
2	With reference to the diagrams above, please describe the way in which the Contractor would implement an integration with the Nevion BCS / VimBiz resource management system in a 'Content-centric' model.
3	With reference to the diagrams above, please describe the way in which the Contractor would implement an integration with the Nevion BCS in the absence of any resource management system.
4	The ingest system must provide a Southbound API to a BCS system to make routes.
5	The ingest system must support NMOS IS-05 to enable the BCS to make connection requests.
6	The ingest system provider should be willing to implement a driver to integrate with NRK's chosen BCS system to make routes.
7	It should be possible to change a source while recording. This might be necessary if there's a fault with a source.

8.2.3. ENTERPRISE RESOURCE MANAGEMENT SYSTEM

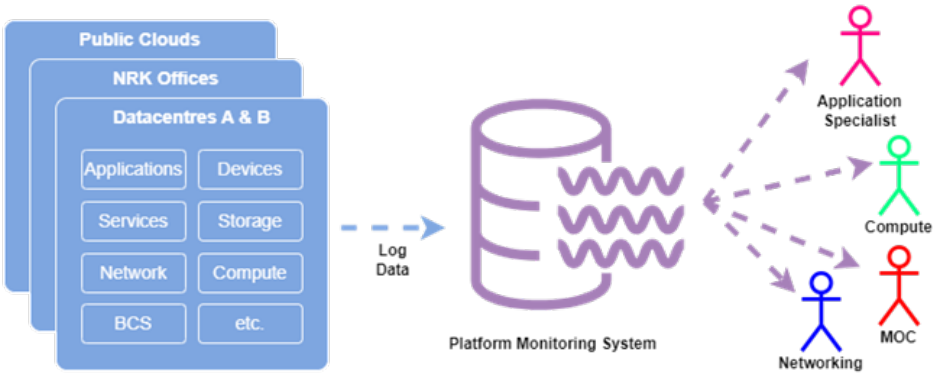
NRK anticipates the use of an enterprise resource management system for, in the ingest system context, management of scheduled recordings. NRK currently uses VimBiz by Vimsoft for resource management, and it may be used for this purpose in the future. The ingest system would take booking information from the resource management system in order to trigger recordings through automation.

For more information about the different approaches to integration, please revisit 8.2.2 “Broadcast Control System (BCS)”.

#	Requirement
1	Please describe the way in which the proposed ingest system may integrate with an enterprise resource management system
2	Please describe any existing integrations the Contractor has with enterprise resource management system products

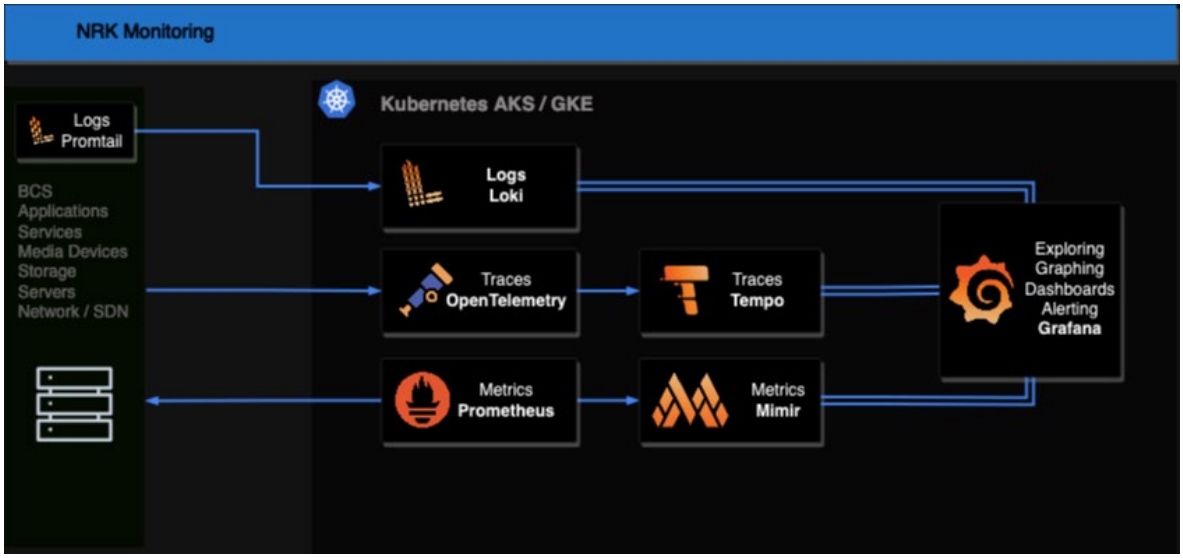
8.2.4. PLATFORM MONITORING AND CONTROL SYSTEM (PMCS)

PMCS will collect log and event data from applications, services, networks, and devices within the modernised production platform. Aggregated log data will be reported on in a variety of ways to provide relevant insights to different user communities.



PMCS tools currently in NRK include, but not limited to:

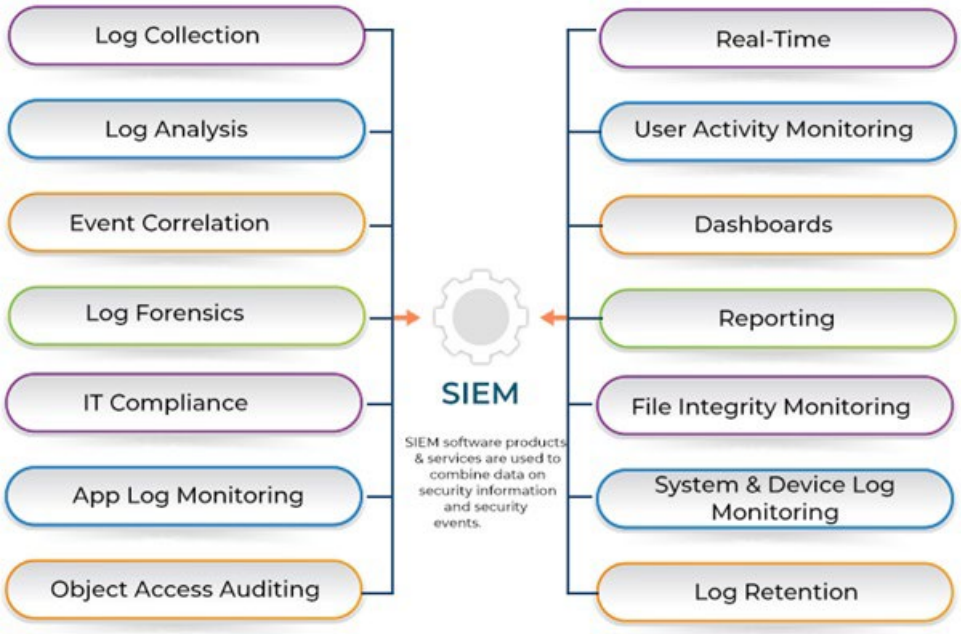
- Log collector (Promtail, Grafana Agent, Systemd, etc.)
- Log store (Loki)
- Time-series events (Prometheus, Mimir)
- Alerting system (Grafana, Icinga, OnCall, VictorOps)
- Data analysis & reporting tool (Grafana)



#	Requirement
1	The ingest system should provide reporting on physical system health, e.g. power supply, fans, etc
2	The ingest system should provide reporting on physical network connectivity
3	The ingest system should provide reporting on PTP status
4	The ingest system should provide flow subscription status
5	The ingest system should provide operation system reporting
6	The ingest system should provide Application layer reporting e.g. recording status
7	The ingest system should provide network data, e.g. packet counts and loss for 2110 NICs
8	For all of the above, please provide a full list of what parameters are reported and how this information is returned to the monitoring platform
9	Please list any other reporting tools provided by the ingest platform

8.2.5. SECURITY INCIDENT AND EVENT MANAGEMENT SYSTEM (SIEM)

SIEM software products and services are used to combine, analyze and report on data on security information and event. NRK is currently using Azure Sentinel.



#	Requirement
1	The ingest system should be able to send security logs to a remote SIEM (Security Incident and Event Management) system

8.2.6. CONFIGURATION DEPLOYMENT PIPELINE (CDP)

The MPP platform is an IT platform for media production. It will be operated based on DevOps practices. Configuration will be managed within a Git repository and CI/CD tools such as GitHub Actions and Ansible will be used to automate the process of deploying devices and configuration. Please revisit 7.4 “Configuration” for more details.

#	Requirement
1	The ingest system should be highly configurable via a programmatic API.
2	Please describe what is configurable programmatically and what is not and describe what is configurable as a service and what is not.
3	Please describe how configuration changes are made to your system and what the service impact is.

8.2.7. NAS STORAGE

NRK will have a Dell PowerScale Isilon NAS installation in each datacentre. The ingest system will concurrently write growing files to both NAS systems.

#	Requirement
1	The solution must be able to transfer growing mezzanine, proxy and thumbnail files to a NAS volume.
2	The solution must be able to concurrently transfer growing mezzanine, proxy and thumbnail files to two NAS volumes (one in each datacentre).
3	The solution must support the SMB3 protocol to integrate with the NAS. Please state which version(s) of the SMB and other protocols are supported.
4	Please describe the mechanisms and protocols the proposed solution would use for writing growing files to NAS storage volumes. This should include how fault conditions are handled (e.g. failed transfer to one volume).
5	Please describe any storage latency requirements for the proposed solution.

8.2.8. AVOIP DEVICE INTEGRATION STANDARDS

The AMWA NMOS suite of standards is an integral part of the MPP architecture. For example, Node/Device support of NMOS IS-04, which allows control and monitoring applications to find the resources on a network, is required by both the BCS and Configuration Management systems.

#	Requirement
1	The ingest system must comply with the standards described in Attachment 1 NRK Device ST2110 ST2059 NMOS Conformance.

9. CLIMATE AND ENVIRONMENTAL REQUIREMENTS

The Customer's ambition is to reduce its footprint in all internal and external production in line with the Paris Agreement's climate goals. Thus, NRK need to incorporate climate and environmental considerations when purchasing new IT equipment.

For this project, NRK has determined four important activities which individually and in total have a positive environmental impact through a reduced carbon footprint.

1. Pooling resources which are currently distributed across Norway to increase overall utilization.
2. Reducing duplication of ingest jobs.
3. Upgrading old hardware for modern, more energy efficient and compact systems.
4. Placing the servers in energy efficient colocation datacentres.

When referring to sections in requirements 4-11, please see III-a-NRK-2024-295_Ingest_Solution_SSA-T_App 01-3-Attachment 3_2024 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency

The Customer’s preferences associated with environmental requirements related to this procurement are listed below. The Contractor is encouraged to provide detailed descriptions of how the preferences are met, preferably supported by supplementary documentation from sub-contractors or third parties, including independent certification authorities.

#	Requirement
	Long expected lifetime
1	The products must have long expected lifetime in order to reduce the need for replacement and avoid creating waste. E.g. how the product has been tested for durability. Please state the projected product life.
2	After the warranty on the equipment has expired, NRK should be able to receive components and documentation for all equipment in order to repair it themselves. Please detail your spares policy.
	Energy efficiency
3	The equipment should meet energy efficiency standards to minimize power consumption during operation. Please attach relevant energy performance certificates.
4	Please describe the Energy efficiency performance of the proposed ingest solution. (see section 4.1.1 for further information)
5	Equipment should be purchased that allows for operation within ASHRAE Class A2. If no equipment can be procured which meets the operating temperature and humidity range of Practice 4.1.3 (ASHRAE Class A2), then equipment supporting ASHRAE Class A1 at a minimum may be procured. (see section 4.1.2 for further information).
6	Equipment provided by the Contractor should be able to operate and be within warranty for the full ASHRAE Class A2 allowable temperature and humidity range. (see section 4.1.3 for further information).

#	Requirement
7	The Contractor should supply at minimum the total system power for a range of temperatures covering the full allowable inlet temperature range for the equipment at 100% load on a specified recognised benchmark such as Linpack. (see section 4.1.6 for further information).
8	The Contractor should provision power and cooling only to the planned power draw of the IT equipment as configured (based on the components actually installed), rather than the Power Supply Unit (PSU) size or nameplate rating (see section 4.1.9 for further information)
9	The Contractor should comply with the EU Eco Design Directive and Lot 9 amendments to EU Commission regulation for servers and online storage systems (see section 4.1.10 for further information).
10	The Contractor should offer equipment with power and inlet temperature reporting capabilities, preferably reporting energy used as a counter in addition to power as a gauge. Where applicable, industry standard reporting approaches should be used such as IPMI, DMTF Redfish and SMASH (see section 4.1.11 for further information).
11	The Contractor should offer equipment containing high efficiency AC/DC power converters. These should be rated at 90% power efficiency or better across the range of loads expected for the equipment to be installed (see section 4.1.15 for further information).
Delivery and disposal of equipment	
12	The manufacturer should have a take-back program for old equipment promoting responsible disposal and recycling. The equipment should be designed for easy disassembly, recycling, and proper disposal at the end of its lifecycle. Manufacturers should have clear guidelines for handling electronic waste (e-waste).
13	Packaging materials: the equipment should have minimal packaging, recyclable materials, and reduced plastic content.
14	Transporting and logistics should be environmentally friendly.
15	Describe how the manufacturer works systematically to minimize the environmental impact of its solutions.

10. BILL OF MATERIALS - PROPOSED SW AND HW

The Contractor shall in Appendix 2 provide an overview of the hardware and software included in the provided solution.

10.1. SOFTWARE

The Contractor shall in Appendix 2 provide an *overview* of the software included (as well as standard software and/or open-source software) in the provided solution, including which license terms apply for such components, cf. section 12.5.3. The actual terms shall be presented in Appendix 10.

Please address which part of the scope (cf. section 3.1) the software is supporting.

10.2. HARDWARE

The Contractor shall in Appendix 2 provide an *overview* of the hardware included in the provided solution, including which license terms apply for such components.

Please address which part of the scope (cf. section 3.1) the hardware is supporting.

11. INFORMATION SECURITY AND PERSONAL DATA PROTECTION (CF. CLAUSES 9.2 AND 9.3)

11.1. SECURITY

High public trust is essential for NRK, and safeguarding content production and delivery is vital. Therefore, NRK should always follow security best practices. Going forward, NRK expects Contractors to adhere to security best practice, such as EBU Cybersecurity Recommendations for Media Vendors' Systems, Software and Systems (EBU R 143).

The Ingest system is a critical production component and must employ adequate protection and security measures. **The Contractor shall review, complete, and comply with NRK's Supplier Security Requirements as specified in Attachment 2.**

#	Requirement
1	The Ingest system should support single sign on using oauth2/openid and/or SAML.
2	The Ingest system can use either Active Directory or Azure Active Directory for users and groups. If the Ingest system has its own internal user and group database, the Ingest system should support provisioning users and groups using SCIM.
3	The Ingest system should support role-based access control.
4	Communication between the users and the Ingest system should be encrypted using TLS1.3 or higher.
5	Security logs from the Ingest system should include the following information: Log in information Audit logs for changes done by users Audit logs for changes done by administrators Audit logs for changes done via API User and group synchronization
6	The Ingest system should be able to send security logs to a remote SIEM (Security Incident and Event Management) system. Currently NRK uses Azure Sentinel.
7	The Ingest system should support API access using supplier specific access tokens or OAuth2.
8	The Ingest system should support RBAC for API access.
9	The provider should provide a SBOM for the Ingest system. Please refer to chapter 10.1
10	The provider has a Responsible Disclosure Policy.
11	The provider should have security.txt implemented to allow security researchers to easily report security vulnerabilities.
12	The provider should have a defined patch strategy with specific time frames for when patches are provided, differentiated by severity levels of the security issue.
13	Any passwords used by service users or for accessing administrative interfaces should be editable by the customer. There should be no usage of default passwords.
14	The ingest system must support multifactor authentication using an authenticator app and/or smart card or FIDO security key

11.2. PERSONAL DATA PROTECTION

Any personal data shall be processed according to the current legislation in the Norwegian Personal Data Act. The Norwegian Personal Data Act is aligned with the EU's "General Data Protection Regulation" (GDPR).

Compliance with applicable privacy regulations
The supplier (including the supplier's subcontractors, hereunder cloud service providers (if relevant)) shall only process personal data in accordance with the Personal Data Act and the EU General Data Protection (GDPR). Describe how the requirement is met.

Requirements for a data processing agreement
A data processing agreement must be entered into between the Supplier and NRK in accordance with GDPR article 28, which regulates the Supplier's processing of personal data on behalf of NRK. If NRK is to enter into a data processing agreement with the cloud service provider, this must also be in accordance with GDPR article 28.

Description of role and responsibility
The supplier is asked to explain whether the supplier (including supplier subcontractors, hereunder cloud service providers) considers itself to be the data controller for certain processing activities related to what is covered by the Agreement. If so, explain which processing activities this applies to and what is the legal basis for the processing.

#	Requirement description
1	The Contractor shall explain how their obligations under Clause 9.2 on ensuring the confidentiality and integrity of the Customer's data, are handled.
2	The Contractor shall describe how satisfactory processing, including information system and security measures in line with the personal data protection regulations will be achieved and performed.
3	The supplier is asked to fill in the attached checklist with comments so that NRK can assess if a data processing agreement is required, and consequently ensure that the correct data processing agreement is applied.

12. OTHER REQUIREMENTS

12.1. PROJECT IMPLEMENTATION METHODOLOGY (CF. CLAUSE 2.3.3)

The Contractor shall describe the proposed method and approach for the project including how the method facilitates user involvement.

12.2. DOCUMENTATION (CF. CLAUSE 2.3.6)

The Ingest system including customisations and configurations must be documented so that the Customer has the necessary and correct documentation available in all areas of the Ingest system. The documentation shall facilitate effective use, training, further development, and service of the Solution. The Ingest system shall be provided at least with the following documentation:

12.2.1. DETAILED SPECIFICATION - DESIGN DOCUMENTATION

If relevant, the Ingest system is provided with a detailed specification document that is developed during the specification phase. This design document is a description of how the processes and requirements are to be fulfilled in the new solution. The document describes how to solve the desired functionality and the guide to those who will configure and complete the solution for NRK's use.

The Contractor shall state as part of the Appendix 4 relevant activities needed that will be documented as part of a specification document.

12.2.2. TRAINING MATERIAL

The Contractor will provide training material. The training material must be adapted to the individual user group and must be written in Norwegian or English.

12.2.3. USER DOCUMENTATION

The Ingest system is provided with NRK-specific user documentation that is:

- Provided in a common electronic format.
- Adapted to different user groups, including advanced users, such as superuser, system managers, and end-users.

12.2.4. DOCUMENTATION OF INTEGRATIONS

The Ingest system is provided with technical documentation in English describing public API, integrations, and APIs specific to NRK (interfaces, methods, etc.).

12.2.5. FUNCTIONAL SYSTEM DOCUMENTATION

The Ingest system is provided with functional documentation in English describing configurations and setup, including functional design for any customizations.

12.2.6. TECHNICAL SYSTEM DOCUMENTATION

The Ingest system comes with a technical system documentation in English, describing logical service and information architecture, security, and access architecture (ADFS, etc.), provisioning and orchestration functionality and procedures.

12.2.7. INSTALLATION AND MAINTENANCE DOCUMENTATION

The Ingest system comes with installation and maintenance documentation in English. This requirement applies only to on-premises-solutions.

12.3. TRAINING (CF. CLAUSE 2.3.7)

12.3.1. TRAINING METHOD

The Contractor shall plan and develop a training program, including training material, and train NRK in the use of the Ingest system. The training shall ensure that NRK can perform qualified testing of the Ingest system and start using the Ingest system properly and efficiently.

All user groups shall receive training. The training shall be designed appropriately for each specific user group. Training methods shall be described.

12.3.2. DESCRIPTION OF TRAINING COURSES

Training material shall as a minimum be in English or Norwegian and have use cases that are relevant for the different user groups.

The Contractor shall describe how the training will be for the different target groups. The description shall at minimum include the following:

a) Objective of the training
b) Training content
c) Expected benefits from completing the training

d) Training style
e) Duration

12.4. OPTIONS

The Contractor is kindly requested to describe the possible delivery of the options listed below in Appendix 2. Predictable pricing methods and principles to be stated in Appendix 7. NRK reserves the right to increase capacity and improve scale by using other sources and agreements. E.g. acquiring compatible hardware from other sources or using cloud providers which NRK already has agreements with.

After deployment, the solution must be able to scale-out in response to future needs. Currently we do not expect the system to scale-out more than 76 x video inputs per datacentre.

NRK envisions that the ingest solutions scale and capacity may be increased dynamically and seamlessly.

A. Event-based capacity increase

Events such as e.g. broadcasting the Olympic Games may require increased capacity of ingest inputs and video formats, e.g. UHD for a limited period. NRK envisions that this could be achieved, but not limited to, in the following ways:

- Renting or leasing equipment from the Contractor to be installed in NRKs existing data centers.
- Utilizing public or private cloud services for temporarily capacity increase.

B. Permanent scale-out

To cover future ingest requirements, permanent scale-out of the solution may be required. NRK envisions that this could be achieved, but not limited to, in the following ways:

- Procuring equipment from the Contractor to be permanently installed in NRKs existing data centers.
- Gradually utilizing public or private cloud services for permanently capacity increase.

C. Possible future extensions

With reference to functional items not included in the initial scope, cf. section 3.1 above, NRK request the Contractor to describe which kind of functional support that may be offered to support those possible options. Prices and pricing principles to be stated in Appendix 7.

12.5. RIGHT OF OWNERSHIP AND RIGHT OF DISPOSAL (CLAUSE 10.5.2 AND 10.2.2)

The Ingest system is an essential component in the Customers broadcast production platform, and the Customer foresees a long-term partnership with the Contractor for the service.

However, the broadcast industry may be subject to future changes; bankruptcy and merges may occur, the Supplier or its subcontractor may discontinue their solution/service etc, affecting the Supplier to deliver according to this Agreement.

Depending on which part in the delivery chain that may be affected, measures may imply inter alia.

- Access to the source code of the ingest solution, hereunder any code specifically developed by the Contractor for NRK.
- Access to expertise for the ingest solution is offered for a sufficient period of time, including overview of other companies with necessary competence of the solution offered.
- A fulfilment of the obligations in the contract with an alternative ingest system.

- Parent or solidary guarantee for continued services/deliveries.

In those circumstances where the Customer is entitled to have such arrangements put in place, the Party that obtain access to the source code shall have an expanded right of disposal that covers the right to use, copy, modify and develop the solution itself, or with the aid of a third party, to the extent necessary to achieve the purpose of the procurement. The measures must last until NRK has obtained a new service. Thus, the Supplier is required to suggest and describe in a binding manner in Appendix 2 appropriate measures that satisfactorily secures the Customer's interests according to which the Customer shall be notified if events described in the General Contract Terms clause 10.2.2 may occur. Any related third-party terms should be described, and prices be included in Appendix 7.

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 1 – Customer requirement specification

[Contractor name]

[Contractor logo]

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Attachments

Attachment 1 – NRK Device ST2110 ST2059 NMOS Conformance
Attachment 2 - NRK Supplier Security Requirements
Attachment 3 - Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency.
Attachment 4 - Checklist transfer to third countries

1. INTRODUCTION

1.1. ABOUT THIS APPENDIX

This Appendix describes background for and scope of the procurement and the Customer's objectives, needs and requirements for a solution for new ingest system of media assets (hereinafter referred to as "the Solution") The needs and requirements must be answered in subsequent appendices as indicated, where an overall description of the Solution must be provided as well as a detailed description of how the Contractor's objectives, needs and requirements will be fulfilled.

The list below provides an overview of this document:

- Chapter 2 summarizes the background and main objectives of the project.
- Chapter 3 describes the scope of the Solution, including options.
- Chapter 4 contains instructions for the documentation of the Contractor's high-level solution proposal.
- Chapter 5 describes the Customer's needs for workflows and automation.
- Chapter 6 describes the Customer's needs and requirements related to the solution architecture.
- Chapter 7 and 8 describes the Customer's technical needs and requirements, also related to integrations and API.
- Chapter 9 describes the Customer's requirements and preferences regarding climate environmental requirements.
- Chapters 10-12 describe needs and requirements related to other deliveries and performances; including processing and storage of personal data, implementation methods, documentation; training and administrative and legal requirements.

Attachments according to the table of contents.

Further, this Appendix contains a combination of textual descriptions of objectives, needs, cases, and requirements as well as tabulatory listings of requirements of a more technical character.

The specified needs and requirements must be understood on the basis of descriptions of the background, as well as the Customer's purpose and needs in chapters 2 and 3. By answering all requirements and describing how the requirements are met in the offered solution, the Contractor is expected to present its best proposed solution based on the described needs that fulfils the objectives in a best possible manner.

For practical purposes "the Customer" may also be referred to as "NRK".

Any reference to "clause" refers to a section in the General Contract Terms (SSA-T).

1.2. EXPLANATION TO THE REQUIREMENTS SPECIFICATION

The requirement specification table consists of the columns shown below. Light gray shaded columns in Appendix 2 only and to be filled out by the Contractor.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	

#: Requirement ID - Consecutive numbering of needs/requirements within each section.

Requirement: Textual description of the need/requirement.

"Requirement fulfilment:

- **STD**: the requirement is fulfilled through default standard functionality "preconfigured out of the box".
- **CON**: the requirement is fulfilled through configuration, e.g. screen/GUI config, reports, etc.
- **DEV**: the requirement is fulfilled through custom development (changes to the source code of the standard solution or custom extensions/add-ons to the standard solution).
- **3RD INT**: the requirement is fulfilled through third-party software with built-in integrations as part of the standard solution.
- **3RD**: the requirement is fulfilled through third-party software.
- **FUT**: the requirement is fulfilled through future software release. Future software release refers to versions that are released after the Solution is put into operation for the Customer. The Contractor must comment on which future version will fulfil the requirement and the estimated time for when this version will be available to the Customer.
- **WA**: the requirement is **not** fulfilled as intended by the Customer's requirement description, but the Contractor has a workaround solution (describe workaround solution).
- **NO**: the requirement is **not** fulfilled.

The Contractor's Solution Description: The Contractor's detailed description of *how* the need/requirement is fulfilled as well as which parts of the requirement are possibly not fulfilled according to the applied fulfilment code. Please also refer to section 1.3 below.

1.3. INSTRUCTIONS FOR COMPLETING APPENDIX 2

The Contractor is required to document degree of fulfilment of and compliance with the specified objectives, needs and requirements in Appendix 1 by completing the corresponding Appendix 2 Contractor's solution description.

In Appendix 2 the Contractor shall:

- provide a high-level solution overview, cf. chapter 4
- document fulfilment of requirements as specified in chapters 5 through 12.

The Contractor must in Appendix 2, provide for each case and requirement, an exhaustive elaboration of how the Solution addresses the Customer's needs and requirements. The Contractor is encouraged to add illustrations and screenshots whenever this may help the Customer to a better understanding of how the Solution addresses the requirement. References to general materials such as sales and/or product brochures, product magazines and web content is not sufficient. Any relevant supplementary information may be provided as attachment(s) to Appendix 2 with clear and unambiguous reference.

Where requirement tables are used the Contractor must answer each requirement with a confirmation by marking an "X" in the relevant column(s) under the heading "Requirement fulfilment":

If the Contractor marks either one of columns "STD", "CON", "DEV", "3RD INT", "3RD" or "FUT", the requirement is accepted as fulfilled.
If the Contractor has any reservations to the requirement, this must be explained in the "Solution Description"-column.

If the Contractor will fulfil part of the requirement with one of the categories and another part with another category, then the Contractor may mark more than one category. In that case, the Contractor must be very explicit in his description in Appendix 2 about how each part of the requirement is fulfilled.

The Contractor shall, inform the Customer of the likely consequences of any customizations in terms of the complexity and price of any future maintenance of the standard system and customization.

If the Contractor does not fulfil the requirement as intended by the Customer's requirement description, but the Contractor has a workaround solution, the Contractor must put a mark in the "WA"-column and describe the workaround solution in the "Workaround solution"-column.

If the Contractor does not fulfil the requirement, the Contractor must mark the "No"-column.

The Contractor's Solution Description must be sufficiently exhaustive for the Customer to assess whether the solution meets the requirement and otherwise may be considered suitable, possibly adding value, and thus form a sufficient framework for any detail specification. If the column "The Contractor's Solution Description" in the opinion of the Contractor does not contain sufficient space for text and possible illustrations for certain requirements the description may be included under each requirements table with clear and unambiguous reference to the applicable requirement number.

Although alternative proposals are not allowed as such, this does not prevent the Customer from accepting a fulfilment of individual requirements that are not necessarily "according to the letter of the requirement" if the Customer has justified this in terms of increased performance, value, efficiency, safety, gain etc., or reduced risk and cost. Similarly, if the Contractor considers certain requirements to be particularly complex or cost-driving the Contractor may justify this and propose and describe an alternative fulfilment.

It is the responsibility of the Contractor to ensure that all requirements are sufficiently addressed. If requirements are left unanswered or uncommented – they are to be considered as fulfilled unless otherwise explicitly stated by the Contractor.

Any limitations, demarcations, assumptions, or deviations must be clearly described in connection with the individual goal/need/requirement in Appendix 2 order to be invoked.

1.4. INSTRUCTIONS FOR COMPLETING OTHER APPENDICES

ID	Instructions
1	The Contractor shall in Appendix 4, in accordance with the structure and instructions provided in the Appendix, describe their overall project and progress plan for the delivery of the Solution, based on the Contractor's applied project methodology as described in Appendix 2. In this Appendix the Contractor shall also provide a plan for establishing the support and maintenance service.
2	The Contractor shall in Appendix 5, in accordance with the structure and instructions provided in the Appendix, describe how testing and approval shall be conducted.
3	In Appendix 6, the Contractor shall, in accordance with the structure and instructions provided in the Appendix, describe its organisation, staff and interaction with the Customer as instructed.
4	The Contractor shall specify prices and the principles for pricing in Appendix 7.
5	If the Contractor has any reservations to the general terms in the agreement these shall be set forth in Appendix 8, except for cases where the General Contract Terms refer to other documents.
6	Any licence terms and conditions for standard software and free software shall be included in Appendix 10.

2. BACKGROUND AND PURPOSE

2.1. BACKGROUND AND PURPOSE

As an incumbent and mature broadcasting organisation we have a long history of ingesting content into our media-production and media asset systems. Times are changing and so are

technology. **Hence, we need to upgrade our production to be future proof** and more in line with future demands. NRK aims to transition from dedicated AV infrastructure to an IT-centric, IP-based media infrastructure. NRKs vision is being actualised through the Modernised Production Platform (MPP) programme, which is briefly described in the next chapter.

NRKs current ingest solution is nearing its end of life/support. The current system is decentralised, with ingest servers located across Norway. Often, the same content is ingested multiple times at different locations. **NRK aims to substitute the old solution and implement a new centralised ingest solution**, housed in data centres and provide remote accessible distributable to production capacities throughout the country.

NRK is also relocating the head office in Oslo and several regional offices, including a large regional centre in Trondheim. **This move urges NRK to adapt to new production, technical, and workflow capabilities**.

The main purpose – in bold – also needs to support our strategic commitment to reduce our carbon footprint by 1. **Pooling resources** which are currently distributed across Norway to **increase** overall utilisation. 2. **Reducing duplication** of ingest jobs. 3. **Upgrading old hardware** for modern, more energy efficient and compact systems. 4. Placing the **servers in energy efficient colocation datacentres.**

Furthermore, MPP provides an opportunity to create a cost-effective, modernised ingest system that promotes collaboration. This can be achieved by centralising the system into the two new data centres and removing the ingest hardware and servers from our offices. In this model, ingest channels will be selected from a shared pool, preventing duplicate captures of identical content.

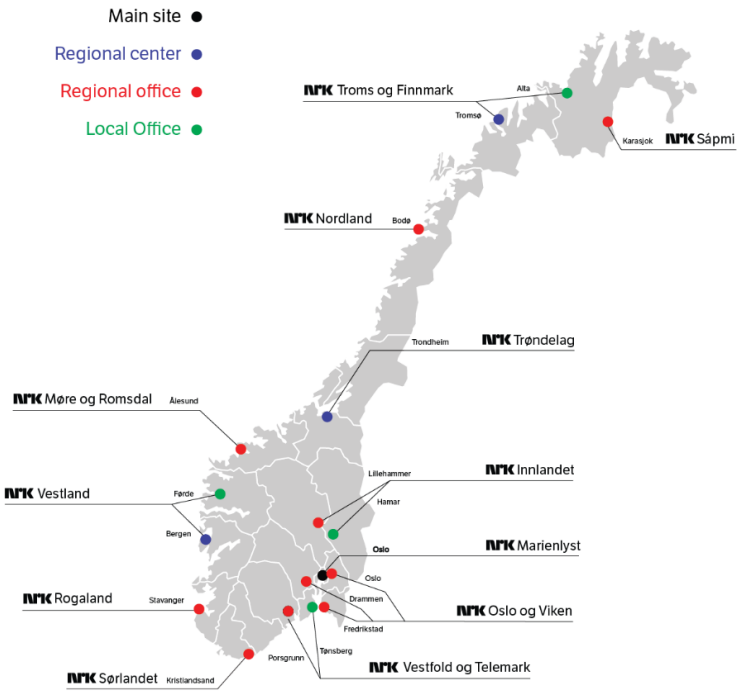


Figure 1. NRK office locations

The new solution will be compatible with MPP technologies (e.g. ST 2110, AMWA NMOS), formats (e.g. 1080i/25 SDR, 1080p50 HDR, 2160p50 HDR), encoding formats (e.g. MXF, AVC, HEVC, ProRes 422) and should be deployable both on premises and on public cloud infrastructure.

2.2.MODERNISED PRODUCTION PLATFORM BRIEF (MPP)

Fuelled by several factors, NRK is currently in the process of performing a business transformation from SDI and AES3 broadcast technologies to native AV over IP services

(AVoIP). The AVoIP model will form the standard model for real-time broadcast activities at all sites.

This business transformation is being co-ordinated by a company-wide programme, referred to as MPP – Modernisation of the Production Platform (MPP). In addition to the transformation to AVoIP, the MPP programme aims to centralise production processing resources in external datacentres, and to lay the groundwork for integrating public cloud services into broadcast workflows.

The MPP high level technical vision encompass the following principles:

- Business transformation from SDI and AES3 broadcast technologies to native AV over IP services (AVoIP).
- Centralize production processing resources in secure, resilient, synchronized external datacenters (DC) as private cloud and to integrate public cloud services into broadcast workflows.
- Applications and workloads will be hosted on public clouds when and where appropriate.
- All suitable technical production resources not requiring direct physical interaction (ingest servers being a good example) will be centralized within the DC locations.
- Utilize general purpose, commercial off the shelf (COTS) network and server hardware.
- Replace hardwiring system components by logically defined "soft" wiring, and "soft coupled" components.
- High-speed, diverse WAN network links will provide connectivity between the datacenters and office locations across Norway. QoS markers will be used to prioritize traffic and ensure service quality.
- Remote access to a subset of platform services and applications will be possible via the Internet.
- Technical workspaces (control rooms, studios, edit suites etc.) located within NRKs offices will access platform applications and services via Wide Area Network (WAN) links.

Figure 2 provides a very high-level, geographical representation of the technical vision for the MPP.

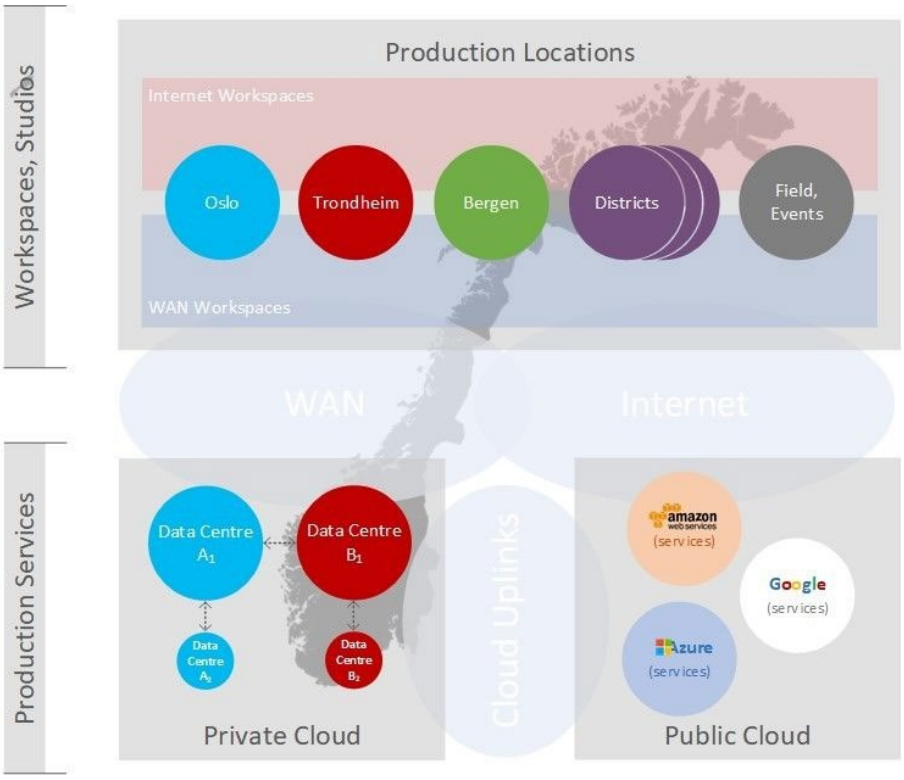


Figure 2. Very-high level context diagram. The working assumption is that one DC will be in southern Norway (A1/A2), in or around Oslo, the other in central Norway, in or around Trondheim (B1/ B2).

2.3. PHASING AND MILESTONES OF THE MPP SCOPE

MPP scope will be delivered in phases, which are described here below. Time plan indicated is tentative. Hence, the new Ingest Solution is part of MPP and will need to be aligned with the "global" timeline and the objectives of MPP.

V0.5 release

The programme phase leading to release v0.5 is in progress. The v0.5 environment is ready for deployments in temporary data centers from Q3 2024 with target to have completed testing in Q4 2024. This phase establishes foundation functionality for use at a minimum viable scale for live services. The goal of V.0.5 is a functional modernized platform in Marienlyst (HQ in Oslo). To achieve this goal, an initial deployment of the ingest system should be delivered. In scope for v0.5 phase and relevant to the Ingest solution is:

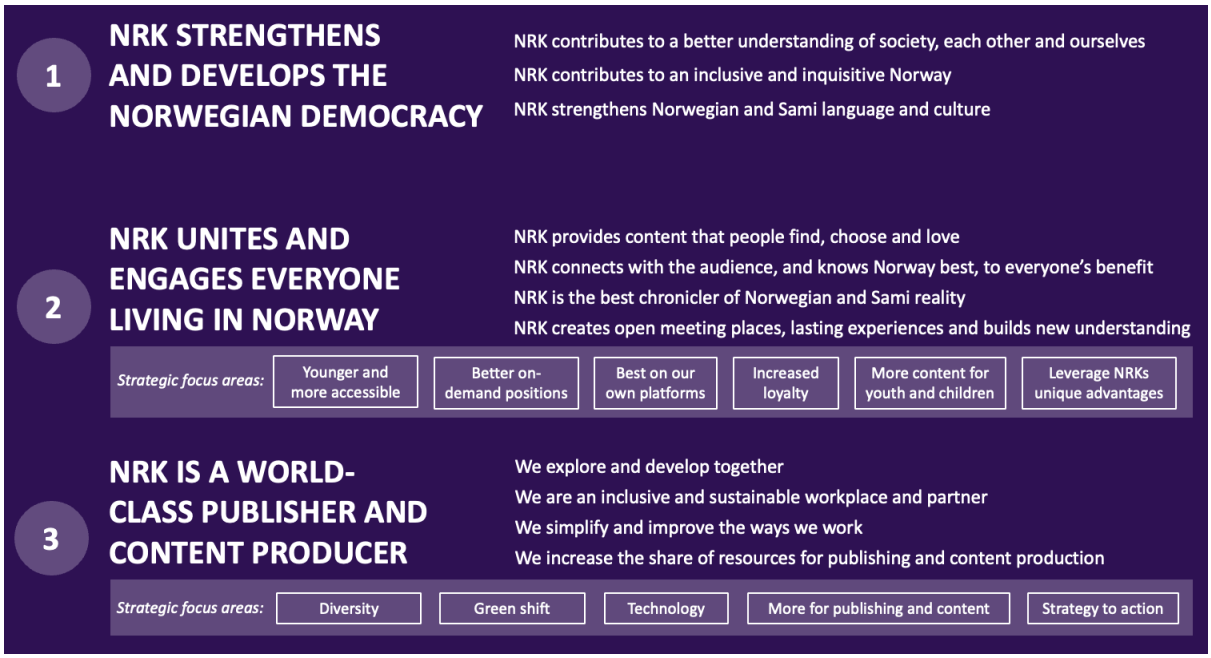
- Implementation of a Broadcast Control System (BCS)
- WAN rollout and networks.
- Compute and NAS.
- Initial deployment of ingest capability.

V1.0 release

Following v0.5 release in Q4 2024, this phase runs for one year to support the new Trondheim facility launch (v1.0) planned for Q4 2025. The v1.0 environment will be ready for deployments in permanent data centers by Q2 2025 with a target to have testing completed by Q4 2025. Scope should be deployed incrementally throughout the stage. v1.0 widens the scope to include all live production and post-production workflows needed for new Trondheim. The new NRK Trondheim facility will launch using this functionality, which will evolve to inform NRKs new headquarter at Ensjø in Oslo. All remaining product integrations are introduced for this phase. This includes an expanded ingest deployment.

2.4.OBJECTIVES

The objective of this RFP and the subsequent negotiations is to provide NRK with a general purpose ingest system that will fulfil NRKs live ingest requirements which will contribute to NRKs long-term strategic goals shown below.



The Ingest system is an essential component in a broadcast production platform. There is an ongoing, long-running project at NRK where the main focus is to provide a modern, automation driven integrated platform for the acquisition, production and management of content.

Apart from the basic tasks an Ingest-system must be able to perform, these are the main objectives that are sought realised through the solution as described below.

2.4.1. TECHNOLOGICAL RENEWAL AND MODERNIZATION

Technological shift from SDI to AVoIP
NRK aims to safely transition from dedicated AV infrastructure to an IT-centric, IP-based media infrastructure. Editorial staff from all offices in NRK should be able to schedule, record, preview, and work on ingested assets regardless of location and physical distance to the resources and data centres.

Modern software development and operation methodologies
Infrastructure as code, version-controlled configuration, continuous integration/delivery and automatic deployment of software and servers.

Scalability and flexibility
Resource requirements will shift over time. We might need to scale up the system for i.e. event purposes. The ability to deploy solutions in private or public data centers is an important park of NRKs technological strategy. A high degree of flexibility is appreciated to meet future requirements for technical standards and formats.

Environmental responsibility
Reduce the carbon footprint by pooling geographically spread resources, increase overall utilization, and choose modern hardware for more energy efficient and compact systems.

2.4.2. INTEGRATION, AUTOMATION, AND EFFICIENCY

API driven
The ingest system will be part of an ecosystem and integrate with other third-party and in-house developed systems. Use of modern API-interfaces and other modern techniques will enhance integrations with up- and down streams systems.

Increase level of automation and performance
Manual operations are time-consuming and prone to errors. Reducing manual operations across multiple systems in the scheduling and ingest workflows will improve efficiency. In progress recordings should be made available for preview and editing to support fast and efficient workflows.

2.4.3. SECURE SERVICE AVAILABILITY

High availability and resilience
Highly available design and components to secure normal operations in case of disruptions in order to maintain NRKs responsibilities as a public broadcaster. Maintainable in service, reduce need for disruptive maintenance windows.

Secure by design, not as an afterthought
High public trust is essential for NRK, and safeguarding the content production chain is vital. Therefore, NRK should always follow security best practices to help ensure the confidentiality, integrity, and accessibility of NRK's data and information technology environment.

3. SCOPE OF THE INGEST SOLUTION PROCUREMENT

The Customer shall procure a new ingest solution (hardware and software) during design (customization) and implementation.

The project aims to deliver a high degree of continuous value to the organization by actively planning for an incremental introduction of the new systems and features.

Combined with a clear Separation of Concern (SoC) and co-developed integrations (cf. section 8) this should enable the responsible teams at NRK a higher change-rate and ability to implement new workflows faster and more reliably.

The Contractor should assume overall responsibility for the deliveries within this contract and use the Customer's resources as far as possible.

Delivery scope 1: In this scope we shall implement the ingest solution in two temporary data centers located within the NRK offices in Trondheim and Oslo. The solution will be limited in both functionality and scale, with a minimal physical footprint of hardware in each data center. The objective of this scope is to assess and test basic functionality including;

- 3G and UHD ingest.
- Playout of media streams capabilities.
- Integration to the MAM-system for registering video assets.
- Integration to the BCS for routing of signals

The ingest solution will not be live and in real production in delivery scope 1.

Delivery scope 2: In this scope we shall implement the ingest solution in the two permanent data centers. At the time being, the location of the data centers is unknown. The objective of this scope is to have a fully functional ingest solution:

- Move ingest servers from temporary to permanent data centers.
- Scaled for production.
- Integrations to up- and downstream systems.

The ingest solution is planned to be incrementally rolled out in Q3/4 2025.

3.1. TECHNICAL SCOPE

The following figure shows a high-level overview of the technical scope illustrated and framed in “as-is” and “to-be”.

The procurement includes an ingest solution with associated hardware, integrated with current and future Media Asset Management (MAM) (cf. section 8.1.1), that supports the reference architecture requirements (cf. section 6) and being compatible with MPP technologies (e.g. ST 2110, AMWA NMOS), formats (e.g. 1080i/25 SDR, 1080p50 HDR, 2160p50 HDR), encoding formats (e.g. MXF, AVC, HEVC, ProRes 422) and should be deployable both on premises and on public cloud infrastructure.

For the purpose of this specification, the scope is as follows:

In scope for Ingest system delivery:

- General purpose ingest
- District and regional news ingest
- Studio / multi-cam ingest
- Visual radio
- Ingest servers and software
- Ingest scheduling software
- Playback of hi-res content

Initially out of scope for Ingest system delivery:

- National news - replay/ingest/edit
- Sports - replay/ingest/edit
- Playout – main transmission playout system
- File ingest/upload

However, although the above functional areas are initially out of scope, NRK reserves the right to consider these items as options for possibly future investigation and implementation if deemed necessary and appropriate to maintain the high-level objective for the new Ingest solution.

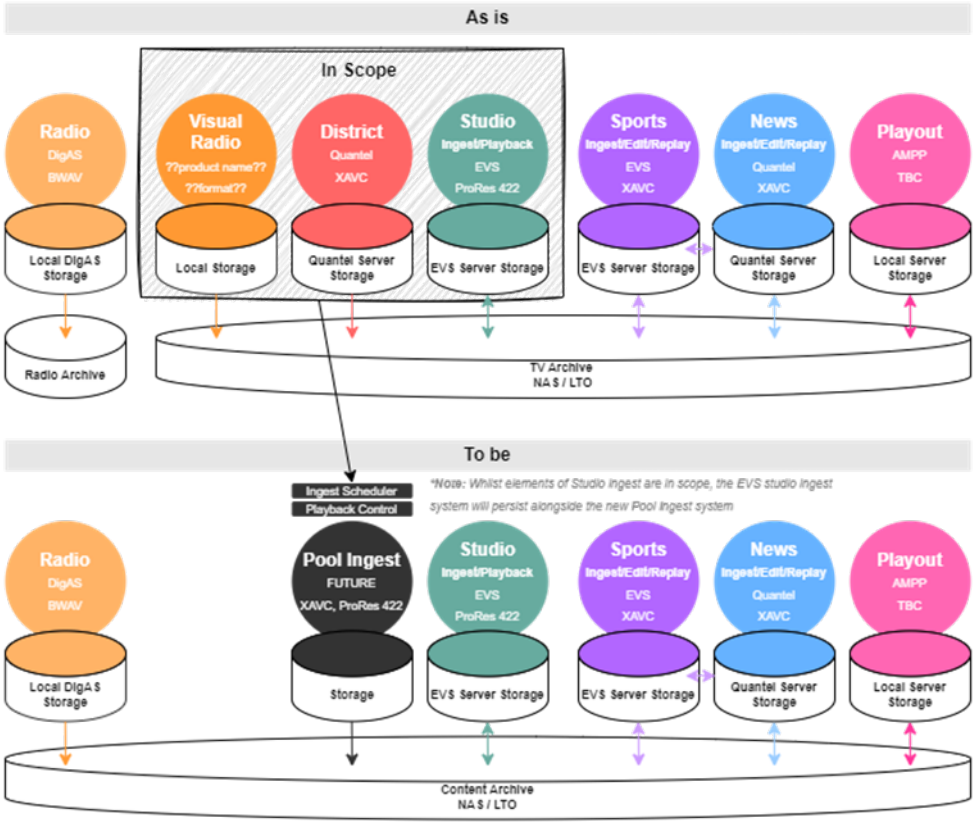


Figure 3. Ingest Scope

3.2. VOLUMES

The ingest system must at least handle the following volumes of concurrent inputs for Delivery Scope 2. In Delivery Scope 1, NRK requires a minimum footprint of hardware that allows us to achieve the objectives described.

Delivery Scope 1:
For Delivery Scope 1, we would like to test 3G ingest, UHD ingest and replay capability with MAM / BCS integration, ideally with the minimum footprint possible in each data centre. We would like the Contractor to suggest a minimum viable product that allows NRK to meet the objectives of this scope.

Delivery scope 2:
For Delivery Scope 2, we would expect the remaining capacity to be delivered. Please note that the capacity described below is the total capacity required in the production environment.

- Datacenter A
  - 38 inputs
    - 32 x 1080p50 inputs
    - 6 x 2160p50 inputs
- Datacenter B
  - 38 inputs
    - 32 x 1080p50 inputs
    - 6 x 2160p50 inputs

Staging environment
NRK requires a cost-efficient staging environment that needs to mirror the production environment in functionality, but not scale. The staging environment is intended to follow the same principles and design as the production environment (cf. section 5). We would like the Contractor to suggest how a cost-efficient staging environment can be set up that meets the requirements of mirroring the production environment.

3.3. OPTIONS

In addition to the volumes described above, the following options shall be briefly described in Appendix 2 and priced in Appendix 7. See detailed descriptions of options in section 12.4 in this Appendix.

4. HIGH-LEVEL SOLUTION OVERVIEW

The Contractor shall provide a comprehensive high-level overview of their Solution based on the objectives and needs described in chapter 2 and 3 and the accompanying cases, user stories and requirements in the following chapters. A high-level technical description/illustration of the Solution should be included.

The Contractor must provide clear and unambiguous statements about which of the Customer needs and requirements they do not support or cannot deliver.

The high-level overview and documentation should emphasise:

a) **Performance**: How the offered Solution contributes to achieve the main objectives of this procurement (cf. chapter 2.4). Please make unambiguous references to the relevant sections in Appendix 2 that contribute to the achievement of the Customer's objectives.

b) **Risk**: How the Contractor will help the Customer to reduce principal risk related to this Solution. Both in establishing the service and running it. Please make unambiguous references to the relevant sections in Appendix 2 where the offered measures provide effect.

c) **Additional Value**: How the Contractor can offer additional value to the Customer in addition to the listed requirements and relative to the competing Contractors. Please make unambiguous references to the relevant sections in Appendix 2 that shows how the offered Solution provides added value and better goal achievement for the Customer.

5. HIGH-LEVEL WORKFLOW DESCRIPTION

This section contains the description of a target workflow and functional needs.

5.1. BASIC WORKFLOW

The following description is intended to provide guidance about the target workflow of the ingest system in its ecosystem. To allow scope for different approaches which achieve a similar result, the description is deliberately high-level.

The purple-coloured parts are the ingest system (in-scope for this procurement), the red, green and blue parts are existing NRK systems to be integrated with the ingest system. Requirements regarding integrations and APIs are stated in section 8 below. The existing NRK systems are described in Appendix 3 – Customer Technical Platform.

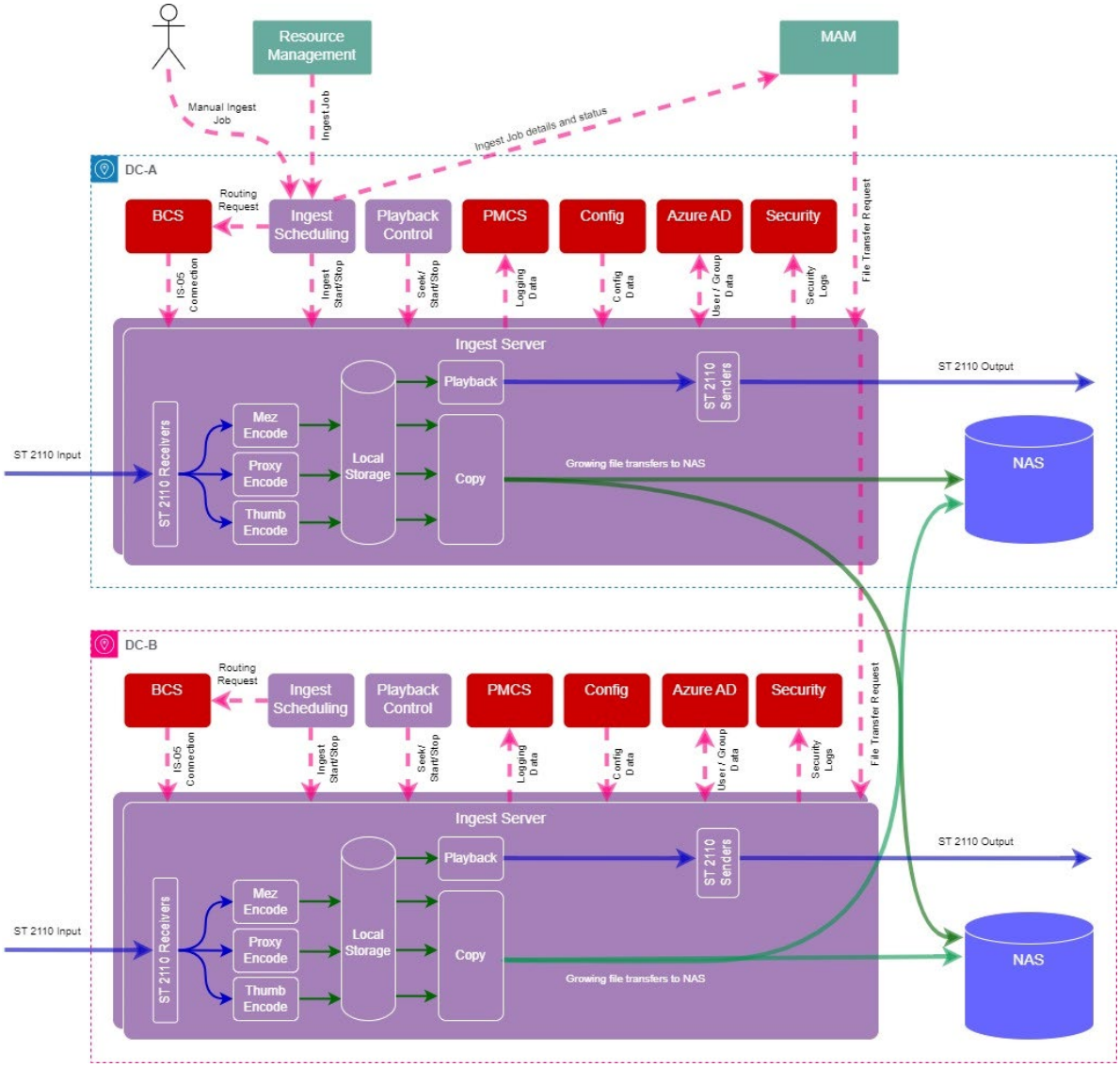


Figure 3. Ingest System Overview

The ingest server ports are a shared resource that can be scheduled either via a Resource Management system or via operators entering jobs directly into an ingest scheduling tool.

1. A Resource Management system issues ingest job information to the DC-A/DC-B Ingest Scheduling systems. The ingest job will include: file name, start time, duration, format, server, server channel, as well as various other metadata fields. The request may be issued days or weeks ahead of the ingest job start time. Users may also create jobs directly within the Ingest Scheduling system.

   Various options exist for content capture, which will be based on the importance of the content. Examples include:
   a) Capture of a live feed to a single server within one datacentre
   b) Concurrent capture of a live feed to two servers within one datacentre
   c) Concurrent capture of a live feed to a single server within both datacentres
   d) Concurrent capture of a live feed to two servers within both datacentres

   NRK anticipate that scenario “c” will be the most common.

2. The Ingest Scheduling system creates corresponding content placeholders within the MAM.
3. Shortly before the ingest job start time, each Ingest Scheduling system issues a routing request to the Broadcast Control System (BCS) to present the required live content to the server.

4. The BCS system in DC-A/B issues IS-05 connection requests to the ingest server channel which has been scheduled to encode the event. The IS-05 connection request will use the "bulk" attribute so that all audio, video and data connections for the ingest job can be communicated in a single request. The BCS also communicates to the AVoIP network to ensure the source media flows are transferred across the network to the network switch the ingest server is attached to.
5. Each ingest server subscribes to the audio, video and data flows associated with the ingest job.
6. Each Ingest Scheduling system issues the job request to the ingest server shortly before it is due to start.
7. Each ingest server encodes and writes Mezzanine, Proxy, and Thumbnail files to local server storage.
8. The MAM initiates parallel growing file copies from the local storage of the primary server to the NAS storage in both DC-A and DC-B. No copies are initiated from the Guard server unless the encode job on the Primary server fails.

Within this workflow, various possibilities exist to resolve failures (e.g. encode failure, file transfer failure, failure to create MAM placeholders).

Please note that whilst the ST 2110 inputs and outputs are illustrated, the solution should support a variety of other transports and codecs such as NDI, TS, SRT, RIST, AES67 (please refer to requirements tables for details).

The "Config" block in Figure 4 refers to NRK's configuration automation environment. The MPP platform is an IT platform for media production. It will be operated based on DevOps practices. Configuration will be managed within a Git repository and CI/CD tools such as GitHub Actions and Ansible will be used to automate the process of deploying devices and configuration.

The "PMCS" block in Figure 4 refers to the Platform Monitoring and Control System. The PMCS will collect log and event data from applications, services, networks, and devices within the modernised production platform. Aggregated log data will be reported on in a variety of ways to provide relevant insights to different user communities (Figure 5).

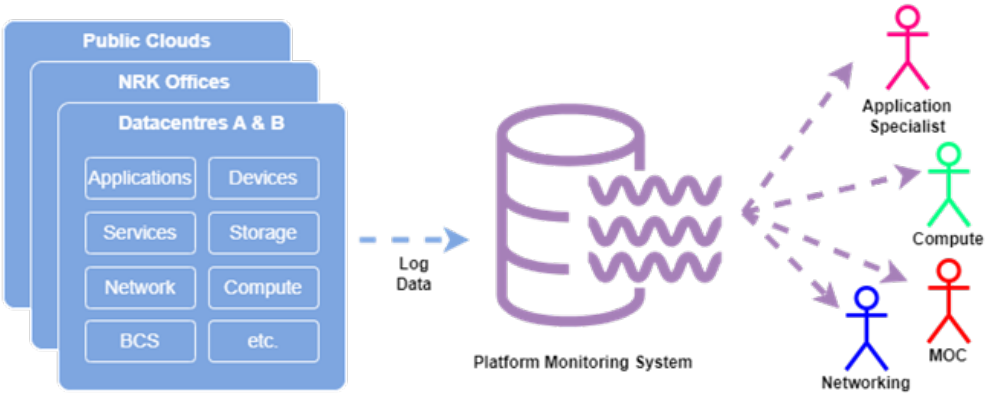


Figure 4. Platform Monitoring Context

Platform monitoring will be based on modern, IT-centric tools (Figure 6), which are aligned with existing tools in use at NRK. The architecture caters both for real-time event processing and alerting, as well was log data analysis, to provide deeper platform insights. The chosen solution will be integrated with this system.

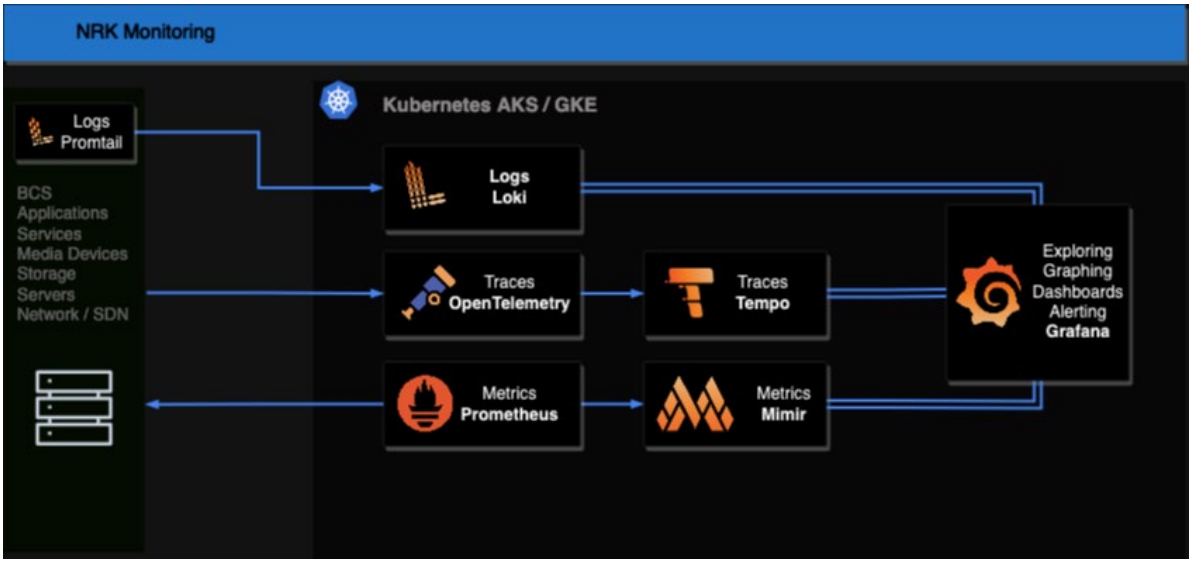


Figure 5. Platform Monitoring Stack

#	Requirement
1	With reference to the diagrams and text above, please describe how the Contractor will meet NRKs workflow objectives with specific reference to the encoding to local server storage and dual data centre model.
2	In the workflow, various possibilities exist to resolve failures (e.g. encode failure, file transfer failure, failure to create MAM placeholders). Please summarise worst case scenarios and how they would be managed within the proposed solution.

5.2. EXAMPLES OF INGEST SOLUTION USAGE

This chapter contains a few examples of the ways in which the current ingest solution is being used including pain points. In addition, the chapter includes future use cases for how we envision the new ingest solution to used.

The wording of these examples cannot be considered literally exhaustive, they are only meant to show functional and technical challenges and requirements in a richer context. While NRK's operating model is yet to be finalised, these examples demonstrate likely ways in which the solution might be employed.

5.2.1. CURRENT USE CASE 1: MANUAL INGEST TASK

This example covers a current scenario in which an unscheduled recording must be triggered manually by an operator, for example for a news event or a press conference.

A request is made by an editorial or operational team for an ad hoc recording with little or no advance notice. This request may come by email, phone or in person.

The operator will get the source from either the staff requesting the recording, or by calling the Master Control Room for any additional information.

The operator selects the source in the ingest scheduling tool, which has the ability to display all sources from the BCS. A human readable clip name is given, in addition to the start time and duration of the recording. The ingest tool will automatically select which input to use and assign a random GUID which is used as a unique identifier in the MAM. The ingest tool will trigger workflows in the MAM, i.e. ingest as growing file and proxy generation once the recording is finalised.

Pain points from the above workflow:

- It is not possible to preview the ingest in the MAM while the recording is ongoing, proxies are generated once the ingest is finished.
- Editing a growing file in Premiere is challenging due to bad performance. There is a delay which prevents real time editing and playback close to “now”.
- It is not practical to play back/playout the high res recording while the ingest is ongoing, for example for time shifting.
- The workflows for making the ingest available as audio only are slow.

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs and pain points described above

5.2.2. CURRENT USE CASE 2: INGESTS OF REGIONAL TRANSMISSIONS BASED ON RULESET

This example covers ingests of daily transmissions in the regional offices. These are used for archival purposes and are also transcoded to be published to NRK’s on demand service.

An operator will create a series of recurring ingests based on a ruleset that contains a clip name, start time, duration and interval. The interval can for example be daily at 19:45:00. A source is selected in the ingest system, and an input is automatically selected.

NRK has created a service that polls all scheduled ingests. If a clip name matches a clip name from a placeholder in the MAM, the service will change the GUID to match the ID from the placeholder. This will force a merge to the placeholder once the recording is ingested to the MAM.

Pain points from the above workflow:

- Limited automation.
- Manual creation of schedules in each regional site.
- These schedules can’t be set to recur indefinitely, forcing the operators to constantly extend the ruleset.
- Manual intervention is required for changes to the schedule, i.e. last-minute change to start of recording.
- The ingest will start at a set time, not when the transmission is actually starting . This can lead to an empty/black head and tail on the on-demand program.
- 20 minutes / four times a week all regional sites have simultaneous transmissions. In this period, port usage is nearly 3 x times higher than baseline. This implies that the ingest system is inefficiently used and scaled with ports to cover peaks for 80 minutes a week.

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs and pain points described above

5.2.3. CURRENT EXAMPLE 3: RECURRING 24/7 SCHEDULES

Some regional news offices record at least 2 x agency feeds per day. These recordings are sometimes duplicated across sites.

Pain points from the above workflow:

- Recordings must be separated into 3-hour chunks for usability
- Inefficient port usage due to lack of capability to overlap recordings – requires two alternating ports to do a single long running schedule.
- Schedules and ruleset must be maintained in the ingest scheduling tool. Cannot be scheduled indefinitely.

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs and pain points described above

5.2.4. CURRENT EXAMPLE 4: PLANNED EVENT FROM AN EXTERNAL SOURCE

This example covers the recordings of a live sports event for use in sports news coverage. The requirement is to record a sporting event and create highlights at a later time.

The sports news producer goes to an external website which provides information on sporting events of the day. The producer finds the most interesting / relevant event based on editorial needs. They make a note of the event details. The producer will then go to an internal website where they have the ability to make a request for a recording. They need to add a clip title, the channel from which the content originates, the start time and end time.

This request is then added to a task list seen by MCR operators. MCR will set up the route from the source and enter the relevant details in the task list.

The ingest operator will copy / past the clip name to the ingest tool, add the start and end times and find the sources specified by MCR and initiates the recording. The request's status is then manually updated by the ingest operator. This status will be visible to the editorial staff.

Pain points from the above workflow:

- Lack of automation
- Manual operations from multiple teams (Production, MCR, Ingest)

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs and pain points described above

5.2.5. FUTURE EXAMPLE 5: RESOURCE MANAGEMENT MODEL

This example is typical of a planned event such as for a transmission directly to a VOD platform. This example assumes integrations with other systems which will not be provided by the ingest solution Contractor.

Recordings are requested by editorial or operational units. These recordings are booked (named, start / end time specified) by operators using a resource management system.

The booking triggers a series of automated actions involving the broadcast control, media management and Ingest systems.

In this example, at the appointed time, the ingest scheduling tool makes a call to BCS to set up the route to the input. The scheduling tool makes a placeholder visible for the operators. The recording stars, either exactly at the scheduled time, or in some cases, this might be frames / seconds / minutes later based on an external trigger. The idea is to make the recording with as little headroom as possible, e.g. for publishing directly to VOD through additional automation.

#	Requirement
1	Please describe how the proposed ingest system will meet the different needs described above

5.2.6. USER INTERFACES DESIGN PRINCIPLES

All functionality within the Ingest system must be available through the Ingest system user interfaces and give the users the ability to interact with the system based on their production role and their login privileges.

The user experience should be recognisable and consistent across user interfaces, e.g., across desktop interfaces, touch screens. The industry best practice to achieve this, is to build user interfaces using a design system – a shared design and code collection of reusable components, guided by clear standards. An international (and best practice) example is Google's open-source design system Material Design.

The Ingest system interfaces should be possible to use by "as many as possible". Ingest system user interfaces and components should be built with accessibility in mind, trying to be as inclusive as possible, using Web Content Accessibility Guidelines (WCAG).

#	Requirement
1	Please describe how the proposed ingest system adheres to these user interface design principles
2	The Ingest system user interface must be accessible as a responsive web interface.
3	The Ingest system user web interface should follow proper HTML semantics (e.g., not using table for visual layout)
4	The Ingest system web interface should support the common browser versions from Edge, Chrome, Firefox, and Safari
5	The user interfaces should have full UTF-8 or UTF-16 support in order to support all characters required for Norwegian, North Sami, South Sami and Lule Sami
6	The Ingest system user interface should support role-based access control
7	The users should have the ability to personalize the user interface for their needs in a flexible way based on their privileges or roles
8	The Ingest system should meet the latest Web Content Accessibility Guidelines (WCAG) at levels A and AA. Currently, the latest version is WCAG 2.1
9	Contractor should use the check list W3Cs WCAG-EM or a similar Accessibility Conformance Report (ACR) to document how the Ingest system matches the WCAG 2.1 requirements on levels A and AA

5.3.INGEST SCHEDULING

Ingest Scheduling features will be an integral feature of the Ingest system or an external system with integration to the Ingest system using northbound APIs. Currently there is limited automated resource management of ingest in NRK, however it will be desirable to have this functionality in the future. Additionally, the ingest system must support manual scheduling of recordings either via a crash record method or integral system for scheduling a future event. In this section these functionalities will be discussed.

5.3.1. CRASH RECORD

While a high level of automation is the objective, there will still be a need to do a crash record, i.e. that an operator manually programs an ingest as that starts immediately (Cf. section 5.2.1).

#	Requirement
1	An operator must be able to manually trigger a recording event through the user interface. In this scenario, the crash record is triggered immediately.
2	The operator is responsible for the metadata input and the integral ingest scheduling system should be able to register the asset in the MAM
3	The integral ingest scheduling system should be able to either be routed manually using the BCS, or trigger a BCS route while crash recording
4	The integral ingest scheduling system should provide the ability to follow the crash record in a nearfield monitor.

5.3.2. SCHEDULE AN EVENT IN THE INGEST SYSTEM

Sometimes an operator would need to schedule an impending ingest in the near future without going through an Enterprise Resource Management System (cf. sections 5.2.2, 5.2.4).

#	Requirement
1	An operator must be able to manually schedule a single event through the user interface. In this scenario, the recording is triggered at the time desired by the user.
2	The user interface must provide customisable fields to support metadata entry. The operator is responsible for the metadata input and the integral ingest scheduling system will register the asset in the MAM.
3	Scheduled recordings should be generated and be visible on a port and time frame user interface
4	The integral ingest scheduling system should support manually routed inputs (where an operator uses the BCS to route a source to an ingest server input), and automated routing (where the ingest system triggers a BCS route when a recording starts).
5	The system should allow an operator to manually schedule a recurring event through the user interface. In this scenario, the recordings are triggered at a user specified date/time and repeat interval and will continue until a user specified end date or indefinitely.
6	The system should support the creation of templates with pre-defined metadata for different events, which can be easily recalled. For example, following a naming convention.

5.3.3. SCHEDULE AN EVENT IN THE RESOURCE MANAGEMENT SYSTEM

An integration with the Resource Management System is a key part of reducing the number of manual tasks and automate ingest (cf. section 8.2.2 and 8.2.3).

#	Requirement
1	The ingest solution must provide a northbound API to enable ingest jobs to be created/updated/deleted by an upstream resource management system in which bookings are created and managed.
2	The northbound API should allow the format of incoming flows to be set. The format may differ between jobs for example 1080i/25 SDR, 1080p50 HDR, 2160p50 HDR.

5.3.4. CLIP PLAYBACK

Sometimes there is a requirement to quickly playout ongoing ingests, for example a live event with a time delay, or in scenarios where it would be impractical and slow to first do an edit and then transcode to a new file (cf. section 5.2.1).

#	Requirement
1	The system should provide functionality to playout ingested files and ongoing ingests.
2	The system should support a pass-through mode, which it can delay a feed by a user defined time offset.
3	The system should provide the ability for a user to review growing files, create, replay and publish sub-clips.

4	The system should provide tools to review and annotate growing files. It should be possible to publish the captured data.
5	The system should provide tools to create and play a basic playlist from clips and subclips.
6	The system should provide the ability to overlay static graphics over content being played out.

5.3.5. INGEST SCHEDULING USER INTERFACE

Please refer to section 5.2.6 User interface design principles for technical requirements for the user interface.

#	Requirement
1	The system should support both graphical and text-based display formats. In either format: • previous, current, and new schedules should be represented and be visually distinct. • current and future schedules will appear as indefinite unless/until an end time is added, or the scheduled event is manually ended. • current schedules should be visually distinguishable from future and past schedules. • individual schedules in a concurrent series of the same connection must be distinguishable. • failed schedules must be visibly distinguishable from successful schedules. • the current time should be graphically displayed via a progress bar or similar.
2	The UI should provide a list-based view (vertical view of ingest jobs associated with an ingest channel).
3	The graphical display should be in the form of linear timelines relating to ingest resources. The current time should be indicated on the timelines. It should be possible to: • filter the visible ingest resources by type (user defined) • filter the visible ingest resources by upcoming events. • zoom the visible time frame in and out. • scroll the visible time frame forward and backward. • Search for a given event on the timeline. • Search for a given port on a timeline. • Show the source for a given event on the timeline.
4	There should be customizable metadata fields that would allow for metadata from the scheduling interface to be mapped to other systems (i.e. MAM/PAM)
5	The system should allow for 3rd party web components to be available in the scheduler, i.e. to allow for searching MAM for placeholders or adding metadata.
6	The ingest UI should provide a thumbnail view of active ingest feeds.
7	The ingest UI should provide audio metering for ingest feeds.
8	The ingest UI must allow a user to manually create/update/delete jobs.
9	The ingest UI should provide users with an overview of system, ingest server, ingest channel health.
10	The ingest UI should allow users to play back and preview ingested files.
11	The ingest UI should enable active ingest jobs to be shortened or lengthened.

6. SOLUTION ARCHITECTURE REQUIREMENTS

Being an important component in NRK's live production infrastructure, the Ingest system must be fully resilient and fault tolerant. Each Ingest system instance must also be able to operate autonomously, so that for instance if one data center is cut off, NRK can still produce and distribute content using the remaining data centers and locations.

The architecture requires that the ingest solution should support ganging of ports to enable resilient feed capture. The basic architecture requires that a farm of ingest servers is located within two datacentres (DCs). The DCs are loosely coupled. A major systems outage in one DC must not prevent the other DC from functioning. Contribution feeds can be dual presented to the two datacentres and ingested in a variety of ways depending on the value of an incoming feed and availability of technical resources.

Dual DC, single server 1:0|1:0 - A feed is presented to both DCs simultaneously and encoded by ingest servers located in each DC. This is considered the default mode.

Other modes are also possible, and the solution should not prevent them from being implemented:

- **Single DC, single server 1:0|0:0 -** A feed is presented to one DC and ingested be a single ingest server.
- **Single DC, dual server 1:1|0:0 -** A feed is dual presented to one DC. The feeds encoded by ingest channels hosted on different ingest servers within that DC.
- **Dual DC Dual Server 1:1|1:1 -** A feed is dual presented to both DCs. The feeds within each DC are encoded by ingest channels hosted on different ingest servers within that DC.

As a general principle, a contribution feed received in one DC should be encoded by an ingest server within the same DC. To maximise platform resilience, NRK want to minimise the incidence of feeds crossing between DCs.

#	Requirement
1	The Ingest system must have no single point of failure in the system core.
2	The Ingest system must not rely on a single instance of a database.
3	The Ingest system should be able to merge configuration changes which will be applied without disrupting existing operation and ongoing ingests. For example, adding/removing/reconfiguring ingest servers and inputs/outputs.
4	The ingest system should have a persistent store for scheduled ingest jobs, such that in the event of an outage, system state can be recovered.
5	Each Ingest system instance must be able to function autonomously.
6	The ingest system must support setup of SMTPE 2022-7 redundant streams across two networks fabrics.
7	System must support automatic re-establishing of connections after an error on underlying infrastructure such as network or storage.
8	Ingest servers must have separate network interfaces for control (x2 interfaces) and ST 2110 flow exchange (x2 interfaces).
9	Control (e.g. IS-05 subscription requests) and monitoring communication (e.g. ST 2110 endpoint status) should not be conveyed to a device by the media exclusive (AVoIP) network, even if the communication involves routing of signals to/from that device, unless there is no alternative.
10	Supplier to describe how solution can deliver resilient feed capture within a datacentre and between data centres. Example include: a) Concurrent capture of a live feed to two servers within one datacentre b) Concurrent capture of a live feed to a single server within both datacentres c) Concurrent capture of a live feed to two servers within both datacentres The description should highlight any integration requirements for external systems (e.g. Resource Management, BCS, MAM).
11	Please state if there are parts of the system that has quorum requirements – i.e., if there are a minimum number of nodes that need to be healthy for a cluster to be available, and how this may affect deployment strategies and requirements.
12	Please make sure that it is clearly stated what parts of the system hold local (and authoritative) state – i.e., what part of the system holds data that has to survive a re-installation/re-deployment, and thus needs traditional backup.
13	Please describe suggested backup strategies (database backups, snapshots etc) for the stateful instances, and any if any operational considerations must be taken (downtime, failover etc) for backing up or restoring the system to a previous state.
14	Please describe other solution resilience strategies both within a datacenter and across datacenters.

7. TECHNICAL REQUIREMENTS

This section contains the Customers' technical requirements for the Ingest system. In order of essence, the security requirements (personal data and technical security) have been extracted to a separate chapter below (cf. section 11)

7.1. PHYSICAL INTERFACES

All equipment shall be installed in NRKs data centers and must comply with the hardware requirements as specified below.

#	Requirement
1	The equipment should be mountable in 19in racks.
2	The Contractor should specify the dimensions of the equipment (WxDxH).
3	The Contractor must specify the total physical space in terms of rack units
4	The Contractor must specify the total maximum and average power consumptions of the system (excluding client pc's).
5	The Contractor must specify the required cooling capacity to cool the entire system (excluding client pc's).
6	Specify any operational environmental requirements (temperature/humidity) for the equipment
7	Due to various requirements from our data center providers, NRK needs to know how you require airflow and any special needs regarding mounting and cooling.
8	All equipment must bear the CE marking for declaration of conformity and meet the current applicable EU directives.
9	All hardware delivered with the system should have hot-swappable dual power supplies (where applicable).
10	All equipment must be operating at nominal 230 VAC, 50Hz.
11	All hardware with network connectivity should have dual network ports for redundancy.
12	All network connectivity over 1Gb should be presented as SFP or QSFP cages to enable patching to ToR switches using copper DAC or fibre MPO cables. Please list supported optics and DAC cables. Please also highlight any limitations (e.g. unsupported brands).
13	All 1Gb or below network connectivity should be presented on RJ45 connectors.
14	All equipment must meet the current RoHS directive.
15	Provided hardware should have a suitable cable management solution
16	Provided hardware should come with an out of band management module (iLO, iDRAC, IPMI or similar)

7.2. CONTROL STANDARDS

NRK endeavours to be a driving force in the utilization of a standards driven IT-centric production platform. To support this strategy the Ingest system should prioritise standards over vendor specific solutions.

#	Requirement
1	The Ingest system must support NMOS IS-04 for device registration
2	The Ingest system must support NMOS IS-05 for connection management
3	The Ingest system should support NMOS IS-07 for event and tally
4	The Ingest system should support NMOS IS-08 for audio channel mapping
5	The Ingest system should support NMOS IS-09 for system parameters
6	The Ingest system should support NMOS IS-10 for authorization
7	The ingest system must provide an open API for control of ingest and player ports

7.3.PLATFORM AND OPERATIONAL ENVIRONMENT

As part of the transition to an IT and standard driven approach for media production, all the systems used for the media production, including the Ingest system must adhere to common operational best practices.

We see many benefits from deploying applications on containers and using a container orchestration and runtime environment such as Kubernetes. We would like to see that also parts of the Ingest system, where appropriate, moves in the same direction for the flexibility this

#	Requirement
1	The Ingest system must support one or more of these runtime environments in preferred order: Running as a container Running as a Linux service Running as a Windows service Running as a Windows Gui application is not an acceptable runtime environment
2	It should be possible to deploy the ingest system software on virtual machines where applicable
3	The ingest system should be deployable on virtual machines or the public cloud (e.g. to support the capture of NDI or ARQ based formats such as SRT and RIST).
4	The Ingest system should support the following log configurations based on the runtime environment: When running as a container, writes logs to standard out/standard error When running as a Linux service, writes logs either to standard out/standard error or directly to journal When running as a Windows service, writes logs to the Windows event log
5	The Ingest system should support providing runtime metrics using Prometheus. If Prometheus is not supported, describe the supported runtime metrics system(s).
6	The Ingest system should support OpenTelemetry.
7	The Ingest system should support patching and upgrades without downtime when run in a HA configuration.
8	NRK has standardized on preferred HP and Dell servers. If the ingest system is running on COTS hardware, please list hardware manufacturers.

7.4.CONFIGURATION

Through its many internal development teams and in-house developed services, NRK has learned the huge benefits of automated deployments – both for reducing risk, documenting installation procedures, ensure repeatability, increase development and deployment speed - and ultimately making higher-quality services available for both users and viewers.

It is therefore expected that all virtual server instances may be automatically provisioned based on pre-created images, or preferably be created completely from scratch on-demand by leveraging technologies like HashiCorps Packer or similar.

In the same vein, it is expected to be able to automatically configure and set up both infrastructure, servers, and software using terraform, ansible, salt or other provisioning and configuration technology enabling a version-controlled environment.

NRK has local experience and resources for working in collaboration with the Contractors to set up such deployment strategies. Still, it requires that the software, hardware, and infrastructure is capable of being configured and installed this way.

#	Requirement
1	Please describe what deployment technologies and strategies the system may support, including both initial installation and subsequent updates and upgrades.
2	The Ingest system should have a complete REST or GraphQL API for configuration, providing at a minimum: • Adding, removing, and modifying ingest channels • Modifying software components

#	Requirement
3	The Ingest system should have support for configuration using Ansible or Terraform with an Ansible module or Terraform provider supported by the Contractor.
4	The Ingest system should support administrator-configurable webhooks to interact with other generic APIs (e.g., on status updates).

7.5.MEDIA FORMATS

The Ingest System should generate the NRK house standard in mezzanine and proxy formats as specified below. Additionally, the Ingest System should support a wide range of professional formats and codecs including but not limited to those described below.

7.5.1. LIVE CAPTURE FORMATS

Whilst ST 2110 will be the primary capture format, wider input format support will enable NRK to utilise the solution in a wider range of use cases with a large degree of flexibility. We envisage that not all ingests have to be equal, and that we could have lower quality tiers using less demanding formats for easier deployment and scaling to virtual machines and the public cloud.

Please refer to “III-a-NRK-2024-295_Ingest_Solution_SSA-T_App 01-1-Attachment 1-2 NRK Device ST2110 ST2059 NMOS Conformance - v3.5” for detailed ST 2110 conformance requirements.

#	Requirement
1	Must support the frame-accurate capture of live feeds, based on timing information in an ingest job
2	Audio and video must be synchronous
3	Should support the capture of SRT encapsulated flows
4	Should support the capture of RIST encapsulated flows
5	Should support the capture of NDI flows
6	Should support the capture of SDI flows
7	Must support the capture of SMPTE ST 2110-20/30/40 flows
8	Should support the capture of SMPTE ST 2110-22 flows (JPEG-XS encoded video)
9	Should support audio only capture of SMPTE ST 2110-30 flows
10	Must support the capture of up to 16 audio channels per ST 2110 video flow
11	Should support the capture of up to 32 audio channels per ST 2110 video flow
12	Should support ST 2110-30 Conformance Level C (support for 125uS packet timing)
13	Must support the capture of up to 4 x ST 2110-30 audio flows per ST 2110 video flow
14	Should support different channel counts and packet timing per ST 2110-30 flow. (Future Dolby Atmos requirements are driving this)

7.5.2. RESOLUTION AND FRAMERATE

#	Requirement
1	Must support the input and encoding of 1080i25 SDR
2	Must support the input and encoding of 1080p25 SDR
3	Must support the input and encoding of 1080p25 HDR

#	Requirement
4	Must support the input and encoding of 1080p50 SDR
5	Must support the input and encoding of 1080p50 HDR
6	Must support the input and encoding of 2160p50 HDR
7	Please attach an overview of supported resolutions, framerates, audio and video formats and wrappers

7.5.3. WRAPPERS, CODING AND AUDIO

#	Requirement
1	Must support capture to MXF OP1a
2	Must support capture to MXF OP Atom
3	Must support capture to Quicktime
4	Must support capture to MPEG
8	Must support AVC Intra encoding
9	Must support XAVC Intra encoding
10	Must support ProRes 422 encoding
11	Must write frame accurate timestamp into wrapper, where this is supported by the wrapper
12	Must write accurate media format information into wrappers
13	Must support the capture of uncompressed audio as linear PCM 48kHz, 24bit as an AES3 stream, within an MXF wrapper
14	Must support the capture of uncompressed audio as linear PCM 48kHz, 24bit as a BWAV file
15	Must support AAC audio

7.5.4. PROXIES AND THUMBNAILS

The MAM is generating proxies and thumbnails for preview purposes. Currently any ongoing ingest will have to be finished before the previews and proxies can be generated.

Preview images are generated are downscaled and compressed to a format like jpeg.

There is currently a limited number of workflows utilizing editing on proxy files. A future PAM solution might include a web editor which make use of growing proxies.

#	Requirement
1	Should support capture of a thumbnail image at a customizable resolution and offset. Please specify which formats are supported.
2	Should support capture of multiple images at a customizable time interval to enable an NRK's service to create a preview of the stream (filmstrip).
3	Proxy encoding must output discrete audio and video files.
4	Must support capture of proxy files with the native resolution and framerate.
5	Must support h.264 with AAC audio and mp4 wrapper for low bitrate proxy files.
6	Should support h.265 with AAC audio and mp4 wrapper for low bitrate proxy files.
7	Must update mp4 moov atom as the file grows to facilitate browse of growing proxy files

7.6.DEVELOPMENT ENVIRONMENTS

The Solution must be delivered with a staging-environment for testing changes, installation, patching and features before they are put into production.

NRK requires a cost-efficient staging environment that needs to mirror the production environment in functionality, but not scale. The staging environment is intended to follow the same principles and design as the production environment (cf. section 5).

We would like the Contractor to suggest how a cost-efficient staging environment can be set up that meets the requirements of mirroring the production environment.

Additional developer-software-licenses for running the software on developer machines and/or in build/test-chains (if applicable) should also be provided.

7.7.CHANGES TO THE TECHNICAL PLATFORM

The Contractor shall describe how the offered Solution will cooperate with the Customer's technical platform described in appendix 3. Any assumptions/prerequisites or required changes in the customer's technical platform must be explicitly described in Appendix 2 in order to apply.

The Customer will itself ensure such upgrading and reserves the right to purchase the necessary equipment and software required by its own agreements.

8. API'S AND INTEGRATIONS

Most of NRKs critical productions systems are thoroughly integrated into our production platform. Hence, we will be reliant on robust APIs for our new ingest solution.

This chapter covers general API requirements, followed by integrations needed between the Ingest system and adjacent systems at NRK.

Please also revisit the relevant paragraphs in section 5.1 to fully understand NRKs need regarding integrations.

8.1.API

NRK has a strong developer community, and being able to create new workflows, automate operations and adjust integrations between in-house built software and third-party systems is an important principle for NRK.

We value well-defined, documented APIs with a hight degree of functionality coverage, and has come to expect this as an essential part of any new system or software delivery.

#	Requirement description
1	The system must provide access to all vital functionality in the business layer like record scheduling and media handling through a public API.
2	The APIs must be thoroughly documented.
3	The data model in use by the API should be documented and include formal schema definitions.
4	Usage of the API must be covered by the support level agreements.
5	The API and documentation must be kept up to date when new features are added to the system so that requirements #2 and #3 are always fulfilled.
6	If the API is exposed through one or more HTTP REST-like endpoints, they should use proper HTTP methods and response codes (i.e. errors should be in the 400-500 range etc).

#	Requirement description
7	Access to the API should at a minimum be controlled by the same authorization and authentication mechanisms (built-in/LDAP/Azure AD etc) as present in the user interface.
8	The API authentication should offer single sign on through Azure AD supported authentication protocols.
9	The API should allow external systems to subscribe to events affecting assets in the system (like creation, modification, etc) through persistent callbacks, message queues or other event systems. I.e. messages should be guaranteed to be delivered at least once on a persistent level.
10	The system-provided user interfaces should rely on publicly exposed and documented APIs
11	Responsiveness of the API should not be linked to the responsiveness or availability of the ingest/workflow/playout-capabilities; it should not be possible to affect the stability of ingest or playout due to excessive use of the API by an ill-behaving client.
12	The Ingest system must provide a northbound API, preferably using modern REST-like interfaces.
13	Please describe which standards are in use by the API for date, time and duration, i.e. ISO8601.
14	Please provide API documentation if it is publicly available.

8.2. INTEGRATIONS

Where there are well known and/or well-defined protocols and transports with little technical, business- or data-modelling ambiguity (like router-control), NRK prefers and expects the offered automation system to include proper integrations to the external system in question (integration type A below).

However, NRK has a strong developer community, and especially in areas where NRK has very bespoke needs or expects frequent changing business or user requirements, there is a policy of (co)developing and owning these integration-services or -modules in-house rather than asking the involved vendors to deliver a bespoke integration on their own. This is based on prior experience where the most complicated and difficult part of many integrations are not the technical implementation or development, but the business and data model impedance and the need to be able to adjust and adapt the mapping and logic over time (integration type B/C below).

If an integration is missing or inadequate, NRK would prefer that work and effort is put into providing proper, public APIs and/or SDKs or stand-alone modules over writing a black-box integration as an internal part of the provided system/software.

In Appendix 7, the Contractor shall price the integration or facilitation of integration with the listed systems/applications in this chapter by means of at least one of

A. An existing, already working and documented integration that covers the required integration.
   If only minor adaptations or adjustments are needed this may still be a viable option.

B. Existing APIs/SDKs.
   Well documented interfaces, module SDKs, extension-points and/or event-based integrations that enable NRK to do the integration described.

C. New APIs/SDKs developed to facilitate the requirements.
   In the case that an integration is not currently supported, or the supported integration deviates in vital areas from what is requested, please provide price estimates for enabling the integration in question through creation of public APIs as described in section 8.2. NRK emphasizes that the estimate must be a starting point for further detailing together with the Customer in the specification stage of the project. Please see the requirements below for expected details in the descriptions.

The following sections describe the adjacent systems / applications at NRK with which the new ingest system must interact.

The Contractor shall as attachment to Appendix 2 include the descriptions of their available APIs.

Please summarize in the table below how the Contractor will propose the needed integrations:

#	Integration	Integration proposed: A, B or C
1	Media Asset Management (MAM)	
2	Broadcast Control System (BCS)	
3	Enterprise Resource Management system	
4	Platform Monitoring and Control System (PMCS)	
5	Security Incident and Event Management system (SIEM)	
6	Configuration Deployment Pipeline (CDP)	
7	NAS Storage	
8	AVoIP Device Integration Standards	

8.2.1. MEDIA ASSET MANAGEMENT (MAM)

The involvement of the in-house development teams will especially be important for the MAM-integration. The MAM-installation is a part of a larger file-based production platform developed by NRK ("The Program Bank"), with a host of integrations with both third-party software and services, and NRK-developed systems and applications.

The Program Bank APIs may provide endpoints and events for:

- Querying technical metadata (formats, codecs, preview urls ++)
- Querying availability of media
- Querying media status (placeholder)
- Media conversion/transcoding
- By further agreement, other requests the ingest system needs to fulfill its media flows

Finalizing the specs for the needed operations and APIs will be done in collaboration with NRK-developers, including a possible small integration-service owning the interfacing between the Program Bank and the ingest system.

#	Requirement description
1	Please describe what type of hooks, callbacks, events and APIs are available to handle automatic query, fetch or push of media files and technical metadata from the Ingest system to the MAM system.

8.2.2. BROADCAST CONTROL SYSTEM (BCS)

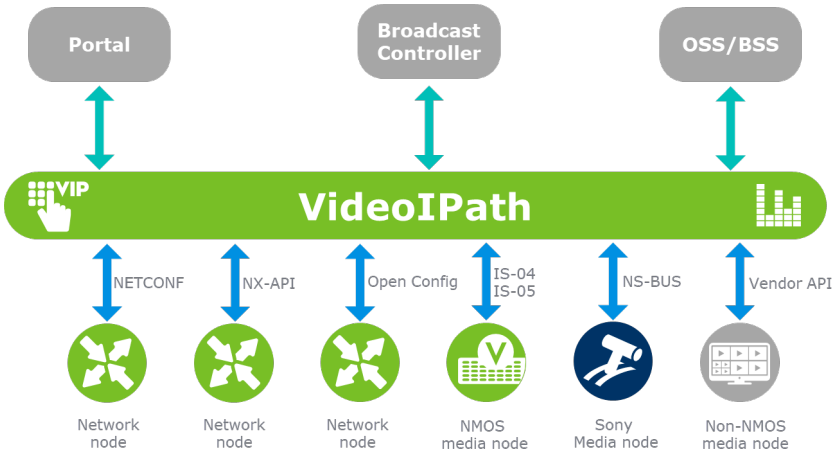
NRK has chosen Nevion Video iPath to provide broadcast control system functionality. The expectation is that all contractors will implement some level of integration with this critical platform component. This section details two different approaches to integration with the BCS and the chosen resource management system, VimBiz from VimSoft (cf. 8.2.3).

Integration of 3rd party Controllers and Devices

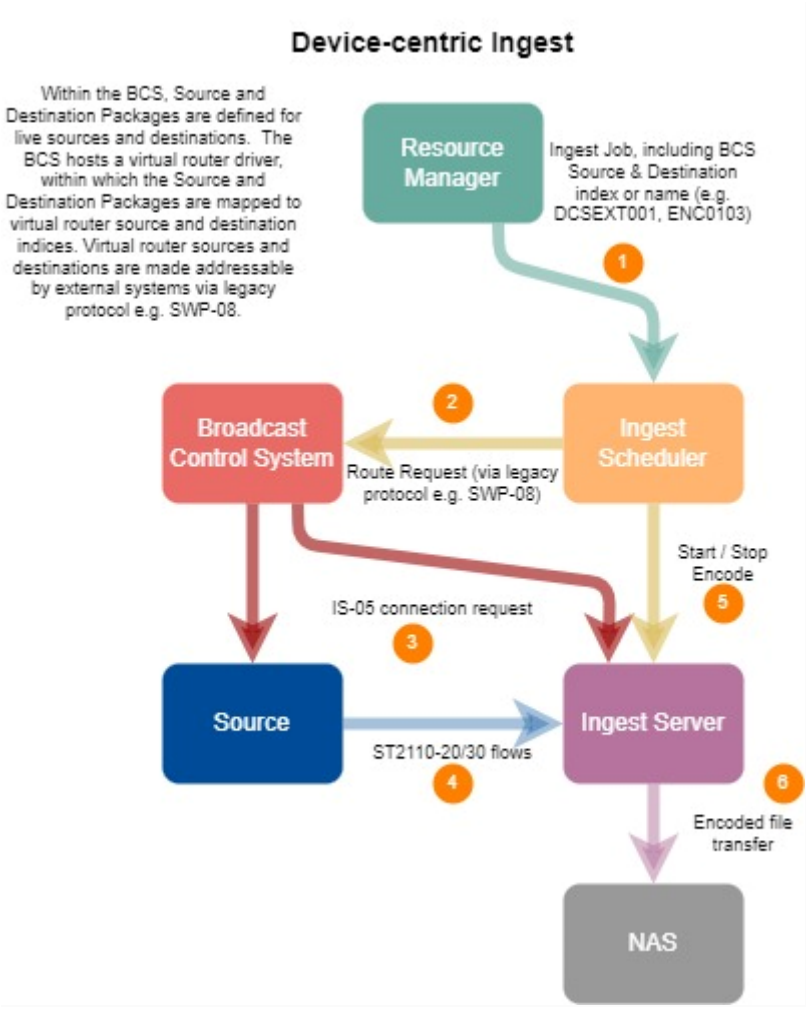
VideoIPath is designed as an open product that can interface with any external system. This is facilitated using an industry standard REST interface that exposes all data within the system and allows external systems to access the functionality and to modify the data provided by the system. The REST interface is already used for integration with a range of existing 3rd party systems. Full API documentation is available under NDA with Nevion.

VideoIPath also supports the following traditional routing protocols when being controlled by and 3rd party system: Nevion MRP, Sony NS-bus, Probel SW-P-08, Lawo Ember+, Imagine LRC and Evertz Quartz.

The figure below illustrates how the orchestrator typically interfaces with other systems and devices.



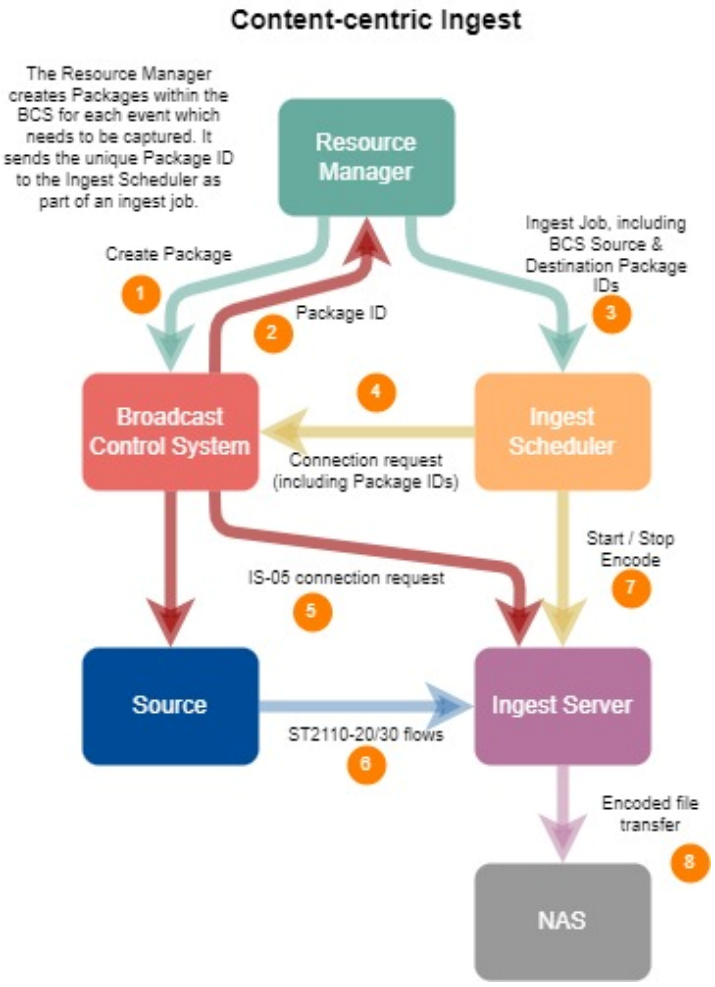
NRK hasn't finalized the resource management and routing model for MPP and invites the suppliers to discuss the following approaches.



Device-centric ingest

In the above diagram, the BCS defines Source and Destination Packages for live sources and destinations. The BCS hosts a virtual router driver, within which the Source and Destination Packages are mapped to virtual router source and destination indices. Virtual router sources

and destinations are made addressable by external NMOS systems such as an Ingest Scheduler via legacy protocol e.g. SW-P-08. The BCS would then create routes from source to destination and the Ingest Scheduler instructs the Ingest Server to record the 2110 flows, encoding and writing the files to NAS storage.



Content-centric ingest

The Resource Manager creates Packages within the BCS for each event which needs to be captured. It sends the unique Package ID to the Ingest Scheduler as part of an ingest job. The Ingest Scheduler makes a call (including the package IDs) to the BCS to create the route from the source to the destination. The ingest Server starts and stops the recording based on the job information.

#	Requirement
1	With reference to the diagram above, please describe the way in which the Contractor would implement an integration with the Nevion BCS / VimBiz resource management system in a 'Device-centric' model.
2	With reference to the diagrams above, please describe the way in which the Contractor would implement an integration with the Nevion BCS / VimBiz resource management system in a 'Content-centric' model.
3	With reference to the diagrams above, please describe the way in which the Contractor would implement an integration with the Nevion BCS in the absence of any resource management system.
4	The ingest system must provide a Southbound API to a BCS system to make routes.
5	The ingest system must support NMOS IS-05 to enable the BCS to make connection requests.
6	The ingest system provider should be willing to implement a driver to integrate with NRK's chosen BCS system to make routes.
7	It should be possible to change a source while recording. This might be necessary if there's a fault with a source.

8.2.3. ENTERPRISE RESOURCE MANAGEMENT SYSTEM

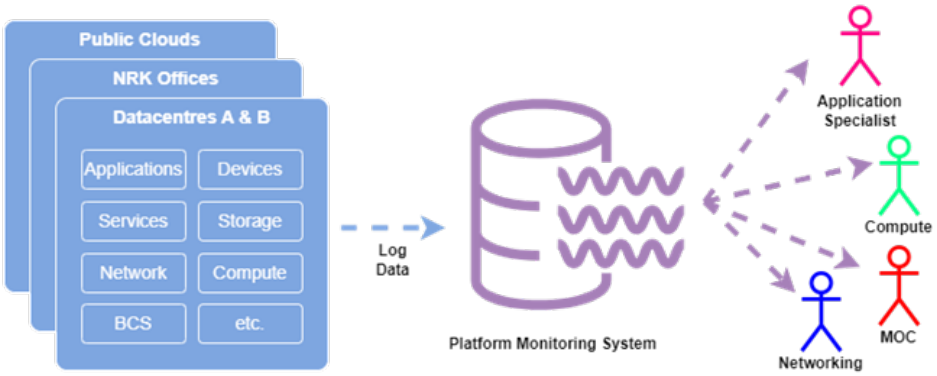
NRK anticipates the use of an enterprise resource management system for, in the ingest system context, management of scheduled recordings. NRK currently uses VimBiz by Vimsoft for resource management, and it may be used for this purpose in the future. The ingest system would take booking information from the resource management system in order to trigger recordings through automation.

For more information about the different approaches to integration, please revisit 8.2.2 “Broadcast Control System (BCS)”.

#	Requirement
1	Please describe the way in which the proposed ingest system may integrate with an enterprise resource management system
2	Please describe any existing integrations the Contractor has with enterprise resource management system products

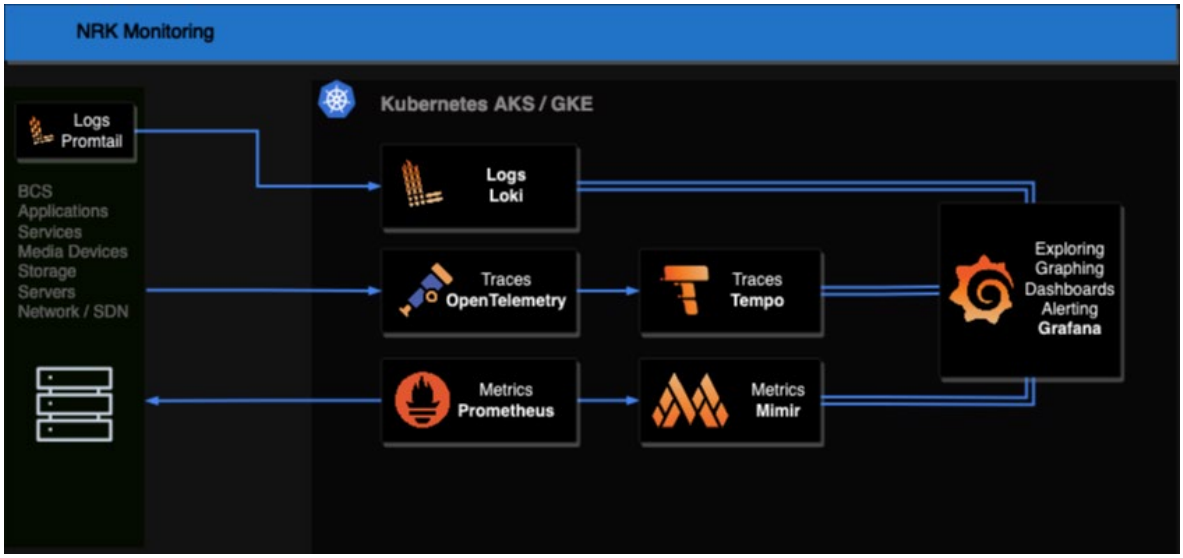
8.2.4. PLATFORM MONITORING AND CONTROL SYSTEM (PMCS)

PMCS will collect log and event data from applications, services, networks, and devices within the modernised production platform. Aggregated log data will be reported on in a variety of ways to provide relevant insights to different user communities.



PMCS tools currently in NRK include, but not limited to:

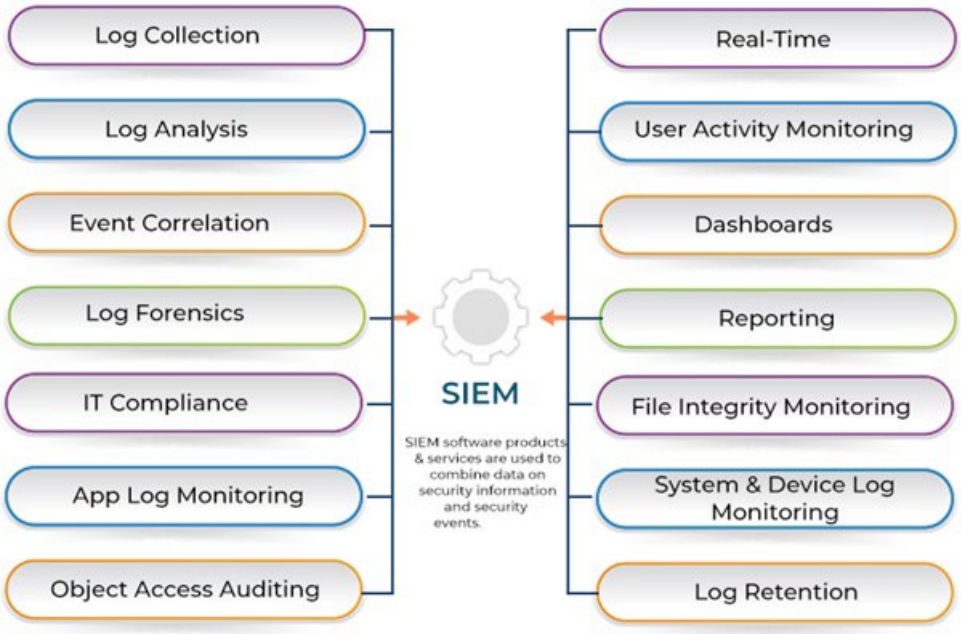
- Log collector (Promtail, Grafana Agent, Systemd, etc.)
- Log store (Loki)
- Time-series events (Prometheus, Mimir)
- Alerting system (Grafana, Icinga, OnCall, VictorOps)
- Data analysis & reporting tool (Grafana)



#	Requirement
1	The ingest system should provide reporting on physical system health, e.g. power supply, fans, etc
2	The ingest system should provide reporting on physical network connectivity
3	The ingest system should provide reporting on PTP status
4	The ingest system should provide flow subscription status
5	The ingest system should provide operation system reporting
6	The ingest system should provide Application layer reporting e.g. recording status
7	The ingest system should provide network data, e.g. packet counts and loss for 2110 NICs
8	For all of the above, please provide a full list of what parameters are reported and how this information is returned to the monitoring platform
9	Please list any other reporting tools provided by the ingest platform

8.2.5. SECURITY INCIDENT AND EVENT MANAGEMENT SYSTEM (SIEM)

SIEM software products and services are used to combine, analyze and report on data on security information and event. NRK is currently using Azure Sentinel.



#	Requirement
1	The ingest system should be able to send security logs to a remote SIEM (Security Incident and Event Management) system

8.2.6. CONFIGURATION DEPLOYMENT PIPELINE (CDP)

The MPP platform is an IT platform for media production. It will be operated based on DevOps practices. Configuration will be managed within a Git repository and CI/CD tools such as GitHub Actions and Ansible will be used to automate the process of deploying devices and configuration. Please revisit 7.4 “Configuration” for more details.

#	Requirement
1	The ingest system should be highly configurable via a programmatic API.
2	Please describe what is configurable programmatically and what is not and describe what is configurable as a service and what is not.
3	Please describe how configuration changes are made to your system and what the service impact is.

8.2.7. NAS STORAGE

NRK will have a Dell PowerScale Isilon NAS installation in each datacentre. The ingest system will concurrently write growing files to both NAS systems.

#	Requirement
1	The solution must be able to transfer growing mezzanine, proxy and thumbnail files to a NAS volume.
2	The solution must be able to concurrently transfer growing mezzanine, proxy and thumbnail files to two NAS volumes (one in each datacentre).
3	The solution must support the SMB3 protocol to integrate with the NAS. Please state which version(s) of the SMB and other protocols are supported.
4	Please describe the mechanisms and protocols the proposed solution would use for writing growing files to NAS storage volumes. This should include how fault conditions are handled (e.g. failed transfer to one volume).
5	Please describe any storage latency requirements for the proposed solution.

8.2.8. AVOIP DEVICE INTEGRATION STANDARDS

The AMWA NMOS suite of standards is an integral part of the MPP architecture. For example, Node/Device support of NMOS IS-04, which allows control and monitoring applications to find the resources on a network, is required by both the BCS and Configuration Management systems.

#	Requirement
1	The ingest system must comply with the standards described in Attachment 1 NRK Device ST2110 ST2059 NMOS Conformance.

9. CLIMATE AND ENVIRONMENTAL REQUIREMENTS

The Customer's ambition is to reduce its footprint in all internal and external production in line with the Paris Agreement's climate goals. Thus, NRK need to incorporate climate and environmental considerations when purchasing new IT equipment.

For this project, NRK has determined four important activities which individually and in total have a positive environmental impact through a reduced carbon footprint.

1. Pooling resources which are currently distributed across Norway to increase overall utilization.
2. Reducing duplication of ingest jobs.
3. Upgrading old hardware for modern, more energy efficient and compact systems.
4. Placing the servers in energy efficient colocation datacentres.

When referring to sections in requirements 4-11, please see III-a-NRK-2024-295_Ingest_Solution_SSA-T_App 01-3-Attachment 3_2024 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency

The Customer’s preferences associated with environmental requirements related to this procurement are listed below. The Contractor is encouraged to provide detailed descriptions of how the preferences are met, preferably supported by supplementary documentation from sub-contractors or third parties, including independent certification authorities.

#	Requirement
	Long expected lifetime
1	The products must have long expected lifetime in order to reduce the need for replacement and avoid creating waste. E.g. how the product has been tested for durability. Please state the projected product life.
2	After the warranty on the equipment has expired, NRK should be able to receive components and documentation for all equipment in order to repair it themselves. Please detail your spares policy.
	Energy efficiency
3	The equipment should meet energy efficiency standards to minimize power consumption during operation. Please attach relevant energy performance certificates.
4	Please describe the Energy efficiency performance of the proposed ingest solution. (see section 4.1.1 for further information)
5	Equipment should be purchased that allows for operation within ASHRAE Class A2. If no equipment can be procured which meets the operating temperature and humidity range of Practice 4.1.3 (ASHRAE Class A2), then equipment supporting ASHRAE Class A1 at a minimum may be procured. (see section 4.1.2 for further information).
6	Equipment provided by the Contractor should be able to operate and be within warranty for the full ASHRAE Class A2 allowable temperature and humidity range. (see section 4.1.3 for further information).

#	Requirement
7	The Contractor should supply at minimum the total system power for a range of temperatures covering the full allowable inlet temperature range for the equipment at 100% load on a specified recognised benchmark such as Linpack. (see section 4.1.6 for further information).
8	The Contractor should provision power and cooling only to the planned power draw of the IT equipment as configured (based on the components actually installed), rather than the Power Supply Unit (PSU) size or nameplate rating (see section 4.1.9 for further information)
9	The Contractor should comply with the EU Eco Design Directive and Lot 9 amendments to EU Commission regulation for servers and online storage systems (see section 4.1.10 for further information).
10	The Contractor should offer equipment with power and inlet temperature reporting capabilities, preferably reporting energy used as a counter in addition to power as a gauge. Where applicable, industry standard reporting approaches should be used such as IPMI, DMTF Redfish and SMASH (see section 4.1.11 for further information).
11	The Contractor should offer equipment containing high efficiency AC/DC power converters. These should be rated at 90% power efficiency or better across the range of loads expected for the equipment to be installed (see section 4.1.15 for further information).
Delivery and disposal of equipment	
12	The manufacturer should have a take-back program for old equipment promoting responsible disposal and recycling. The equipment should be designed for easy disassembly, recycling, and proper disposal at the end of its lifecycle. Manufacturers should have clear guidelines for handling electronic waste (e-waste).
13	Packaging materials: the equipment should have minimal packaging, recyclable materials, and reduced plastic content.
14	Transporting and logistics should be environmentally friendly.
15	Describe how the manufacturer works systematically to minimize the environmental impact of its solutions.

10. BILL OF MATERIALS - PROPOSED SW AND HW

The Contractor shall in Appendix 2 provide an overview of the hardware and software included in the provided solution.

10.1. SOFTWARE

The Contractor shall in Appendix 2 provide an *overview* of the software included (as well as standard software and/or open-source software) in the provided solution, including which license terms apply for such components, cf. section 12.5.3. The actual terms shall be presented in Appendix 10.

Please address which part of the scope (cf. section 3.1) the software is supporting.

10.2. HARDWARE

The Contractor shall in Appendix 2 provide an *overview* of the hardware included in the provided solution, including which license terms apply for such components.

Please address which part of the scope (cf. section 3.1) the hardware is supporting.

11. INFORMATION SECURITY AND PERSONAL DATA PROTECTION (CF. CLAUSES 9.2 AND 9.3)

11.1. SECURITY

High public trust is essential for NRK, and safeguarding content production and delivery is vital. Therefore, NRK should always follow security best practices. Going forward, NRK expects Contractors to adhere to security best practice, such as EBU Cybersecurity Recommendations for Media Vendors' Systems, Software and Systems (EBU R 143).

The Ingest system is a critical production component and must employ adequate protection and security measures. **The Contractor shall review, complete, and comply with NRK's Supplier Security Requirements as specified in Attachment 2.**

#	Requirement
1	The Ingest system should support single sign on using oauth2/openid and/or SAML.
2	The Ingest system can use either Active Directory or Azure Active Directory for users and groups. If the Ingest system has its own internal user and group database, the Ingest system should support provisioning users and groups using SCIM.
3	The Ingest system should support role-based access control.
4	Communication between the users and the Ingest system should be encrypted using TLS1.3 or higher.
5	Security logs from the Ingest system should include the following information: Log in information Audit logs for changes done by users Audit logs for changes done by administrators Audit logs for changes done via API User and group synchronization
6	The Ingest system should be able to send security logs to a remote SIEM (Security Incident and Event Management) system. Currently NRK uses Azure Sentinel.
7	The Ingest system should support API access using supplier specific access tokens or OAuth2.
8	The Ingest system should support RBAC for API access.
9	The provider should provide a SBOM for the Ingest system. Please refer to chapter 10.1
10	The provider has a Responsible Disclosure Policy.
11	The provider should have security.txt implemented to allow security researchers to easily report security vulnerabilities.
12	The provider should have a defined patch strategy with specific time frames for when patches are provided, differentiated by severity levels of the security issue.
13	Any passwords used by service users or for accessing administrative interfaces should be editable by the customer. There should be no usage of default passwords.
14	The ingest system must support multifactor authentication using an authenticator app and/or smart card or FIDO security key

11.2. PERSONAL DATA PROTECTION

Any personal data shall be processed according to the current legislation in the Norwegian Personal Data Act. The Norwegian Personal Data Act is aligned with the EU's "General Data Protection Regulation" (GDPR).

Compliance with applicable privacy regulations
The supplier (including the supplier's subcontractors, hereunder cloud service providers (if relevant)) shall only process personal data in accordance with the Personal Data Act and the EU General Data Protection (GDPR). Describe how the requirement is met.

Requirements for a data processing agreement
A data processing agreement must be entered into between the Supplier and NRK in accordance with GDPR article 28, which regulates the Supplier's processing of personal data on behalf of NRK. If NRK is to enter into a data processing agreement with the cloud service provider, this must also be in accordance with GDPR article 28.

Description of role and responsibility
The supplier is asked to explain whether the supplier (including supplier subcontractors, hereunder cloud service providers) considers itself to be the data controller for certain processing activities related to what is covered by the Agreement. If so, explain which processing activities this applies to and what is the legal basis for the processing.

#	Requirement description
1	The Contractor shall explain how their obligations under Clause 9.2 on ensuring the confidentiality and integrity of the Customer's data, are handled.
2	The Contractor shall describe how satisfactory processing, including information system and security measures in line with the personal data protection regulations will be achieved and performed.
3	The supplier is asked to fill in the attached checklist with comments so that NRK can assess if a data processing agreement is required, and consequently ensure that the correct data processing agreement is applied.

12. OTHER REQUIREMENTS

12.1. PROJECT IMPLEMENTATION METHODOLOGY (CF. CLAUSE 2.3.3)

The Contractor shall describe the proposed method and approach for the project including how the method facilitates user involvement.

12.2. DOCUMENTATION (CF. CLAUSE 2.3.6)

The Ingest system including customisations and configurations must be documented so that the Customer has the necessary and correct documentation available in all areas of the Ingest system. The documentation shall facilitate effective use, training, further development, and service of the Solution. The Ingest system shall be provided at least with the following documentation:

12.2.1. DETAILED SPECIFICATION - DESIGN DOCUMENTATION

If relevant, the Ingest system is provided with a detailed specification document that is developed during the specification phase. This design document is a description of how the processes and requirements are to be fulfilled in the new solution. The document describes how to solve the desired functionality and the guide to those who will configure and complete the solution for NRK's use.

The Contractor shall state as part of the Appendix 4 relevant activities needed that will be documented as part of a specification document.

12.2.2. TRAINING MATERIAL

The Contractor will provide training material. The training material must be adapted to the individual user group and must be written in Norwegian or English.

12.2.3. USER DOCUMENTATION

The Ingest system is provided with NRK-specific user documentation that is:

- Provided in a common electronic format.
- Adapted to different user groups, including advanced users, such as superuser, system managers, and end-users.

12.2.4. DOCUMENTATION OF INTEGRATIONS

The Ingest system is provided with technical documentation in English describing public API, integrations, and APIs specific to NRK (interfaces, methods, etc.).

12.2.5. FUNCTIONAL SYSTEM DOCUMENTATION

The Ingest system is provided with functional documentation in English describing configurations and setup, including functional design for any customizations.

12.2.6. TECHNICAL SYSTEM DOCUMENTATION

The Ingest system comes with a technical system documentation in English, describing logical service and information architecture, security, and access architecture (ADFS, etc.), provisioning and orchestration functionality and procedures.

12.2.7. INSTALLATION AND MAINTENANCE DOCUMENTATION

The Ingest system comes with installation and maintenance documentation in English. This requirement applies only to on-premises-solutions.

12.3. TRAINING (CF. CLAUSE 2.3.7)

12.3.1. TRAINING METHOD

The Contractor shall plan and develop a training program, including training material, and train NRK in the use of the Ingest system. The training shall ensure that NRK can perform qualified testing of the Ingest system and start using the Ingest system properly and efficiently.

All user groups shall receive training. The training shall be designed appropriately for each specific user group. Training methods shall be described.

12.3.2. DESCRIPTION OF TRAINING COURSES

Training material shall as a minimum be in English or Norwegian and have use cases that are relevant for the different user groups.

The Contractor shall describe how the training will be for the different target groups. The description shall at minimum include the following:

a) Objective of the training
b) Training content
c) Expected benefits from completing the training

d) Training style
e) Duration

12.4. OPTIONS

The Contractor is kindly requested to describe the possible delivery of the options listed below in Appendix 2. Predictable pricing methods and principles to be stated in Appendix 7. NRK reserves the right to increase capacity and improve scale by using other sources and agreements. E.g. acquiring compatible hardware from other sources or using cloud providers which NRK already has agreements with.

After deployment, the solution must be able to scale-out in response to future needs. Currently we do not expect the system to scale-out more than 76 x video inputs per datacentre.

NRK envisions that the ingest solutions scale and capacity may be increased dynamically and seamlessly.

A. Event-based capacity increase

Events such as e.g. broadcasting the Olympic Games may require increased capacity of ingest inputs and video formats, e.g. UHD for a limited period. NRK envisions that this could be achieved, but not limited to, in the following ways:

- Renting or leasing equipment from the Contractor to be installed in NRKs existing data centers.
- Utilizing public or private cloud services for temporarily capacity increase.

B. Permanent scale-out

To cover future ingest requirements, permanent scale-out of the solution may be required. NRK envisions that this could be achieved, but not limited to, in the following ways:

- Procuring equipment from the Contractor to be permanently installed in NRKs existing data centers.
- Gradually utilizing public or private cloud services for permanently capacity increase.

C. Possible future extensions

With reference to functional items not included in the initial scope, cf. section 3.1 above, NRK request the Contractor to describe which kind of functional support that may be offered to support those possible options. Prices and pricing principles to be stated in Appendix 7.

12.5. RIGHT OF OWNERSHIP AND RIGHT OF DISPOSAL (CLAUSE 10.5.2 AND 10.2.2)

The Ingest system is an essential component in the Customers broadcast production platform, and the Customer foresees a long-term partnership with the Contractor for the service.

However, the broadcast industry may be subject to future changes; bankruptcy and merges may occur, the Supplier or its subcontractor may discontinue their solution/service etc, affecting the Supplier to deliver according to this Agreement.

Depending on which part in the delivery chain that may be affected, measures may imply inter alia.

- Access to the source code of the ingest solution, hereunder any code specifically developed by the Contractor for NRK.
- Access to expertise for the ingest solution is offered for a sufficient period of time, including overview of other companies with necessary competence of the solution offered.
- A fulfilment of the obligations in the contract with an alternative ingest system.

- Parent or solidary guarantee for continued services/deliveries.

In those circumstances where the Customer is entitled to have such arrangements put in place, the Party that obtain access to the source code shall have an expanded right of disposal that covers the right to use, copy, modify and develop the solution itself, or with the aid of a third party, to the extent necessary to achieve the purpose of the procurement. The measures must last until NRK has obtained a new service. Thus, the Supplier is required to suggest and describe in a binding manner in Appendix 2 appropriate measures that satisfactorily secures the Customer's interests according to which the Customer shall be notified if events described in the General Contract Terms clause 10.2.2 may occur. Any related third-party terms should be described, and prices be included in Appendix 7.

NRK Device ST 2110, ST 2059 and NMOS Conformance

[20xx-20xx]

601 Platform Standards

1. Contents

2. Version Control

Rev.	Date	Detail	Author(s)
3.0	17/06/22	First draft release of document for review Alignment with architectural model and AVoIP live media production formats.	GH
3.1	27/06/22	Updates from NRK review: Stig Krokstad, Henning Bernsten, Thomas Berglund, Odd Erling Høgberg, Erik Vold, Dag Gulbrandsen. 1. Added NMOS IS-07 and 09 to optional standards support table. 2. Added mandatory RTP Offset = 0 parameter to ensure AES67 / ST 2110 compatibity. 3. Added requirement for 64 channel flow for certain categories of audio devices.	GH
3.2	17/08/2022	NMOS IS-07, 08 and 10 made mandatory in Section 5 standards tables. Updated link to TR-1001-1. Section 7. Update to IS-04 heartbeat support parameter support. Added section 11. Security, requiring demonstration of robust cyber security practices per EBU r143. Updated diagram in Section 4.	GH
3.3	02/09/2022	Section 9. Point 13 - Added requirement. «It shall be possible for a Receiver to subscribe to a multicast group that originates on the same interface (i.e. loopback).» Section 9. Point 8 – Minor adjustment to expected device behaviour.	GH
3.4	10/10/2023	Introduced NMOS IS-11, 12, 13, IS-06, IS-08, IS-11, IS-12 Updated wording NMOS resource labelling wording Made some adjustments to audio requirements relating to the carriage of uncompressed and compressed audio within the same flow.	GH
3.5	12/04/2024	Minor updates to mandatory requirements	GH

3. Introduction

To support the transition to AVoIP production, our industry has created many new standards and built on many existing ones.

To build supportable, interoperable IP production platforms, it is critical that vendors implement these standards in a consistent way. Furthermore, it is necessary that vendors support the specific configuration options within those standards necessary for successful deployment within NRK's AVoIP infrastructure.

This document details the NRK's conformance requirements for AVoIP devices supporting ST 2110, ST 2059 and AMWA NMOS standards.

Broadly, endpoints shall adhere to the requirements detailed in EBU Tech 3371 (https://tech.ebu.ch/docs/tech/tech3371.pdf), AMWA NMOS JT-NM_TR-1001 (https://www.jt-nm.org/tr-1001-1) and AMWA NMOS BCP-003 (https://amwa-tv.github.io/nmos/). Additionally, endpoints shall adhere to the requirements detailed in this document.

When reviewing the documentation, vendors are requested to state their product compliance by marking the feature "comply" and where more detail is required, describe the current product capability. Where a feature is not currently available within a product, vendors shall state their current capability and when the required feature will become available. Where a feature is not relevant to a product, vendors should simply mark it "not applicable". Where a feature will be implemented vendors should mark it "roadmap [delivery date]". Where a vendor has no plans to implement a requested feature, it should be marked "does not comply".

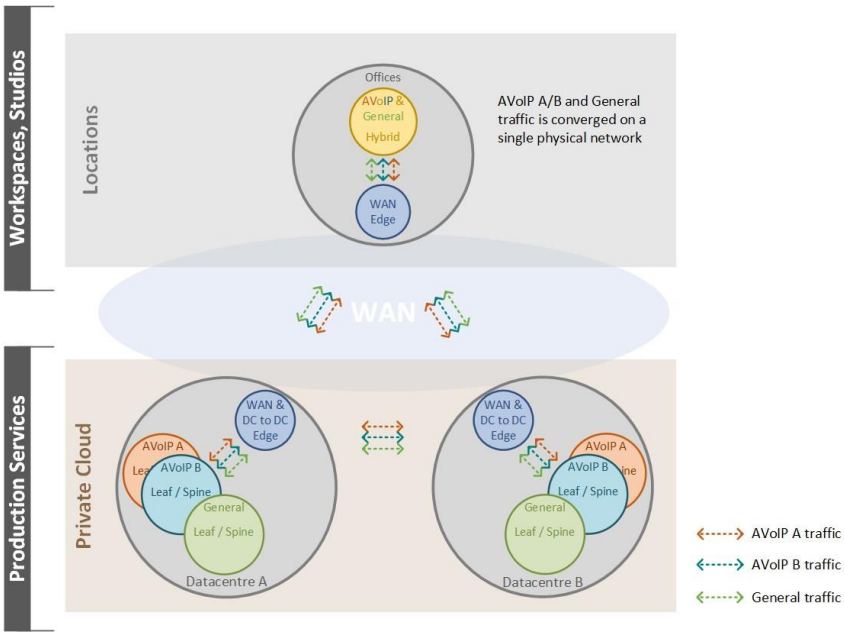
4. Platform Configuration Overview

NRK's production platform shall be built around two datacentres.

Within each datacentre is all the backend processing equipment required to support operational workspaces (e.g. edit suites, PCRs, MCRs, Tx suites etc) located in different regional offices in Norway.

Regions and datacentres are all connected via a nationwide, high-bandwidth WAN. Additionally, datacentres are directly connected via resilient and diverse high-bandwidth network connections.

Within a datacentre, two independent leaf/spine networks (Fabric A and Fabric B) provide the audio/video switching fabric. A third leaf/spine network provides control and monitoring connectivity. Devices supporting ST 2110 are connected to both A and B networks. Resilient, GPS locked PTP GMs provide ST 2059 profile PTP to network fabrics. Each leaf will be configured as a Boundary Clock (BC). BC's shall select the best clock to lock to. Endpoints shall lock to the local BC.



Within a region, control and AVoIP traffic is converged on a single network. The network is virtualised and dedicated AVoIP uplinks between switches create A and B networks and carry ST 2110 traffic. Resilient, GPS locked PTP GMs provide ST 2059 profile PTP to network fabrics. Each leaf will be configured as a Boundary Clock (BC). BC's shall select the best clock to lock to. Endpoints shall lock to the local BC.

Devices deployed across the platform are required to be interoperable across the WAN and between datacentres. The instantaneous path differential (PD) timing for resilient ST 2022-7

flows between the datacentres shall be less than 10ms. Between a datacentre and region, instantaneous path differential timing for resilient ST 2022-7 flows shall be less than 10ms. Receivers shall be 2022-7 Class B compliant and be able to tolerate an instantaneous PD of up to 50ms.

Network flows within the DCs and Offices are orchestrated by SDN controllers. No other SDN controllers are permitted within the platform.

All endpoints shall support IS-04 for registration/discovery and IS-05 for direct device control. Each datacentre and office shall have a separate IS-04 registry.

5. Standards

Devices shall support the following standards, where applicable:

#	Standard	Title
1	SMPTE ST 2059	SMPTE Profile IEEE-1588 PTP
2	SMPTE ST 2110-10	System Timing and Definitions
3	SMPTE ST 2110-20	Uncompressed Active Video
4	SMPTE ST 2110-21	Traffic Shaping Uncompressed Video
5	SMPTE ST 2110-22	Constant Bit-Rate Compressed Video
6	SMPTE ST 2110-30	PCM Digital Audio
7	SMPTE ST 2110-31	AES3 Transparent Transport
8	SMPTE ST 2110-40	SMPTE ST 291-1 Ancillary Data
9	SMPTE ST 2022-7	Seamless Protection Switching
10	AMWA NMOS IS-04 v1.3.x	Discovery and Registration
11	AMWA NMOS IS-05 v1.1.x	Device Connection Management
12	AMWA NMOS IS-07 v1.0.x	Event & Tally
13	AMWA NMOS IS-10 v1.0.x	Authorization
14	AMWA NMOS BCP-003	Security recommendations for NMOS APIs
15	IEEE 1588v2	Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
16	IEEE 802.1AB	Specifically, the Link Layer Discovery Protocol (LLDP)
17	AES67	High-performance streaming audio-over-IP interoperability
18	IETF RFC 3376	IGMPv3/SSM
19	ISO/IEC 21122	JPEG XS low-latency lightweight image coding system
20	AES-r16-2016	PTP parameters for AES67 and SMPTE ST 2059-2 interoperability
21	VSF TR-08	Transport of JPEG XS Video in ST 2110-22

Table 1. Mandatory standards support

Devices should support the following standards:

#	Standard	Title
1	AMWA NMOS IS-08 v1.0.x	Audio Channel Mapping
2	AMWA NMOS IS-09 v1.0.x	System Parameters
3	AMWA NMOS IS-11	Stream Compatibility Management
4	AMWA NMOS IS-12	Device Control
5	AMWA NMOS IS-13	Annotation
6	SMPTE ST 2110-41	Fast Metadata [when it is released]

Table 2. Desirable standards support

6. Exceptions to EBU Tech 3371: Minimum User Requirements to Build and Manage an IP-Based Media Facility Using Open Standards and Specifications

Devices shall adhere with the requirements detailed in the latest version of EBU Tech 3371, with the following exceptions:

- I.1.1 Single link video: SMPTE ST 2110-20

  *"For simplicity of operation, troubleshooting and optimally dense use of the network, video Media **shall** use single link streams (i.e. Media Nodes should not use SMPTE ST 2110-23). For instance, a single 59.94 Hz UHD stream requires a 25 Gigabit Ethernet (GbE) port and a high-density device (such as a multiviewer or a vision mixer) **shall** take benefit of bi-directional 100 GbE."*

  Please note alterations to text above.

- I.3.1 Universal, multichannel, low latency audio: SMPTE ST 2110-30 Level B

  "In addition to SMPTE ST 2110-30 Level A, which is compatible with all AES67 and 2110-30 devices, audio Senders and Receivers shall support Level-C to support low latency applications and future multi-channel audio applications;"

  Please note alterations to text above.

- I.4.2 Stream protection with SMPTE ST 2022-7:2018

  "Receivers shall support SMPTE ST 2022-7:2018 Class D with Ultra Low-Skew 150 µs that is adapted to engineered LAN with adding minimal latency"

  Requirement does not apply.

- II.2.1 & II.2.2 PTPv2 configurable within SMPTE and AES profiles

  "PTP parameters of Media Nodes shall be configurable within the union of the ranges covered by the both SMPTE ST 2059-2 profile, the AES67 media profile and the IEEE-1588 default profile so that we can use the Media Nodes for the full range of possible operational scenarios;"
  "However, it is recommended to the users to select an operational point within the range of AES-r16-2016 so that it is compatible with equipment previously delivered on the market that might be limited to one of the two profiles;"

  Please ignore. PTP GMs shall be configured with SMPTE ST 2059-2:2021 default parameters. Importantly, in this release of the standard, portDS.logAnnounceInterval

has been change from -2 to 0, reducing the frequency of Announce message which enables a common PTP domain for AES67 and ST 2110 devices.

7. Exceptions to JTNM TR-1001-1:2020 System Environment and Device Behaviours for SMPTE ST 2110 Media Nodes in Engineered Networks

Devices shall adhere with the requirements detailed in the latest version of JTNM TR-1001-1:2020, with the following exceptions:

- 10.2.6 NMOS System Parameters (IS-09)

  *" Media Nodes ~~shall~~ **should** use the registry heartbeat_interval value specified in the System API defined in AMWA IS-09 when maintaining their registration."*

  Please note alterations to text above.

- 10.3 Multicast Media Streams

  *"Media Nodes ~~should~~ **shall** provide a user mechanism for selecting the DSCP markings of the generated streams."*

  Please note alterations to text above.

- 11.2 Media Node Startup and Multicast Addresses

  "The System API defined in IS-09 includes a System ID, which shall be assigned uniquely (e.g. randomly) in each facility. Media Nodes shall store the System ID and their DHCP-assigned address as part of their current operating settings, and shall check at re-start, before generating any multicast outputs, that the current Network Environment's System ID and DHCP-assigned address match the previously stored values. If the current system ID and address are the same as before, then recalling the previous operating settings might be appropriate and safe, subject to the clause below."

  Products should support IS-09.

8. Interoperability

8.1. RTP Payload Values

1. Devices shall support SDP configuration.
2. Receiver endpoints shall autodetect and select RTP payload values from the Sender SDP file.
3. Devices shall support SDP Payload Type values 96 to 127. See Section 6, Table 4 of https://datatracker.ietf.org/doc/html/rfc3551 and Section 6.2 of ST 2110-10.

8.2. Synchronisation, Timing and Latency

1. As defined within ST 2059, all devices shall support IEEE1588-2008. IEEE1588v1 is not supported.
2. Default values within ST 2059-2:2021 shall be used.
3. Devices shall support a hybrid PTP communications model. Sync and Follow_Up (multicast), Delay_Request and Delay Response (Unicast).
4. Devices shall be capable of handling asynchronous baseband video and audio inputs. If alignment cannot be achieved, Audio is to be passed through out of sync and an alarm raised.
5. Devices shall have an optional “minimum latency” mode, whereby baseband outputs are presented without further frame synchronisation.
6. SMPTE ST 2110-10 mandates that the media clock and the network timebase shall share the SMPTE ST 2059-1 epoch, with an offset of zero between the Media Clock and the RTP Clock, as specified in SMPTE ST 2110-10. All audio devices (specifically AES67) shall adhere to this.

8.3. Traffic Shaping

1. Senders shall adhere to ST 2110-21 ‘Narrow’ or ‘Narrow Linear’ definitions.
2. If a Sender complies with the ‘Wide’ definition, vendors must state how ‘Wide’ the Sender is.
   The SMPTE ST 2110-21 ‘Wide’ definition permits a range of performance levels. For example, whilst one Sender implementation may come very close to meeting ‘Narrow’ performance, another may meet the widest definition of ‘Wide’. Senders marginally outside of the Narrow definition may (subject to testing be acceptable).
3. Receivers shall be ST 2110-21 ‘Type A’ compliant i.e. capable of receiving signals from a type N, NL, or W sender, regardless of the value of the sender’s `ts-refclk clksrc` or the sender’s `TROFF` parameter value. Vendors must state any device performance implications resulting from supporting ‘Wide’ flows.

8.4. Receiver WAN Interoperability

1. Some endpoints will be required to receive 2022-7 protected flows which have originated from a Sender located at another site on NRK's WAN. The instantaneous path differential timing between diverse network paths across the WAN may be greater than 10ms. Vendors must state their ST 2022-7:2018 receiver class compliance.

8.5. Audio Devices and Endpoints

1. The NRK audio architecture is based around the exchange of 1-channel, 2-channel, 8-channel and 16-channel, 125us ST 2110-30 flows (Conformance Level: C). Audio Senders and Receivers responsible for processing uncompressed PCM audio shall be capable of processing flows in these formats.
2. Audio devices required to send or receive flows via trunk links shall support up to 64 channels of audio per flow.
3. The NRK audio architecture also supports the exchange of 2-channel 125us ST 2110-31 flows (Conformance Level : C). Audio Senders and Receivers responsible for processing AES3 signal shall be capable of processing flows in this format.
4. An audio Sender which is capable of handling more than 2 channels of audio should be capable of generating multiple 2 channels flows up to the maximum number of channels the device can handle.
5. An audio Receiver which is capable of handling more than 2 channels of audio per flow should be capable of receiving audio as 2110-30 (PCM) or 31 (compressed) within the same flow.
6. Senders should be capable of combining any mixture of uncompressed and compressed audio feeds in the same ST 2110-30 source flow.
7. For a contribution decoder the propagation delay for each Transport Stream through to ST-2110-30 sender shall be consistent, irrespective of whether the audio is PCM or compressed.
8. Receivers capable of receiving multiple 2110-30 multicast groups shall be able to receive groups with different channel counts.
9. Receivers capable of receiving multiple 2110-30 multicast groups should be able to shuffle audio as required. Associated with this, support for AMWA IS-08 should be planned as a roadmap feature.
10. All AES67 / ST2110 audio devices shall support 2022-7 on two physical network interfaces.
11. The device shall guarantee phase coherence to within 0.2 samples between channels in a flow.

9. Device Behaviours

1. Devices shall be capable of locking to PTP on both Fabric A and Fabric B network interfaces.
2. Devices shall compare PTP sources using the Best Master Clock Algorithm (BMCA) defined in IEEE 1588-2008 to compare clocks on Fabric A and Fabric B and lock to the best clock.
3. In normal operation, the clock that an endpoint locks to on each of its network interfaces will be equal. In the event of a tie, the device shall use the BMCA algorithm defined in IEEE 1588-2008 to determine which interface to take time from.
4. Should a device lose lock to the BC it is currently syncing to, it shall transparently failover to the PTP source on its other network interface and be capable of failing back when service is restored. This process must have zero impact on the performance of the endpoint from a user perspective.
5. A device which has lost connectivity to one fabric for a prolonged period (e.g. due to a leaf failure) will receive many routing requests during the outage, which it won't be able to fulfill on the failed link. On recovery of a failed network interface, a device shall re-acquire the current set of multicast groups to which it is subscribed. Historic subscription requests which were requested during the outage, and which have been superseded by newer requests must be discarded. Historic route requests which have not been superseded must be automatically acquired.
6. The possibility exists that a fault may arise which causes an endpoint to lose one flow from a logical group of flows (e.g. the audio, video or ancillary) on one or both network connections.
    a. If the route is still current, an endpoint shall re-acquire the multicasts transparently when the flow(s) are reestablished.
    b. The loss and recovery process shall not affect the stability of the endpoint. E.g. loss of the video flow shall mean that the endpoint shall display optionally black, freeze frame or another still image with the audio and any ancillary data continuing.
    c. Loss of an audio stream shall mute relevant channels, until such time as the flow is restored. Whilst audio will be restored as quickly as possible, this shall not result in loud clicks or pops as the audio is reacquired.
7. The possibility exists that an endpoint may become flooded with multicast traffic. Once the flood is resolved, the endpoint shall remain stable and recover all current multicast groups it should be subscribed to without user intervention.
8. Devices are not permitted to create a 1:1 relationship between a multicast receiver and a device input. NRK may wish to present the audio within a multicast to multiple device inputs simultaneously. It is not possible for a network interface to subscribe to the same multicast more than once. An endpoint which is capable of receiving multiple flows and presenting them to an application shall also be capable of internally routing the same IP input stream to all application inputs. In

such a situation, all receivers shall report the ‘actual’ sender, rather than an any internally replicated source which may be used to work around the limitations of multicast.

9. Endpoints shall reliably exchange SMPTE ST 2110 compliant flows with endpoints from other manufacturers.
10. Devices must not place any restrictions on the multicast group address assignment. e.g. restricting to 239.x.x.x.
11. Devices shall allow the TTL parameter to be user configurable.
12. Devices shall support SSM.
13. It shall be possible for a Receiver to subscribe to a multicast group that originates on the same interface (i.e. loopback).

10. Control

1. Devices shall be directly controllable via an NMOS API, rather than via separate API gateway server.
2. Devices shall support NMOS IS-04 v1.3.x and IS-05 v1.1.x.
3. Devices shall support NMOS IS-07 v1.0.x.
4. Devices shall implement the BCP-002 `GroupHint` tag.
5. Devices shall support BCP-003 to provide secure communications.
6. Where in-band control is supported, devices shall allow NMOS control on both A and B NICs simultaneously. Binding NMOS control to one NIC or the other in not permitted.
7. NMOS UIDs shall not be derived from replaceable device components. For example, replacing a NIC should not result in the generation of new UIDs.

10.1. Device Performance

A logical source may consist of multiple Senders associated with multiple Devices / Nodes (typically a video, multiple audio and multiple data flows) and a logical destination may optionally select from flows from multiple Senders associated with multiple Devices / Nodes. In a ST 2110 based platform, a lot of messaging between systems must take place between systems to establish connectivity between a logical source and logical destination. To avoid unacceptably slow connection request response times, it is therefore important that control systems and devices process commands as quickly as possible and communicate with other systems efficiently.

Though other protocols are supported (RTP and MQTT), in practice the majority of NMOS implementations use the WebSockets protocol for message exchange. WebSocket connections are slow. Establishing a connection can take ~200ms and requests ~80ms to complete. It is therefore easy to see how (without careful optimisation) subscribing a device to multiple audio, video and data flows could take seconds to complete and a salvo to a multiviewer, vision mixer or audio mixer might take significantly longer.

1. Devices shall provide support for IS-05 “bulk” connection requests.
2. Devices shall process individual connection requests within a bulk connection request in parallel.
3. The Supplier shall state how long it takes a Receiver to process a bulk request containing ten connections.

10.2. NMOS Resource Labelling

The NMOS IS-04 specification defines description and label properties of nodes, devices, senders and receivers but does not provide any guidance on how they should be populated.

Consistent labelling is critical to device commissioning and ongoing platform support. For example, having 100 decoders all advertising with device labels that contain the model number

is unhelpful. Similarly, sender/receiver labels which are manufacturer specific e.g. “Sender Video 0 of Receiver device SNXXXX” will further add to the confusion.

Not all vendors implement logical grouping tags (and those that do use a variety of different syntaxes).

MPP plans to adopt a simple naming scheme for devices and senders/receivers which results in consistency across control and configuration platforms. Whilst this exact structure has yet to be formalised, the scheme might be as follows

Each device has a unique id (UID) - in the form 12345/THING/001 - the first segment denotes a physical or operational area, the second the device category (e.g. IRD/CODEC/DECODER) and the last segment is a counter. This device UID forms the basis of a sender or receiver id:

12345/THING/001_s01_v01	12345/THING/001_s01_a05
12345/THING/001_s01_a01	12345/THING/001_s01_a06
12345/THING/001_s01_a02	12345/THING/001_s01_a07
12345/THING/001_s01_a03	12345/THING/001_s01_a08
12345/THING/001_s01_a04	12345/THING/001_s01_m01

These 10 senders would represent one video, eight audios and one metadata flow - i.e. a logical grouping or spigot. For receivers, we substitute _s for _r

10.2.1. Requirement

Vendors shall provide a mechanism for project engineers to enter the following [minimum] metadata set for IS-04 as freely definable text.

- Node label
- Device label
- Sender label
- Receiver label

This shall be achieved through one of the following methods (in order of preference)

- Manufacturer’s API
- Plain text (e.g. xml, json) File loaded into your system
- Direct entry through web page or Manufacturer’s configuration tool

Ideally, the solution SHOULD NOT involve manual labelling of each resource

It may be permissible to employ sender/receiver patterns, such that {Node}, {Device}, {Spigot}, {Flow Type} variables can be used to build a hierarchical label definition.

Vendors are encouraged to actively participate in AMWA NMOS, as this topic is likely to form part of a forthcoming activity.

10.3. Multiformat

One of the key benefits to broadcasters of the transition to IP is that the data transmission technology (the professional media network) is format agnostic, allowing rapid adoption of new

media formats and multiple media formats to coexist on the same network fabric. Such flexibility requires care be taken when defining platform control system design and philosophy.

Increasingly, devices are becoming reconfigurable to be able to create and consume a broad range of compressed and uncompressed media formats, each with very different bandwidth requirements. Such flexibility presents challenges to platform management.

To ensure the correct operation of a large professional media network, it is critical that the opportunity for unsolicited flows to get onto the network is minimised. Furthermore, it is important to be able to detect and set correct Sender and Receiver format configuration.

1. The device shall provide an API call to report and set Sender and Receiver format configuration.
2. The Supplier must explain how the device presents Senders and Receivers via NMOS when Sender / Receiver format/bandwidth is changed and how this relates to the internal processing capabilities of the device. For example, when switching between 1080i25/1080p50 and 2160p50 modes, several different behaviours have been observed, including:
    a. The device presents different sets of NMOS UIDs for UHD and 3G modes.
    b. Existing NMOS UIDs are retained but three out of four UIDs are invalidated.

11. Security

Suppliers shall demonstrate that processes are in place to:

a. Minimise the risk of product / service vulnerabilities and;
b. Minimise the risk that of professional or support services exposing NRK to threats

Suppliers are expected to review EBU r143 and complete columns A and B of the R 143 Security Controls Assertation.

Supplier shall deliver a software bill of materials.

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SUPPLIER SECURITY REQUIREMENTS

Version	0.9
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Contents

1 INTRODUCTION

This document establishes minimum security standard required for suppliers to meet appropriate organisational and technical measures, to help ensure the confidentiality, integrity, and accessibility of NRK's data and information technology environment.

All requirements are based on ISO/IEC 27001:2018 *Information Security Management Systems*, and *Cybersecurity for Media Vendor Systems, Software & Services*, which is a standard (R 143, 2020) developed by the European Broadcasting Union (EBU).

2 SCOPE

The scope of this document includes any suppliers that process or have access to NRK's data. This includes, but not limited to:

- Suppliers that process, access, hold or transmit data for NRK.
- Suppliers that have access to NRK's physical sites or IT systems.

Suppliers must demonstrate compliance with each of the requirements below in Section 3 *Organisational measures*.

Suppliers providing software, middleware, hardware, platforms, or other systems and/or components integrated with, or connected to, NRK's information technology environment, must also comply with Sections 4 *Technical Measures* of this document.

3 ORGANISATIONAL MEASURES

#	Description	Fully meets	Partially meets	Don´t support	Comment
1	**Security Governance** The supplier must have a security policy that is regularly evaluated and updated.				
2	**Risk Management** The supplier must identify risks that are caused by its services and provide mitigating measures.				
3	**Personnel Security** The supplier must ensure that all personnel who will have access to any of NRK's sites or data, are screened prior to engagement.				
4	**Supply Chain** The supplier must ensure that their subcontractors is compliant with the measures in this document.				

4 TECHNICAL MEASURES

#	Description	Fully meets	Partially meets	Don´t support	Comment
5	**Vulnerability Management** The supplier must ensure that a vulnerability management process is in place to keep track of identified vulnerabilities and patches that may fix them.				
6	**Security Testing** The supplier must perform regular technical security analysis such as penetration or vulnerability testing of the service.				
7	**Incident Management** The supplier must have an incident response procedure implemented. To collect security events, technical controls must be established.				
8	**Incident Reporting** The supplier must have a documented process in place to notify NRK when a security incident occurs.				
9	**Disaster Recovery** The supplier must have appropriate backup procedures implemented, and recovery plans that are tested.				
10	**Access Control** The supplier must ensure that their services support role-based access control and NRK's Single Sign On (SSO).				
11	**Data Encryption** The suppliers must have an established method of encrypting sensitive data in storage and in transit following industry best practice.				
12	**Change Management** The supplier must ensure that changes of the services are controlled and authorised through a formal, documented process.				
13	**Separation of Environments** The supplier must ensure that production, test, and development environments are kept separate.				
14	**Segregation of Customer Data**				

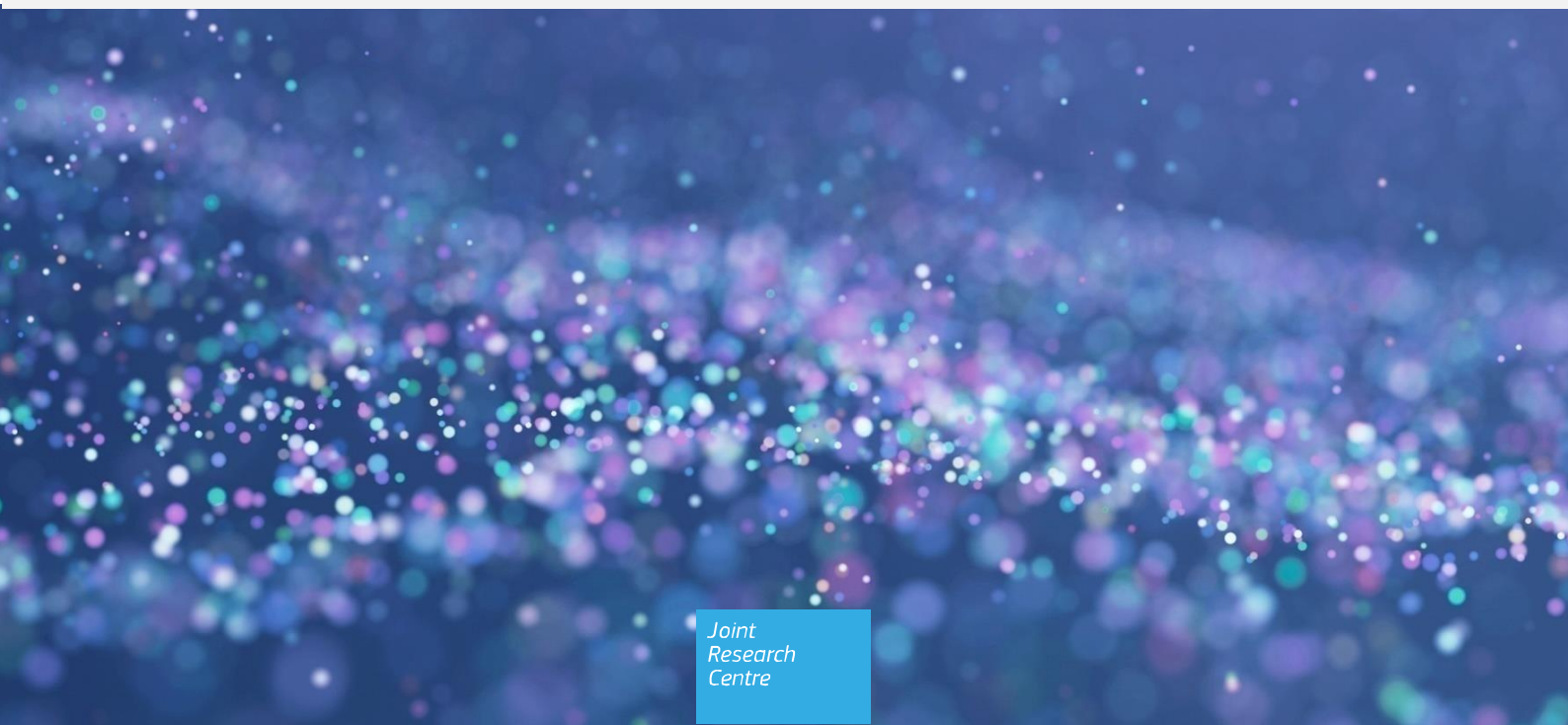
	The supplier must have in place appropriate segregation of customer data where it is being stored or processed in a multi-tenanted environment.				
15	**Physical Security** The supplier must have established access control and necessary physical security of its premises.				
16	**Personal Data** The supplier must disclose if personal data is being processed outside of the EEA.				

European Commission

2024 Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency

Acton, M., Bertoldi, P., Booth, J.

2024



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Contents

Abstract

This Best Practice document for the *European Code of Conduct for Energy Efficiency in Data Centres* is both an education and reference document to assist data centre operators in identifying and implementing measures to improve the energy efficiency of their data centres. This Best Practice document contains a full list of the identified and recognised data centre energy efficiency best practices within the Code of Conduct. The best practice list provides a common terminology and frame of reference for describing an energy efficiency practice, to assist Participants and Endorsers in avoiding doubt or confusion over terminology. Customers or suppliers of IT services may also find it useful to request or provide a list of Code of Conduct Practices implemented in a data centre to assist in procurement of services that meet their environmental or sustainability standards. The Best Practice document is also a reference for the Taxonomy Delegated Act for climate mitigation in data centres and it is mentioned in the 2023 Energy Efficiency directive in article 12.

1 Document Information

1.1 Version History

Version	Description	Version Updates	Date
15.0.0	2024 Initial Draft	Comments from 2023 Best Practices stake-holders meeting incorporated	14 Nov 2023
14.1.0	2024 Final	Release Version	01 Jan 2024

1.2 Release History

Version	Description	Authoriser	Date
15.1.0	2024 Release	Mark Acton	01 Jan 2024
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12.1.0	2021 Release	Mark Acton	01 Jan 2021
11.1.0	2020 Release	Mark Acton	01 Jan 2020
10.1.0	2019 Release	Mark Acton	01 Jan 2019
9.1.0	2018 Release	Mark Acton	01 Jan 2018
8.1.0	2017 Release	Mark Acton	01 Jan 2017
7.1.2	2016 Release	Mark Acton	06 Jan 2016
6.1.1	2015 Release Fix	Mark Acton	02 Jan 2015
6.1.0	2015 Release	Mark Acton	10 Dec 2014
5.1.1	2014 Release Fix	Mark Acton	23 Feb 2014
5.1.0	2014 Release	Mark Acton	17 Feb 2014
4.0.5	2013 Release	Mark Acton	30 May 2013
3.0.8	2012 Release	Liam Newcombe	15 Dec 2011
3.0.1	2011 Release Fix	Liam Newcombe	01 Mar 2011
3.0.0	2011 Release	Liam Newcombe	28 Feb 2011
2.0.0	2010 Release	Liam Newcombe	19 Nov 2009
1.0.0	First Release	Liam Newcombe	23 Oct 2008

1.3 Authors

The following people are the current editorial team associated with this document

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2 Introduction

This document is a companion to the EU Code of Conduct on Data Centre Energy Efficiency and provides the full list of identified Best Practices for data centre operators as referenced in the Code of Conduct Participant and Endorser Guidelines documents.

2.1 Role of Best Practices

This Best Practice supplement to the Code of Conduct is provided as an education and reference document as part of the Code of Conduct to assist data centre operators in identifying and implementing measures to improve the energy efficiency of their data centres. A broad group of expert reviewers from operators, vendors, consultants, academics, professional and national bodies have contributed to and reviewed the Best Practices.

This Best Practice supplement is a full list of the identified and recognised data centre energy efficiency best practices within the Code of Conduct. The best practice list provides a common terminology and frame of reference for describing an energy efficiency practice, to assist Participants and Endorsers in avoiding doubt or confusion over terminology. Customers or suppliers of IT services may also find it useful to request or provide a list of Code of Conduct Practices implemented in a data centre to assist in procurement of services that meet their environmental or sustainability standards.

2.2 Expected Minimum Practices

To help ensure that Participants to the Code of Conduct are recognised as having committed to a useful and substantial level of energy saving effort, a subset of the Best Practices are identified in this document as being the expected minimum level of energy saving activity for Participant status.

The less disruptive or intrusive of the Practices are identified as being applied to the existing data centre and IT equipment, retrospectively where necessary. It is accepted that a number of the Practices identified as expected are inappropriate or present an unnecessary burden when applied to an existing running data centre. These Practices are identified as being expected either, when new IT equipment or software is sourced and deployed, or during a retrofit of the facility. These Practices provide substantial benefits and are intended to achieve efficiency improvements through the natural churn of equipment and facilities.

All expected Practices should be applied to any data centre constructed from 2011 onwards, specifically all Practices marked as “Entire data centre”, “New software”, “New IT equipment” and “New build or retrofit” which are within the applicants’ control.

Practices are marked in the expected column as follows:

Category	Description
Entire Data Centre	Expected to be applied to all existing IT, Mechanical and Electrical equipment within the data centre
New Software	Expected during any new software install or upgrade
New IT Equipment	Expected for new or replacement IT equipment
New build or retrofit	Expected for any data centre built or undergoing a significant refit of the M&E equipment from 2011 onwards
Optional Practices	Practices without a background colour are optional for Participants

Note that existing IT equipment moved from another data centre is not expected to comply with the New IT Equipment or New Software Practices. New or replacement IT equipment excludes the direct replacement of failed hardware with like for like as part of normal operations. New software install or upgrade refers to major upgrades of software and not the application of service packs and patches in normal management and use.

Retrofit is intended to describe major disruptive works in the data centre which present the opportunity at little incremental cost to implement these additional Practices. Examples of retrofit would be (a) when the power to the data floor is shut off and the IT equipment and cabinets removed it is expected that Practice 5.1.1 Contained hot or cold aisle would be implemented (b) if the CRAC / CRAH units are being upgraded or replaced it is expected that Practice 5.5.1 Variable speed fans would be implemented as part of this change.

2.3 Application and Assessment

The Best Practices form part of the application and assessment for Participant status. This process is described in the Participant and Endorser Guidelines documents.

2.4 Value of Practices

Each Practice has been assigned a qualitative value to indicate the level of benefit to be expected from an action and the relative priorities that should be applied to them. These values are from 1 to 5 with 5 indicating the maximum value. These values are not intended to be totalled or aggregated to provide an overall 'operator score' and should not be mistaken for quantitative. This would require large scale data on the effects of each Practice or technology which is not yet available as well as a complex system of scoring representing the combinational increase or reduction of individual Practice values within that specific facility.

2.5 Applicability of Expected Practices

It is understood that not all operators will be able to implement all of the expected Practices in their facilities due to physical, logistical, planning or other constraints. In these instances an explanation of why the expected action is not applicable or practical should be provided in the "Reason why this Practice cannot be implemented in this data centre" column in the reporting form, alternative best practices from the Code of Conduct or other sources may be identified as direct replacements if they result in similar energy savings.

2.6 Type of Participant

Each Participant should identify the type of operator that best describes their activity within the data centre for which they are completing the form on the "Data Centre Information" tab as follows:

Table 1 Types of Participants

Type	Description
Operator	Operates the entire data centre from the physical building through to the consumption of the IT services delivered.
Colocation provider	Operates the data centre for the primary purpose of selling space, power and cooling capacity to customers who will install and manage their own IT hardware and services.
Colocation customer	Owns and manages IT equipment located in a data centre in which they purchase managed space, power and cooling capacity.
Managed service provider (MSP)	Owns and manages the data centre space, power, cooling, IT equipment and some level of software for the purpose of delivering IT services to customers. This would include traditional IT outsourcing.
Managed service provider in colocation space	A managed service provider which purchases space, power or cooling in a data centre in order to provide services to third parties.

Source:JRC

The type of operator serves two purposes, first it assists the secretariat in the assessment of an application and second it will be included in the listing for data centres which achieve Participant status on the Code of Conduct website.

2.7 Participants who do not control the entire data centre

It is understood that not all operators are responsible for all aspects of the IT environment defined within the Best Practices. This is not a barrier to Participant status, but the operator should sign as a Participant and act as an Endorser for those Practices outside of their control.

The following sections are included to provide guidance to operators with partial control of the data centre on which practices they are expected to implement and which they are expected to Endorse.

It is suggested that you download the application form, select your type of operator and then your areas of responsibility whilst reading this document to understand how this categorisation guides practice implementation.

2.7.1 Guidance to operators with partial control of the data centre

The Best Practice tab of the reporting form provides guidance for each of the minimum expected Practices on whether these are considered to apply to each of these example types of operator, in which cases responsibility is to be shared and how that may be implemented. This may be found in the columns labelled "Guidance to operators with partial control of the data centre".

2.7.2 Areas of Responsibility

Operators' areas of responsibility are defined as follows:

Table 2 Areas of responsibility

Area	Description
Physical building	The building including security, location and maintenance.
Mechanical and electrical plant	The selection, installation, configuration, maintenance and management of the mechanical and electrical plant.
Data floor	The installation, configuration, maintenance and management of the main data floor where IT equipment is installed. This includes the floor (raised in some cases), positioning of CRAC / CRAH units and basic layout of cabling systems (under floor or overhead).
Cabinets	The installation, configuration, maintenance and management of the cabinets into which rack-mount IT equipment is installed.
IT equipment	The selection, installation, configuration, maintenance and management of the physical IT equipment.
Operating System / Virtualisation	The selection, installation, configuration, maintenance and management of the Operating System and virtualisation (both client

Area	Description
	and hypervisor) software installed on the IT equipment. This includes monitoring clients, hardware management agents etc.
Software	The selection, installation, configuration, maintenance and management of the application software installed on the IT equipment.
Business Practices	The determination and communication of the business requirements for the data centre including the importance of systems, reliability availability and maintainability specifications and data management processes.

Source: JRC

An example of Participant responsibility would be a collocation provider who does not control the IT equipment should actively endorse the Practices relating to IT equipment to their customers. This might include the provision of services to assist customers in adopting those Practices. Equally an IT operator using collocation should request their collocation provider to implement the Practices relating to the facility.

Note that these boundaries of responsibility do not apply within organisations. An applicant is considered to control an area if a parent, subsidiary or group company owns or controls the area. For example, if another division of the same group of companies operates a colocation (Colo), facility within which the applicant operates equipment as a service provider this is considered to be a managed service provider with responsibility for the physical building, mechanical and electrical plant, data floor and cabinets, not a managed service provider in collocation space (Colo).

2.7.3 Implement or Endorse

Each operator should determine which of the Practices apply to them based on their areas of responsibility. The table below provides an overview for common types of Participant:

Table 3 Areas of responsibility for common applicant types

	Operator	Colo provider	Colo customer	MSP in Colo	MSP
Physical building	Implement	Implement	Endorse	Endorse	Implement
Mechanical & electrical plant	Implement	Implement	Endorse	Endorse	Implement
Data floor and air flow	Implement	Implement & Endorse	Implement & Endorse	Implement	Implement
Cabinets and cabinet air flow	Implement	Implement & Endorse	Implement & Endorse	Implement	Implement
IT equipment	Implement	Endorse	Implement	Implement	Implement
Operating System & Virtualisation	Implement	Endorse	Implement	Implement	Implement
Software	Implement	Endorse	Implement	Implement & Endorse	Implement & Endorse
Business Practices	Implement	Endorse	Implement	Endorse	Endorse

Source: JRC

There are many instances where the responsibility for a Practice will need to be shared between supplier and customer, for example the installation of IT equipment in the correct orientation in a hot / cold aisle layout data centre. In this case both parties should Implement the Practice themselves and Endorse it to the other party(ies).

3 Data Centre Utilisation, Management and Planning

It is important to develop a holistic strategy and management approach to the data centre. This will enable the Participant to effectively deliver reliability, economic, utilisation and environmental benefits.

3.1 Involvement of Organisational Groups

Ineffective communication between the disciplines working directly and indirectly in the data centre is a major driver of inefficiency as well as capacity and reliability issues.

No	Name	Description	Expected	Value
3.1.1	Group Involvement	Establish an approval board containing representatives from all disciplines including Senior Management, IT, M&E Engineering, Applications/Software and Procurement. Require the approval of this group for any significant decision to ensure that the impacts of the decision have been properly understood and an effective solution reached. For example, this could include the definition of standard IT hardware lists through considering the M&E implications of different types of hardware. This group could be seen as the functional equivalent of a change board.	Entire Data Centre	5

Source: JRC

3.2 General Policies

These policies apply to all aspects of the data centre and its operation.

No	Name	Description	Expected	Value
3.2.1	Consider the embodied environmental impact of installed devices	Carry out an audit of existing equipment to maximise any unused existing capability by ensuring that all areas of optimisation, consolidation and aggregation are identified prior to new material investment. The most important element to this in terms of impact is the IT equipment. The severity of impact is related to the frequency of refresh and replacement.	Entire Data Centre	3
3.2.2	Mechanical and electrical equipment environmental	Recommend the selection and deployment of mechanical and electrical equipment which does not itself require additional cooling beyond standard office room cooling in normal operation (the exception to this being some UPS batteries).	New build or retrofit	4

No	Name	Description	Expected	Value
	operating ranges	Note: Some UPS batteries require to be kept at lower temperatures to preserve performance and reliability and to maximise operational lifetime.		
3.2.3	Service Charging Models	Co-location and Managed Service providers should employ charging models and tariffs that encourage the use of best practice and improve energy efficiency. Enterprise operators should ensure that the true cost of data centre services are fully understood and properly reported.	Optional	3
3.2.4	Life Cycle Assessment	Introduce a plan for Life Cycle Assessment (LCA) in accordance with EU guidelines and internationally standardised methodologies. Examples of which would be *ISO 14040 and ISO 14044.* *EN 15978* 'Sustainability of construction works - assessment of environmental performance of buildings - calculation method' is also a standard that is considered relevant to this Practice. Note: This Practice aims to reduce overall carbon footprint and improve sustainability rather than directly improve energy efficiency. A list of recommended environmental sustainability practices is available in the CEN/CENELEC document *CLC 50600-5-1*.	New build or retrofit	3
3.2.5	Environmental Management	Introduce a plan for Environmental Management in accordance with emerging EU guidelines and internationally standardised methodologies. An example of which would be *ISO 14001*. Consider appointing a cross functional Environmental Sustainability Manager to take responsibility for this initiative.	Entire Data Centre	3
3.2.6	Energy Management	Introduce a plan for Energy Management in accordance with emerging EU guidelines and internationally standardised methodologies. An example of which would be *ISO 50001*. Note: The Code of Conduct can be used effectively to underpin the expectations and reporting requirements specifically for data centres in relation to *ISO 50001*. Consider appointing a cross functional Energy Manager to take responsibility for this initiative.	Entire Data Centre	3

No	Name	Description	Expected	Value
3.2.7	Asset Management	Ensure that Asset Management for both IT and mechanical and electrical assets etc. is implemented and controlled according to a standard and accepted methodology. An example of which would be *ISO 55000*. Understanding the numbers, types and purposes of the assets deployed in a data centre underpins effective energy management.	Entire Data Centre	3
3.2.8	Sustainable energy usage	Consider the proportion of energy used by the data centre that comes from renewable / sustainable sources. Recording and reporting on the proportion of sustainable / renewable energy used against the overall energy consumption is expected to become an expected monitoring and reporting requirement in time. Note: Standardised metrics in this area are available as *EN 50600-4-3* or *ISO/IEC 30134-3*. *EN 50600-4-3* "Information technology — Data centre facilities and infrastructures — Part 4-3: Renewable Energy Factor" specifies the "Renewable Energy Factor, REF" as the ratio of the renewable energy (in kWh) to the total energy consumption (in kWh). Note: REF covers all renewable energy purchased from the utility (with guarantee of origin) and produced on-site. However, renewable energy produced on-site, that is not consumed on-site and partly or in total sold to the grid, shall be excluded from REF. Note: *CLC 50600-5-1* addresses Best Practices for Data Centre Energy Efficiency and Environmental Sustainability. Both are a part of the European *EN 50600* Standard series. Note: The *EN 50600* series has now been adopted by ISO/IEC as *ISO/IEC 22237*. Note: *ETSI EN 305 200-3-1* KPIREN KPI excludes both energy from grid and energy not consumed on site, in conformance with net zero initiatives.	Entire Data Centre	3
3.2.9	Powering of devices via the IT cabling	Monitor and report on usage / energy consumption by devices powered by IT cabling. IT cabling is increasingly being used to deliver power to devices both inside and outside the data centre. The advantage of this technology is that the same cable	Optional	1

No	Name	Description	Expected	Value
		can be used for both network connectivity and power. Examples of this include telephony (voice) handsets, cameras, a variety of different environmental sensors even LED lights and lighting control. Note: The risk here is that this power is being taken directly from network switches, which constitute "IT Load". This needs to be considered when looking at energy usage calculations such as DCiE or PUE which may well give false indications if devices are being powered via IT communications cabling and usage is not being taken into account. Note: This is particularly true if power is being delivered outside the data centre as might be the case with IP Telephony, network switches in the data centre potentially supplying handsets in nearby office spaces.		
3.2.10	Impact of mobile / shifting workloads	Consider the type of workload(s) that will be supported both during the design and operation of data centres. Note: Traditionally steady workload levels in data centres have resulted in relatively constant power draws however developments in applications and software is resulting in increasingly fluctuating workloads and even the ability to migrate workloads seamlessly between sites. This not only potentially changes the required equipment resilience and reliability levels at a particular site it also changes the way that the installed power and cooling infrastructure needs to be managed from both a capacity and energy efficiency perspective.	Optional	2
3.2.11	Alternative power generation technologies	Consideration should be given to energy supplies from alternative and sustainable energy sources including fuel cells, wind power, photo-voltaic and shared local-generation using biomass / bio-fuels etc., which might provide a lower carbon footprint, economically attractive and reliable alternative to utility electricity supplies. Note: This Practice aims to reduce overall carbon footprint and improve sustainability rather than provide direct energy efficiency.	Optional	1
3.2.12	Monitor and manage air quality	Ensure that air quality is monitored and managed to ensure that critical equipment is not damaged by particulates or corrosive elements which might impact	Entire Data Centre	2

No	Name	Description	Expected	Value
		both IT equipment and cooling equipment in terms of performance, energy efficiency and reliability. This should inform the choice of filters used and the planned replacement schedule as well as the frequency of routine technical cleaning programme (including underfloor and ceiling void areas if applicable). Filter choices should be informed by *ISO 16890-1*. Note: The ASHRAE white paper '2011 Gaseous and Particulate Contamination Guidelines for Data Centers' recommends that data centre air quality is monitored and cleaned according to *ISO 14644*-8 Class 8. This can be achieved by routine technical cleaning and simple filtration. Note: Airborne Contaminants including gaseous contaminants should be managed according to *ANSI/ISA 71.04-2013*.		
3.2.13	Consider technical areas of data centres as industrial space	The data centre technical areas and plant rooms should be considered as an industrial space, designed built and operated with the single primary objective of delivering high availability IT services reliably and efficiently. Note: This objective aims to prevent the energy efficiency of the technical space being compromised by the need for human comfort other than to comply with local statutory requirement and law (Health and Safety etc.). Note: Data Centres are primarily technical spaces, not office space, and should therefore only require the control make up air volumes and environmental conditions to pressurise the spaces in order avoid ingress of particles and contaminants rather than for seated human comfort. This only relates to those areas of the centre intended to hold operational IT equipment or supporting mechanical or electrical infrastructure. These areas should not contain desks or workstations. Note: This is not intended to reduce or impose conditions on dedicated and purpose-built office space within the data centre building.	Entire Data Centre	3
3.2.14	Site Documentation	Ensure that high quality, accurate O&M manuals, As-Built records, commissioning records, schematics and single lines diagrams are available to enable all installed infrastructure and equipment to be	Entire Data Centre	3

No	Name	Description	Expected	Value
		maintained as originally designed and operated at optimum levels of efficiency. Accurate documentation and records are essential to the correct operation and use of energy efficiency functions built-In by equipment manufacturers. Updates should be made whenever any settings are changed or equipment is added, replaced or modified. Historical records should also be kept. Effective commissioning and delivery of detailed and accurate documentation should be a key part of any project handover. Note: *EN 50600-3-1* can be referenced for more detail on this area.		
3.2.15	Training and Development	Ensure the Data Centre Manager and any appointed Energy Manager has relevant and appropriate training to fulfil an energy efficiency role and have an in-depth appreciation of Best Practices (such as this Code of Conduct). Ensure that both IT and Facilities personnel are aware of Data Centre energy efficiency Best Practises (such as this Code of Conduct) in order to support organisational strategies to reduce IT energy usage. Remove silos and promote a minimum level of common understanding relating to data centre Operations and Management. An overall training methodology should be defined and delivered to all relevant personnel to improve individual personal development and develop suitably qualified and experienced data centre personnel. Note: Properly trained and qualified personnel are essential to efficient data centre operation.	Entire Data Centre	3
3.2.16	Smart Grid	Continue to evaluate the use of energy storage and usage to support Smart Grid. A Smart Grid is a solution that employs a broad range of information technology resources, allowing for a potential reduction in electricity waste and energy costs. This Practice should aim to include 'Behind the Meter' Support. Guidance and requirements which are currently being developed by the European Commission may impact	Optional	2

No	Name	Description	Expected	Value
		this Practice. Smart Grids are referenced by the EED, which should be examined for Practices in this area. *EN 50600-5-1* already incorporates a Practice in this area which should be considered for adoption.		

3.3 Resilience Level and Provisioning

One of the most significant sources of inefficiency in data centres is the over provisioning of space, power or cooling and the facilities being run at part capacity. Monolithic, as opposed to modular design of facilities also represents a significant and frequently unnecessary capital expenditure. Further, as the level of resilience of the data centre increases the inefficiencies due to fixed overheads increase and this is compounded by poor utilisation.

No	Name	Description	Expected	Value
3.3.1	Build resilience to business requirements	Only the level of resilience and therefore availability actually justified by business requirements and impact analysis should be built or purchased in the case of a collocation customer. 2N infrastructures are frequently unnecessary and inappropriate. If only a single level of resilience is available in the data centre an increased resilience or availability for critical services might be obtained by splitting the IT platform across multiple sites and making applications resilient to the loss of an individual site.	New build or retrofit	3
3.3.2	Consider multiple levels of resilience	It is possible to build a single data centre to provide multiple levels of power and cooling resilience to different floor areas. Many co-location providers already deliver this, for example, optional 'grey' power feeds without UPS or generator back up.	New build or retrofit	3
3.3.3	Lean provisioning of power and cooling for a maximum of 18 months of data floor capacity	The provisioning of excess power and cooling capacity in the data centre drives substantial fixed losses and is unnecessary. Planning a data centre for modular (scalable) expansion and then building out this capacity in a rolling program of deployments is more efficient. This also allows the technology 'generation' of the IT equipment and supporting M&E infrastructure to be matched, improving both efficiency and the ability to respond to business requirements.	New build or retrofit	3
3.3.4	Design infrastructure to maximise part load efficiency	All areas of the data centre should be designed to maximise the energy efficiency of the facility under partial fill / partial load and variable IT electrical and cooling loads. This is in addition to one off modular provisioning and should consider the response of the infrastructure to dynamic loads. E.G. Appropriately controlled Variable Frequency (or speed) Drive for pumps, fans and compressors.	New build or retrofit	3

No	Name	Description	Expected	Value
3.3.5	Design appropriate levels of resilience	Utilise appropriate levels of resilience within the data centre, IT equipment, software and network levels to achieve the service resilience and availability required by the business demands. Installing high levels of resilience require multiple redundant units which reduce overall energy efficiency.	Optional	4

4 IT Equipment and Services

The IT equipment creates the demand for power and cooling in the data centre, any reductions in power and cooling used by or provisioned for the IT equipment will have magnified effects at the utility energy supply.

Note that the specifications of IT equipment operating temperature and humidity ranges in this section do not indicate that the data floor should be immediately operated at the upper bound of these ranges. This is addressed in section 5. The purpose of the equipment environmental specifications in this section is to ensure that new equipment is capable of operating under the wider ranges of temperature and humidity thus allowing greater flexibility in operating temperature and humidity to the operator.

4.1 Selection and Deployment of New IT Equipment

Once IT equipment is purchased and installed in the data centre it typically spends several years in the data centre consuming power and creating heat. The appropriate selection of hardware and deployment methods can provide significant long term savings.

No	Name	Description	Expected	Value
4.1.1	IT hardware – Power	Include the Energy efficiency performance of the IT device as a high priority decision factor in the tender process. This may be through the use of SERT (http://www.spec.org/sert/) or SPECPower. (http://www.spec.org/power_ssj2008/results/) or similar metrics or through application or deployment of specific user metrics more closely aligned to the target environment, which may include service level or reliability components. The power consumption of the device at the expected utilisation or applied workload should be considered in addition to peak performance per Watt figures. Reference ISO/IEC 30134-4 Information technology — Data centres — Key performance indicators — Part 4: IT Equipment Energy Efficiency for servers (ITEEsv). Also ETSI - EN 303 470 Environmental Engineering (EE); Energy Efficiency measurement methodology and metrics for servers	New IT Equipment	5
4.1.2	New IT hardware – Restricted (legacy) operating temperature and humidity range	Equipment should be purchased that allows for operation within ASHRAE Class A2. If no equipment can be procured which meets the operating temperature and humidity range of Practice 4.1.3 (ASHRAE Class A2), then equipment supporting ASHRAE Class A1 at a minimum may be procured. To support the restrictive range of operation equipment should be installed in a separate area of the data floor	New IT Equipment	4

No	Name	Description	Expected	Value
		in order to facilitate the segregation of equipment requiring tighter environmental controls as described in Practices 5.1.11, 5.3.4 and Error! Reference source not found..5. In unusual cases where older technology equipment must be procured due to compatibility and application validation requirements (an example being air traffic control systems), these systems should be considered as subset of this Practice and installed so as not to restrict the operation of other equipment described above. A summary of ASHRAE environmental guidelines can be found at: https://www.ashrae.org/file%20library/technical%20resources/bookstore/supplemental%20files/referencecard_2021thermalguidelines.pdf		
4.1.3	New IT hardware – Expected operating temperature and humidity range	Include the operating temperature and humidity ranges at the air intake of new equipment as high priority decision factors in the tender process. Equipment should be able to operate and be within warranty for the full ASHRAE Class A2 allowable temperature and humidity range. Vendors are required to publish (not simply make available on request) any restriction to the operating hours within this range for any model or range which restricts warranty to less than continuous operation within the allowable range. To address equipment types which cannot be procured to meet this specification exclusions and mitigation measures are provided in Practices 4.1.2 for new IT equipment, 5.1.11 for existing data centres and 5.3.4 for new build data centres. Directly liquid cooled IT devices are addressed in Practice 4.1.14. A summary of ASHRAE environmental guidelines can be found at: https://www.ashrae.org/file%20library/technical%20resources/bookstore/supplemental%20files/referencecard_2021thermalguidelines.pdf	New IT Equipment	5
4.1.4	New IT hardware – Extended operating temperature	Include the operating temperature and humidity ranges at the air intake of new equipment as high priority decision factors in the tender process.	Optional	3

No	Name	Description	Expected	Value
	and humidity range	Consider equipment which operates under a wider range of intake temperature and humidity such as that defined in ASHRAE Class A4 (broadly equivalent to *ETSI EN 300 019–1-3* Class 3.1). This extended range allows operators to eliminate the capital cost of providing mechanical cooling capability in some hotter climate regions. Note: Many vendors provide equipment whose intake temperature and humidity ranges exceed the minimum sets represented by the described classes in one or more parameters. Operators should request the actual supported range from their vendor(s) and determine whether this presents an opportunity for additional energy or cost savings through extending the operating temperature or humidity range in all or part of their data centre. A summary of ASHRAE environmental guidelines can be found at: https://www.ashrae.org/file%20library/technical%20resources/bookstore/supplemental%20files/referencecard_2021thermalguidelines.pdf		
4.1.5	Select IT equipment suitable for the data centre power density and cooling delivery capabilities	Select and deploy IT equipment at the designed power density (per cabinet or m²) of the data centre to avoid running the cooling system outside design parameters. Note: Increasing power density may create cooling and air flow management problems reducing both capacity and efficiency. Power and cooling need to be considered as capacity constraints in addition to physical space as referenced in Practice 5.56.	New IT Equipment	3
4.1.6	IT equipment power usage against inlet temperature	When selecting new IT equipment require the vendor to supply at minimum the total system power for a range of temperatures covering the full allowable inlet temperature range for the equipment at 100% load on a specified recognised benchmark such as Linpack, SERT (http://www.spec.org/sert/) or SPECPower http://www.spec.org/power_ssj2008/). Data should be provided for 5°C or smaller steps of inlet temperature. As a minimum comply with the EU Eco Design Directive and Lot 9 amendments to EU Commission regulation for servers and online storage systems. It is also recommended that:	New IT Equipment	5

No	Name	Description	Expected	Value
		Total system power covering the full allowable inlet temperature range under 0% and 50% load on the selected benchmark. These sets of data are shown easily in a single table and single chart will allow a data centre operator to select equipment to meet their chosen operating temperature range without significant increase in power consumption. This Practice is intended to improve the thermal performance of IT equipment by allowing operators to avoid devices with compromised cooling designs and creating a market pressure toward devices which operate equally well at increased intake temperature.		
4.1.7	Select equipment suitable for the data centre - Air flow direction	When selecting equipment for installation into cabinets ensure that the air flow direction matches the air flow design for that area. This is commonly front to rear or front to top. If the equipment uses a different air flow direction to that defined for the area into which it is installed (such as right to left when the cabinet is intended to be front to back) it should only be used with a correction mechanism such as ducts, or special cabinets that divert the air flow to the defined direction. Equipment with non-standard air flow will compromise the air flow management of the data centre and therefore restrict the ability to increase temperature set points. It is possible to mitigate this issue by segregating such equipment according to Practices 5.1.11, 5.3.4 and 5.3.5.	New IT Equipment	5
4.1.8	Enable power management features	Formally change the deployment process to include the enabling of power management features on IT hardware as it is deployed. This includes BIOS, operating system and driver settings.	New IT Equipment	5
4.1.9	Provision only to the actual IT power usage required	Provision power and cooling only to the planned power draw of the IT equipment as configured (based on the components actually installed), rather than the Power Supply Unit (PSU) size or nameplate rating. This is intended to avoid over-sizing of electrical infrastructure resulting in a low (partial) load and therefore inefficient operation.	New IT Equipment	3

No	Name	Description	Expected	Value
		Note: This may require changes to the provisioning if the IT equipment performance is increased or upgraded.		
4.1.10	EU Eco Design / Energy Star compliant hardware	As a minimum comply with the EU Eco Design Directive and Lot 9 amendments to EU Commission regulation for servers and online storage systems. The Energy Star Labelling programs for IT equipment should be used as a guide to server selection where and when available for that class of equipment. Operators who are able to determine the in-use energy efficiency of hardware through more advanced or effective analysis should select the most efficient equipment for their scenario.	New IT Equipment	4
4.1.11	Energy & temperature reporting hardware	Select equipment with power and inlet temperature reporting capabilities, preferably reporting energy used as a counter in addition to power as a gauge. Where applicable, industry standard reporting approaches should be used such as IPMI, DMTF Redfish and SMASH. To assist in the implementation of temperature and energy monitoring across a broad range of data centres all devices with an IP interface should support one of the following: SNMP polling of inlet temperature and power draw. Note that event based SNMP traps and SNMP configuration are not required IPMI polling of inlet temperature and power draw (subject to inlet temperature being included as per IPMI or Redfish) An interface protocol which the operators' existing monitoring platform is able to retrieve inlet temperature and power draw data from without the purchase of additional licenses from the equipment vendor The intent of this Practice is to provide energy and environmental monitoring of the data centre through normal equipment churn.	New IT Equipment	3
4.1.12	Control of equipment energy use	Select equipment which provides mechanisms to allow the external control of its energy use. An example of this would be the ability to externally restrict a server's maximum energy use or trigger the shutdown of	Optional	5

No	Name	Description	Expected	Value
		components, entire systems or sub-systems. Consider the use of user defined policies.		
4.1.13	When forced to use select free standing equipment suitable for the data centre – Airflow direction	If no alternative is available then select equipment which is free standing or supplied in custom cabinets so that the air flow direction of the enclosures match the airflow design in that area of the data centre. This is commonly front to rear or front to top. Specifically, the equipment should match the hot / cold aisle layout or containment scheme implemented in the facility. Equipment with non-standard air flow can compromise the air flow management of the data centre and restrict the ability to raise temperature set points. It is possible to mitigate this compromise by segregating such equipment according to Practices 5.1.11, 5.3.4 and 5.3.5 Note: Try to avoid free standing equipment as it usually does not allow a well organised airflow through the data centre especially if the major part of the room is equipped with well organised IT equipment mounted in cabinets.	New IT Equipment	4
4.1.14	Operating temperature range – Direct liquid cooled IT equipment	Devices whose primary cooling method is not air and are liquid cooled, are not subject to the air environmental requirements specified in 4.1.2 or 4.1.3. Direct liquid cooling is addressed in section 5.6. As described in 5.4.2.9 this Practice applies to devices which deliver cooling liquid directly to the heat removal system of the components such as water cooled heat sinks or heat pipes and not the delivery of cooling liquid to an internal mechanical refrigeration system or in chassis air cooling systems which are required to deliver coolant liquid or air to the IT components within the range specified. Direct liquid cooling may offer advantages in very high density applications such as High Performance Computing (HPC), and may demonstrate some energy efficiency advantages including the useful extraction and potential re-use of 'waste heat'. Note: ASHRAE offers guidelines for the use of liquid cooling in data centres these are contained in the publication 'Liquid Cooling Guidelines for Datacom Equipment Centers, Second Edition'.	Optional	4

No	Name	Description	Expected	Value
4.1.15	AC/DC Converter efficiency	Select IT equipment containing high efficiency AC/DC power converters. These should be rated at 90% power efficiency or better across the range of loads expected for the equipment to be installed. Reference *ISO/IEC 30134-4* Information technology — Data centres — Key performance indicators — Part 4: IT Equipment Energy Efficiency for servers (ITEEsv) Also *ETSI – EN 303 470* Environmental Engineering (EE); Energy Efficiency measurement methodology and metrics for servers This Practice should also be implemented in line with the *IEC 62040-5* standard.	New IT Equipment	3

4.2 Deployment of New IT Services

The service architecture, software and deployment of IT services have an impact at least as great as that of the IT hardware.

No	Name	Description	Expected	Value
4.2.1	Deploy Virtualisation technologies	Processes should be put in place to require senior business approval for any new service that requires dedicated hardware and will not run on a resource sharing platform. This applies to servers, storage and networking aspects of the service.	New IT Equipment	5
4.2.2	Reduce IT hardware resilience level	Determine the business impact of service incidents for each deployed service and deploy only the level of hardware resilience that is fully justified. Ensure that the IT hardware resilience level is agreed by the application owners.	New IT Equipment	4
4.2.3	Reduce hot / cold standby equipment	Determine the business impact of service incidents for each IT service and deploy only the level of Business Continuity / Disaster Recovery standby IT equipment and resilience that is fully justified by the business impact.	New IT Equipment	4
4.2.4	Select efficient software	Make the energy use performance of the software a primary selection factor. Whilst forecasting and measurement tools and methods are still being developed, approximations could be used such as the (under load) power draw of the hardware required to	New Software	5

No	Name	Description	Expected	Value
		meet performance and availability targets. This is an extension of existing capacity planning and benchmarking processes. See "Further development of software efficiency definitions" in section 11.		
4.2.5	Develop efficient software	Make the energy use performance of the software a major success factor of the project. Whilst forecasting and measurement tools and methods are still being developed approximations, could be used such as the (under load) power draw of the hardware required to meet performance and availability targets. This is an extension of existing capacity planning and benchmarking processes. Performance optimisation should not be seen as a low impact area to reduce the project budget. See "Further development of software efficiency definitions" in section 11.	New Software	5
4.2.6	Incentives to develop efficient software	If software development is being outsourced then include the energy use of the software in the bonus / penalty clauses of the contract. Whilst forecasting and measurement tools and methods are still being developed approximations, could be used such as the (under load) power draw of the hardware required to meet performance and availability targets. This is an extension of existing capacity planning and benchmarking processes. Performance optimisation should not be seen as a low impact area to reduce the project budget. See "Further development of software efficiency definitions" in section 11.	Optional	5
4.2.7	Eliminate traditional 2N hardware clusters	Determine the business impact of short service incidents for each deployed service and replace traditional active / passive server hardware clusters with fast recovery approaches such as restarting virtual machines elsewhere. (This does not refer to grid deployments or High Performance Compute clusters).	Optional	4
4.2.8	IT equipment utilisation	Set minimum or average targets for the utilisation of IT equipment (servers, networking, storage). Note: This presents substantial uncertainty when considered without the load to power profiles of the equipment, with cloud and mobile services and the increasing ability to relocate the IT compute function dynamically to an alternate location and better serve customers and optimise costs, this becomes more	Optional	4

No	Name	Description	Expected	Value
		complex and would require substantial work to usefully determine. Note: This is a specialist area which is being examined in detailed by bodies specialising in this field. Reference *ISO/IEC 30134-5* Information technology — Data centres — Key performance indicators — Part 5: IT Equipment Utilization for servers (ITEUsv) Also *ISO/IEC 21836*. Information technology — Data centres — Server energy effectiveness metric (SEEM)		
4.2.9	Network Energy Use	When purchasing new cloud services or assessing a cloud strategy, assess the impact on network equipment usage and the potential increase or decrease in energy consumption with the aim of being to inform purchasing decisions. The minimum scope shall include elements inside the data centre. The ambition is to include overall energy consumption and energy efficiency including that related to multiple site operation and the network energy use between those sites.	Optional	2

4.3 Management of Existing IT Equipment and Services

It is common to focus on new services and equipment being installed into the data centre but there are also substantial opportunities to achieve energy and cost reductions from within the existing service and physical estate.

No	Name	Description	Expected	Value
4.3.1	Audit existing physical and service estate	Audit the existing physical and logical estate to establish what equipment is in place and what service(s) it delivers. Consider the implementation of an ITIL type Configuration Management Data base and Service Catalogue. A useful standard and reference to use in support of this Practice could be *ISO 55000* See Practice 3.2.7.	Entire Data Centre	5

No	Name	Description	Expected	Value
4.3.2	Decommission and remove unused equipment	Completely decommission and remove any equipment that is not required or used to support services no longer in use. Installed hardware should be regularly examined to ensure that it is still required and is supporting active services. Ensure the decommissioning and removal of test and development platforms once no longer needed.	Entire Data Centre	5
4.3.3	Virtualise and archive legacy services	Servers or services which cannot be decommissioned for compliance, or other reasons, but which are not used on a regular basis should be virtualised and then the disk images archived to a low power media. These services can then be brought online when genuinely required.	Optional	5
4.3.4	Consolidation of existing services	Existing services that do not achieve high utilisation of their hardware should be consolidated through use of resource sharing technologies to improve the use of physical resources. This applies to servers, storage and networking devices.	Entire Data Centre	5
4.3.5	Decommission low business value services	Identify services whose business value or criticality is low and that do not justify the financial or environmental overhead. Consider decommissioning or archiving these services or remove to locations with less reliability / resilience to reduce energy and financial overhead.	Entire Data Centre	4
4.3.6	Shut down and consider removal of idle equipment	Servers, networking and storage equipment that is idle for significant time and cannot be virtualised or archived should be shut down or put into a low power 'sleep' state. Complete removal should also be considered. Note: It will be necessary to validate the ability of legacy applications and hardware to survive these state changes without loss of function or reliability.	Entire Data Centre	4

No	Name	Description	Expected	Value
4.3.7	Control of system energy use	Consider resource management systems capable of analysing and optimising where, when and how IT workloads are executed and their consequent energy use. This may include technologies that allow remote deployment or delayed execution of jobs or the movement of jobs within the infrastructure to enable shutdown of components, entire systems or sub-systems. The desired outcome is to provide the ability to limit localised heat output or constrain system power draw to a fixed limit, at a data centre, row or cabinet level.	Optional	4
4.3.8	Audit of existing IT equipment environmental requirements	Identify the allowable intake temperature and humidity ranges for existing installed IT equipment. Equipment with restrictive intake temperature ranges should be identified so that it may be either marked for replacement with newer equipment capable of a wider intake range or moved and dealt with according to Practices "Equipment segregation" (5.1.11) and "Separate environmental zones" (5.3.4 and 5.3.5).	Entire Data Centre	4

4.4 Data Management

Storage is a major growth area in both cost and energy consumption within the data centre. It is generally recognised that a significant proportion of the data being stored is either unnecessary or duplicated or does not require rapid access and that this presents challenges to most organisations. Some sectors have a specific issue due to very broad and non-specific data retention directions from governments or regulating bodies. Where there is little structure to the data storage, implementation of these regulations can cause large volumes of data not required by the regulations to be unnecessarily heavily protected and archived.

No	Name	Description	Expected	Value
4.4.1	Data management policy	Develop a data management policy to define which data should be kept, for how long and at what level of protection. Communicate the policy to users and enforce. Particular care should be taken to understand the energy consumption impact of any data retention requirements.	Entire Data Centre	3
4.4.2	Separate user logical data storage areas by retention and protection policy	Provide users with multiple data storage areas which are clearly identified by their retention policy and level of data protection. Communicate this policy to users to enable them to store data in an area which matches the required levels of protection and retention. This is particularly valuable where strong retention requirements exist as it allows data subject to those requirements to be separated at source presenting substantial opportunities for cost and energy savings. Where possible automate the application of these policies.	Optional	3
4.4.3	Separate physical data storage areas by protection and performance requirements	Create a tiered storage environment utilising multiple media types delivering the required combinations of performance, capacity and resilience. Implement clear guidelines on usage of storage tiers with defined SLAs for performance and availability. Consider a tiered charging model based on usage at each performance level.	Optional	4

No	Name	Description	Expected	Value
4.4.4	Select lower power storage devices	When selecting storage hardware evaluate the energy efficiency in terms of the service delivered per Watt between options. This may be deployment specific and should include the achieved performance and storage volume per Watt as well as additional factors where appropriate, such as the achieved levels of data protection, performance availability and recovery capability required to meet the business service level requirements defined in the data management policy. Evaluate both the in-use power draw and the peak power of the storage device(s) as configured, both impact per device cost and energy consumption through provisioning. As a minimum comply with the EU Eco Design Directive and Lot 9 amendments to EU Commission regulation for servers and online storage systems.	Optional	4
4.4.5	Reduce total data volume	Implement an effective data identification and management policy and process to reduce the total volume of data stored. Consider implementing 'clean up days' where users delete unnecessary data from storage.	Optional	4
4.4.6	Reduce total storage volume	Implement the data management policy to reduce the number of copies of data, both logical and physical (mirrors). Implement storage subsystem space saving features, such as space efficient snapshots / copies or compression. Implement storage subsystem thin provisioning features where possible.	Optional	4

5 Cooling

Cooling of the Data Centre is frequently the largest energy loss in the facility and as such represents a significant opportunity to improve efficiency.

5.1 Air Flow Management and Design

The objective of airflow management is to circulate only the necessary amount of air through the data centre at any time that is required to remove the heat actually created by the IT equipment. This means no air returns to the cooling system without absorbing heat and no air circulates more than one time through the IT equipment.

Poor airflow management often results attempts to compensate by reducing cooling unit air supply temperatures or supplying excessive air volumes, which has an energy penalty. Addressing these issues will deliver more uniform equipment inlet temperatures and allow set points to be increased (with the associated energy savings) without the risk of equipment overheating. Implementation of air management actions alone does not result in an energy saving – they are enablers which need to be tackled before temperature set points can be raised or airflow volumes reduced.

Note: Computational Fluid Dynamics (CFD) can help to achieve an optimal airflow design if used during the early planning stages prior to construction or room fit-out.

No	Name	Description	Expected	Value
5.1.1	Design – Hot / Cold aisle	As the power densities and air flow volumes of IT equipment have increased it has become necessary to ensure that equipment shares an air flow direction, within the cabinet, in adjacent cabinets and across aisles. The hot / cold aisle concept aligns equipment air flow to create aisles between cabinets that are fed cold air from which all of the equipment draws intake air in conjunction with hot aisles with no cold air feed to which all equipment exhausts air. Reinforce Hot / Cold aisle design with empty but fully blanked cabinets (or solid doors) rather than leaving gaps in aisles.	New IT Equipment and New build or retrofit	5
5.1.2	Design – Contained hot or cold air	There are a number of design concepts whose basic intent is to contain and separate the cold air from the heated return air on the data floor: Hot aisle containment Cold aisle containment Contained cabinet supply, Contained room return and room supply.	New build or retrofit	5

No	Name	Description	Expected	Value
		Contained cabinet return, and cabinet chimneys. Contained cabinet supply, Contained cabinet return Note: Failure to contain air flow results in both a reduction in achievable cooling efficiency and an increase in risk. Changes in IT hardware and IT management tools mean that the air flow and heat output of IT devices is no longer constant and may vary rapidly due to power management and workload allocation tools. This may result in rapid changes to data floor air flow pattern and IT equipment intake temperature which cannot be easily predicted or prevented. This Practice supersedes Practice 5.1.1 when implemented.		
5.1.3	Design – Contained hot or cold air – Retrofit	Where hot / cold aisle separation is already in use but there is no containment of hot or cold air it is possible to retrofit to provide basic separation for example using curtains or other methods. Care should be taken to assess and verify fire system requirements and regulations.	New build or retrofit	4
5.1.4	Cabinet air flow management – Blanking Plates	Installation of blanking plates where there is no equipment to reduce hot air re-circulating through gaps in the cabinet. This reduces air heated by one device being ingested by another device, increasing intake temperature and reducing efficiency.	Entire Data Centre	4
5.1.5	Cabinet air flow management – Other openings	Installation of aperture brushes (draught excluders) or cover plates to cover all air leakage opportunities in each cabinet. This includes: floor openings at the base of the cabinet Gaps at the sides, top and bottom of the cabinet between equipment or mounting rails and the perimeter of the cabinet	New build or retrofit	3
5.1.6	Provide adequate free area on cabinet doors	Solid doors should be replaced (where cooling ventilation is necessary), with perforated doors to ensure adequate cooling airflow. Solid doors impede the cooling airflow and promote recirculation within the enclosed cabinet increasing equipment inlet temperatures.	New IT Equipment New build or retrofit	4

No	Name	Description	Expected	Value
		ISO/IEC 14763-2 recommends a minimum of at least 66% perforated area.80% is considered an ideal target by other authorities.		
5.1.7	Raised floor air flow management	Close all unwanted apertures in the raised floor. Review placement and opening factors of vented tiles to reduce bypass. Maintain unbroken rows of cabinets to prevent re-circulated air. If necessary, fill with empty fully blanked cabinets. Managing unbroken rows is especially important in hot and cold aisle environments. Any opening between the aisles will degrade the separation of hot and cold air.	Entire Data Centre	3
5.1.8	Raised floor air flow management – Obstructions	Review the placement and level of obstruction created by cabling, cable trays and other structures in the air flow paths, these obstruct airflow and create turbulence, increasing the resistance and increasing the energy requirements of air movement and may increase velocities, causing negative pressure. Ensure that the under-floor area is as free of obstructions as possible. The use of overhead cabling trays can substantially reduce the level of obstruction.	Entire Data Centre	3
5.1.9	Design – Return plenums	Consider the use of a return plenum(s) to return heated air from the IT equipment directly to the air conditioning units.	Optional	3
5.1.10	Design – Raised floor or suspended ceiling height	It is common to use the voids in the raised floor, suspended ceiling or both in a data centre to feed cold air to equipment or remove hot air from the equipment. Where they are used, increasing the size of these spaces can reduce the fan losses associated with moving air.	Optional	3
5.1.11	Equipment segregation	Deploy groups of equipment with substantially different environmental requirements and / or equipment airflow direction in a separate area. Where equipment has different environmental requirements it is preferable to provide separate environmental controls. This objective of this Practice is to address the issue of the data centre cooling plant settings being constrained by the equipment with the most restrictive environmental range or poor air flow control as this compromises the efficiency of the entire data centre.	New IT Equipment and New build or retrofit	3

No	Name	Description	Expected	Value
		Note: This Practice applies to IT, mechanical and electrical equipment installed in the data centre.		
5.1.12	Control of supplied air flow volume minimizing over pressure	Investigate operating cooling unit fans to ensure a slight oversupply of air compared to IT equipment flow demand to minimise recirculation whilst avoiding oversupply of air volume (results in bypass and fan energy wastage). This principle is particularly applicable contained systems. In contained air systems, ensure that there is a slightly positive pressure (preferably no more than 5Pa) in the cold air stream with respect to the hot air stream.	New build or retrofit	3

5.2 Cooling Management

The data centre is not a static system and the cooling systems should be tuned in response to changes in the facility thermal load or external ambient conditions such as seasonal variation.

No	Name	Description	Expected	Value
5.2.1	Scalable or modular installation and use of cooling equipment	Cooling plant should be installed in a modular arrangement allowing operators to shut down unnecessary equipment. This should then be part of the review at each cooling load change. Design to maximise the part load efficiency as described in sections 3.3.4, 5.4.2.3 and 5.4.2.4.	Optional	3
5.2.2	Shut down unnecessary cooling equipment	If the facility is not yet fully populated or space has been cleared through consolidation non variable plant such as fixed speed fan CRAC / CRAH units shall be turned off in the empty areas. Note: This should not be applied in cases where operating more plant at lower load is more efficient, e.g. variable speed drive CRAC / CRAH units.	Entire Data Centre	4
5.2.3	Review of cooling before IT equipment changes	The availability of cooling including the placement and flow of vented tiles should be reviewed before all IT equipment changes to optimise the use of cooling resources.	Entire Data Centre	4
5.2.4	Define and review of cooling strategy	Periodically review the IT equipment and cooling deployment against defined strategy.	Entire Data Centre	4
5.2.5	Review CRAC / CRAH Settings	Ensure that CRAC / CRAH units in occupied areas have appropriate and consistent temperature and relative humidity settings properly calibrated to avoid units working against each other. For example, many CRAC / CRAH units now have the option to connect their controls and run together when installed in the same area. Care should be taken to understand and avoid any potential new failure modes or single points of failure that may be introduced.	Entire Data Centre	4

No	Name	Description	Expected	Value
5.2.6	Dynamic control of building cooling	Consider implementing control systems that take multiple factors including cooling load, data floor air temperature and external air temperature into account to optimise the cooling system, (e.g. chilled water loop temperature) in real time. Control should be according to an agreed strategy.	Optional	3
5.2.7	Effective regular maintenance of cooling plant	Implement effective regular maintenance of the cooling system in order to conserve or achieve a "like new condition" is essential to maintain the designed cooling efficiency of the data centre. Examples include the following: belt tension, condenser coil fouling (water or air side), evaporator fouling etc. This includes regular filter changes to maintain air quality and reduce friction losses along with the routine monitoring of air quality and a regular technical cleaning regime (including under-floor areas if applicable).	Entire Data Centre	2
5.2.8	Review and optimise chilled water temperature	Review and if possible, increase the chilled water temperature set points to maximise the use of free cooling and reduce compressor energy consumption. Seasonal impact should be taken into account where applicable. Set points should be raised together with supply air flow set points to avoid reducing capacity. Review and if useful increase the chilled water temperature difference to reduce the water flow and thereby to reduce pump energy consumption. Where a DX system is used the evaporator temperatures should be reviewed. Electronic Expansion Valves (EEVs) allow better control and permit higher evaporator temperatures than Thermostatic Expansion Valves (TEVs).	Entire Data Centre	4

5.3 Temperature and Humidity Settings

Facilities are often overcooled with colder than necessary air temperatures (and hence chilled water temperatures, where used), resulting in an energy penalty. Widening the set range for humidity can substantially reduce humidifier loads. Reviewing and addressing air management issues as described in sections 5.1 and 5.2, is recommended before set points can be changed in order to avoid risk to operational integrity and expert advice should always be sought before changing the environmental range for the facility. An increase in chilled water temperature set points provides enhanced efficiency for free cooling and a reduction in compressor energy consumption. Unnecessary humidifier loads generated by chilled water or evaporator temperatures below the data hall air dew point causing dehumidification should be eliminated through adjustment of the lower humidity set point.

The specification of wider operating humidity and temperature ranges for the data floor should be performed in conjunction with changes in IT equipment procurement policy, over time narrow tolerance equipment will be naturally cycled out and replaced.

No	Name	Description	Expected	Value
5.3.1	Review and if possible, raise target IT equipment intake air temperature	Data Centres should be designed and operated *at their highest efficiency* to deliver intake air to the IT equipment within the ASHRAE Class A2 allowable range for Data Centres. Operations in this range enable energy savings by reducing or eliminating overcooling. Note: Some data centres may contain equipment with legacy environmental ranges as defined in 4.1.2, the maximum temperature for these facilities will be restricted by this equipment until segregation can be achieved as described in Practices 5.1.11, 5.34 and 5.3.5. Note: Additional Best Practices for airflow management as defined in section 5.1 may need to be implemented at the same time to ensure successful operations. Note: Some, particularly older, IT equipment may exhibit significant increases in fan power consumption as intake temperature is increased. Validate that your IT equipment will not consume more energy than is saved in the cooling system. A summary of ASHRAE environmental guidelines can be found at: https://www.ashrae.org/file%20library/technical%20resources/bookstore/supplemental%20files/referencecard_2021thermalguidelines.pdf	Entire Data Centre	4
5.3.2	Review and widen the working humidity range	Reduce the lower humidity set point(s) of the data centre within the ASHRAE Class A2 range to reduce the demand for humidification.	Entire Data Centre	4

No	Name	Description	Expected	Value
		Review and if practical increase the upper humidity set point(s) of the data floor within the current A2 humidity range of decrease the dehumidification loads within the facility. The relevant standard is the ASHRAE Class A2 allowable range for Data Centers. Note: Some data centres may contain equipment with legacy environmental ranges as defined in 4.1.2, the humidity range for these facilities will be restricted by this equipment until segregation can be achieved as described in Practices 5.1.11, 5.3.4 and 5.3.5. Controlling humidity within a wider range of humidity ratio or relative humidity can reduce humidification and dehumidification loads and therefore energy consumption. A summary of ASHRAE environmental guidelines can be found at: https://www.ashrae.org/file%20library/technical%20resources/bookstore/supplemental%20files/referencecard_2021thermalguidelines.pdf		
5.3.3	Expanded IT equipment inlet environmental conditions (temperature and humidity)	Where appropriate and effective, Data Centres can be designed and operated within the air inlet temperature and relative humidity ranges of 5°C to 40°C and 5% to 80% rh, non-condensing respectively, and under exceptional conditions up to +45°C as described in *ETSI EN 300 019–1-3* Class 3.1. Note: Using the full range up to 40°C or 45°C will allow for the complete elimination of refrigeration in most climates allowing the operator to eliminate the capital and maintenance cost of the cooling systems.	Optional	5
5.3.4	Separate environmental zones	Where a data centre houses both IT equipment compliant with the extended range of Practice 4.1.3 and other equipment which requires more restrictive temperature or humidity control as described in Practice 4.1.2, separate areas should be provided. These areas should have separate environmental controls and may use separate cooling systems to facilitate optimisation of the cooling efficiency of each zone. Examples are equipment which: Requires tighter environmental controls to maintain battery capacity and lifetime such as UPS	New build or retrofit	4

No	Name	Description	Expected	Value
		Requires tighter environmental controls to meet archival criteria such as tape Requires tighter environmental controls to meet long warranty durations (10+ year) The objective of this Practice is to avoid the need to set the data centre cooling plant for the equipment with the most restrictive environmental range and therefore compromising the efficiency of the entire data centre.		
5.3.5	Separate environmental zones – Colocation or Managed Service Provider	Customers requiring extremely tight environmental control or items such as legacy equipment should not compromise the entire data centre for specific items of equipment. Service providers should design in such a way that discrete areas may be offered to customers with additional "close control" cooling equipment in order to match specific requirements this and therefore offer a tighter SLA that would inevitably involve reduced energy efficiency. These legacy equipment support areas may be differentially priced to include the capital and operational (Metered), cost overhead of supporting a less energy efficient legacy environment as an incentive for customers to install IT equipment in more efficient areas and consider the options for more energy efficient delivery of IT services.	New build or retrofit	4

5.4 Cooling Plant

5.4.1 Free Cooling / Economised Cooling

Free cooling / economised cooling designs take advantage of cool ambient conditions to meet part or all of the facilities' cooling requirements so that the dependency on any form of mechanical cooling including compressors is reduced or even removed entirely, which can result in significant energy reduction. Free cooling can be retrofitted to some facilities. The opportunities for the utilisation of free cooling are increased in cooler and dryer climates and where increased temperature set points are used. Where refrigeration plant can be reduced in size (or eliminated), operating and capital cost are reduced, including that of the required supporting electrical infrastructure. Free cooling technologies should be considered in all new builds, retrofits and upgrades.

No	Name	Description	Expected	Value
5.4.1.1	Direct air free cooling	External air is used to cool the facility with different operating modes usually deployed. When outdoor conditions are cold exhaust air can be re-circulated and mixed with intake air to control supply air temperature and humidity. In many cases full mechanical cooling / refrigeration capacity is required as a backup to allow operation during periods of high airborne pollutant (E.G. External fires). For this reason special attention should be focussed on external air quality monitoring and filtration. Additional backup mechanical cooling with chiller or CRAC may also be considered to ensure cooling at extreme ambient temperature and humidity conditions or for system redundancy. Note: This design tends to have the lowest temperature difference between external temperature and IT supply air. Note: IT equipment is likely to be exposed to a large humidity range to allow direct air free cooling to work effectively. The achievable free cooling hours are directly constrained by the chosen upper humidity limit.	Optional	5
5.4.1.2	Indirect air free cooling	Re circulated air within the facility is primarily passed through an air to air heat exchanger against external air (may have adiabatic cooling) to remove heat to the atmosphere. A variation of this is a thermal wheel, quasi –indirect free cooling system. This design tends to have a low temperature difference between external temperature and IT supply air.	Optional	5

No	Name	Description	Expected	Value
		Note: The operating IT equipment humidity range may be well controlled at negligible energy cost in this type of design. Note: Air filtration demand is lower compared to direct air free cooling as data centre air is circulating and no external air is induced.		
5.4.1.3	Indirect water free cooling with CRAH and dry cooler or cooling tower	Chilled water cooled by the external ambient air via a free cooling coil. This may be achieved by dry coolers or by evaporative assistance through spray onto the dry coolers. This design tends to have a higher temperature difference between external temperature and IT supply air. Note: Operating IT equipment humidity range may be well controlled at negligible energy cost in this type of design. Note: In this system additional backup mechanical cooling with chiller or CRAC may be considered to ensure cooling at extreme ambient temperature and humidity conditions or for system redundancy.	Optional	5
5.4.1.4	Indirect water free cooling with CRAC with integrated free cooling coil	Chilled water is cooled by the external ambient conditions via cooling towers or dry coolers, the dry coolers may have evaporative assistance. This chilled water is supplied to the free cooling coil of the CRAC if its temperature is low enough to provide full free cooling or at least partial free cooling. Additionally, it is supplied to the plate condenser of the CRAC´s closed DX circuit when compressor operation is needed to provide sufficient cooling. This design tends to have a higher temperature difference between external temperature and IT supply air restricting the free cooling hours available and increasing energy overhead. Note: Partial free cooling (Mix mode) starts a few degrees below the return air temperature of the CRAC. Note: Operating IT equipment humidity range may be well controlled at negligible energy cost in this type of design.	Optional	4
5.4.1.5	Indirect water free cooling with	Chilled water is produced by the free cooling chiller either through the free cooling coils in the chiller if	Optional	3

No	Name	Description	Expected	Value
	CRAH and free cooling chiller	ambient temperatures are low or with compressors in operation at higher ambient temperatures. This chilled water is supplied to the CRAH in the data centre. This design tends to have a higher temperature difference between external temperature and IT supply air restricting the free cooling hours available and increasing energy overhead. Note: Partial free cooling (Mix mode) starts a few degrees below the return water temperature. Note: The operating IT equipment humidity range may be well controlled at negligible energy cost in this type of design.		
5.4.1.6	Indirect water free cooling with condenser water cooling chilled water	Cooling unit chilled water is cooled via a plate heat exchanger to the condenser water circuit passing through dry/adiabatic coolers / cooling towers. This design usually has a highest difference between the external temperature and IT supply air due to the additional heat exchange process.	Optional	3
5.4.1.7	Alternative cooling sources	Evaluate alternative forms of cooling where available, practical to utilise and offer genuine energy efficiency including Ground Source Cooling from rivers, lakes, boreholes and seawater etc.	Optional	4
5.4.1.8	Free Cooling installation	Investigate the installation of free cooling in all new builds and retrofits or upgrades of cooling systems.	New build or retrofit	5

5.4.2 High Efficiency Cooling Plant

When refrigeration is used as part of the cooling system design high efficiency cooling plant should be selected. Designs should operate efficiently at system level and employ efficient components. This demands an effective control strategy which optimises efficient operation, without compromising reliability.

Even in designs where the refrigeration is expected to run for very few hours per year the cost savings in infrastructure electrical capacity and utility power availability or peak demand fees justify the selection of high efficiency plant.

No	Name	Description	Expected	Value
5.4.2.1	Chillers with high COP (EER)	Where refrigeration[1] is installed make the Coefficient of Performance (COP) or Energy Efficiency Ratio (EER) of chiller systems through their likely working range a high priority decision factor during procurement of new plant.	New build or retrofit	3
5.4.2.2	Cooling system operating temperatures	Evaluate the opportunity to decrease condensing temperature and increase evaporating temperature; reducing delta T between these temperatures means less work is required in cooling cycle hence improved efficiency. These temperatures are dependent on required IT equipment intake air temperatures and the quality of air flow management (see Temperature and Humidity Settings).	Entire Data Centre	3
5.4.2.3	Efficient part load operation	Optimise the facility for the partial load it will experience for the majority of operational time rather than max load. Examples are exploiting the heat exchange area, reducing fan energy consumption, sequencing chillers and operating cooling towers with shared load.	New build or retrofit	3

[1] Note that this refers to mechanical compressors and heat pumps, any device which uses energy to raise the temperature of the rejected heat

No	Name	Description	Expected	Value
5.4.2.4	Variable speed drives for compressors, pumps and fans	Using variable speed control reduces energy consumption for these components in the part load condition where they operate for much of the time. Consider new or retrofit of Electrically Commutated (EC) motors which are significantly more energy efficient than traditional AC motors across a wide range of speeds. In addition to installing variable speed drives it is critical to include the ability to properly control the speed according to demand. It is of limited value to install drives which are manually set at a constant speed or have limited control settings.	New build or retrofit	3
5.4.2.5	Select systems which facilitate the use of "Free Cooling"	Cooling designs should be chosen which allow the use of as much "Free Cooling" as is possible according to the physical site constraints, local climatic or regulatory conditions that may be applicable. Select systems which facilitate the use of free cooling. In some data centres it may be possible to use direct or indirect air side free cooling. Others may not have sufficient available space and may require a chilled liquid cooling system to allow the effective use of economised cooling.	New build or retrofit	5
5.4.2.6	Do not share data centre chilled water system with comfort cooling	In buildings which are principally designed to provide an appropriate environment for IT equipment, and that have cooling systems designed to remove heat from technical spaces, do not share chilled water systems with human comfort cooling in other parts of the building. The required temperature to achieve latent cooling for comfort cooling is substantially below that required for sensible cooling of the data centre and will compromise the efficiency of the data centre cooling system. If comfort cooling remains a requirement, consider the use of heat pumps to provide either cooling or heating for office area comfort.	New build or retrofit	4
5.4.2.7	Do not allow non-IT equipment to dictate cooling system set-points	Where other equipment requires a more restrictive temperature or humidity control range than the IT equipment this should not be permitted to dictate the set points of the cooling system responsible for the IT equipment.	New build or retrofit	4

No	Name	Description	Expected	Value
5.4.2.8	Chilled water pump control strategy	Chilled water systems configured with dual pumps, one active, one on standby, can be reviewed for improved energy efficiency during operation. Using the pump manufacturers' graphs of energy use vs pump speed, evaluate running two pumps in parallel vs a single pump running at a higher speed. If beneficial implement the running of two low speed pumps to reduce energy usage while achieving the same target flow rate and pressure.	New build or retrofit	1

5.5 Computer Room Air Conditioners / Air Handlers

The second major component of most cooling systems are the air conditioning / air handling units within the computer room. The computer room side of the cooling system is frequently poorly designed and poorly optimised in older facilities.

No	Name	Description	Expected	Value
5.5.1	Variable Speed Fans	Many old CRAC / CRAH units operate fixed speed fans which consume substantial power and obstruct attempts to manage the data floor temperature. Variable speed fans are particularly effective where there is a high level of redundancy in the cooling system, low utilisation of the facility or highly variable IT electrical load. These fans may be controlled by factors such as the supply or return air temperature or the chilled air plenum pressure. Note: CRAC / CRAH units with fixed speed compressors have minimum flow requirements which constrain the minimum operating load and therefore minimum air flow.	New build or retrofit	4
5.5.2	Control on CRAC / CRAH unit supply air temperature	Controlling on supply temperature ensures an even supply air temperature independent of the load on each CRAC / CRAH unit. Historically many CRAC / CRAH units were controlled on return temperature which is no longer considered appropriate practice.	New build or retrofit	3
5.5.3	Run variable speed CRAC / CRAH units in parallel	It is possible to achieve efficiency gains by running CRAC / CRAH units with variable speed fans in parallel to reduce the electrical power necessary to achieve the required air movement as electrical power is not linear with air flow. Care should be taken to understand any new failure modes or single points of failure that may be introduced by any additional control system.	Optional	4
5.5.4	Sequencing of CRAC / CRAH units	In the absence of variable speed fans it is possible to turn entire CRAC / CRAH units on and off to manage the overall air flow volumes. This can be effective where there is a high level of redundancy in the cooling system, low utilisation of the facility or highly variable IT electrical load.	Optional	2
5.5.5	Do not control humidity at	The only humidity control that should be present in the data centre is that on fresh "Make Up" air coming into	New build or retrofit	4

No	Name	Description	Expected	Value
	CRAC / CRAH unit	the building and not on re-circulating air within the equipment rooms. Humidity control at the CRAC / CRAH unit is unnecessary and undesirable. Humidity control should be centralised. Do not install humidity control at the CRAC / CRAH unit on re-circulating air. Instead control the specific humidity of the make-up air at the supply AHU. This provides better control and allows use of adiabatic humidification (with lower energy consumption) and potential additional opportunities for some free cooling. The chilled water loop or DX evaporator temperature should in any case be too high to provide de-humidification. When purchasing new CRAC / CRAH units select models which are not equipped with humidity control capability, including any reheat capability, this will reduce both capital and on-going maintenance costs.		
5.5.6	Cooling unit sizing and selection	Air volumes required by IT equipment not only depend on the IT load (kW) but also on the IT equipment Delta-T, which will also vary with utilisation. Consider these factors, plus likely future utilisation and bypass to size the cooling units design flow rates. As air flow is inversely proportional to delta T for the same load, if the IT Delta-T is overestimated, this will result in undersized CRAC / CRAH air volumes and potential air management problems. Additionally, if it is underestimated, CRAC / CRAH air volumes will be oversized which makes low part load inefficient operation and air bypass more likely.	New build or retrofit	4

5.6 Direct Liquid Cooling

In some situations, direct liquid cooling may offer advantages over air cooling. This is particularly true in extremely high power density deployments. Direct liquid cooling may also offer advantages in the ability to harvest and utilise the heat generated by data centres, which is typically rejected rather than re-used. Directly liquid cooled IT equipment is likely to generate a higher return temperature of coolant.

No	Name	Description	Expected	Value
5.6.1	Direct liquid cooling of IT devices	In place of air cooling it is possible to directly liquid cool part or all of some IT devices. This can provide a more efficient thermal circuit and allow the coolant liquid system temperature to be substantially higher, further driving efficiency, allowing for increased or exclusive use of free cooling or heat re use. Note: This Practice applies to devices which deliver cooling liquid directly to the heat removal system of the components such as water cooled heat sinks or heat pipes and not the delivery of cooling liquid to an internal mechanical refrigeration plant or in-chassis air cooling systems. Note: ASHRAE offers guidelines for the use of liquid cooling in data centres. These can be found in the publication 'Liquid Cooling Guidelines for Datacom Equipment Centers, Second Edition'.	Optional	4

5.7 Reuse of Data Centre Waste Heat

Data Centres produce significant quantities of waste heat, whilst this is typically at a relatively low temperature there are some applications for reuse of this energy. As IT equipment utilisation is increased through consolidation and virtualisation the exhaust temperature is likely to increase which will provide greater opportunity for waste heat to be re-used. Data Centres should therefore consider the potential for the reuse of the 'waste' heat that they produce. Directly liquid cooled IT equipment is likely to provide a further improvement in the return temperature of coolant.

No	Name	Description	Expected	Value
5.7.1	Waste heat re-use	Evaluate the possibility of providing grade heating to industrial space or to other targets such as adjacent office space fresh air directly from heat rejected from the data centre. This does not reduce the energy consumed by the data centre itself but does offset the total energy overhead by potentially reducing energy use elsewhere.	New build or retrofit	4
5.7.2	Heat pump assisted waste heat re-use	Where it is not possible to directly re-use the waste heat from the data centre due to the temperature being too low it can still be economic to use additional heat pumps to raise the temperature to a useful point. This possibility should be evaluated and can potentially supply office, district and other heating needs.	New build or retrofit	4
5.7.3	Use data floor waste heat to warm office, generator and fuel storage areas	Evaluate reducing or eliminating the electrical preheat loads for generators and fuel storage by using warm exhaust air from the data floor to maintain temperature in the areas housing generators, fuel storage tanks and office areas.	Optional	2
5.7.4	Energy reuse metrics and reporting	The opportunity for the reuse of waste heat from data centres is referenced by *ISO/IEC 30134-6* Information technology — Data centres — Key performance indicators — Part 6: Energy Reuse Factor (ERF)	Optional	1
5.7.5	Capture Ready Infrastructure	Consider installing 'Capture Ready' Infrastructure to take advantage of, and distribute, available waste heat during new build and retrofit projects.	Optional	1

6 Data Centre Power Equipment

The other major part of the facility infrastructure is the power conditioning and delivery system. This normally includes uninterruptible power supplies, power distribution units and cabling but may also include backup generators and other equipment.

6.1 Selection and Deployment of New Power Equipment

Power delivery equipment has a substantial impact upon the efficiency of the data centre and tends to stay in operation for many years once installed. Careful selection of the power equipment at design time can deliver substantial savings through the lifetime of the facility.

No	Name	Description	Expected	Value
6.1.1	Modular UPS deployment	It is now possible to purchase modular (scalable) UPS systems across a broad range of power delivery capacities. Physical installation, transformers and cabling are prepared to meet the design electrical load of the facility but the sources of inefficiency (such switching units and batteries) are installed, as required, in modular units. This substantially reduces both the capital cost and the fixed overhead losses of these systems. In low power installations these may be frames with plug in modules whilst in larger installations these are more likely to be entire UPS units.	New build or retrofit	3
6.1.2	High efficiency UPS	If static AC UPS systems are to be installed select energy efficient UPS systems that are compliant with the "elite requirements" of the 2021 version of the EU Code of Conduct on Energy Efficiency of AC Uninterruptible Power Systems. A UPS compliant to this Code of Conduct requirement should also be compliant to *IEC 62040* series for UPS systems, which also provides environmental operating conditions. A UPS conforming to this standard should be able to perform as rated when operating within the following minimum ambient ranges: Temperature 0°C to +40°C. Relative Humidity 20% to 80% Note: Rotary and Direct Current UPS systems are not included in the 2021 version of the EU Code of Conduct on AC Uninterruptible Power Systems, but this does not in any way suggest that rotary or Direct Current UPS should not be used, rather that these technologies are not currently covered by an EU Code of Conduct	New build or retrofit	3

No	Name	Description	Expected	Value
		providing shared evidence of meeting high efficiency requirements for these systems.		
6.1.3	Use efficient UPS operating modes	Deploy UPS units in their most efficient operating modes where appropriate. Note Use of alternative UPS technologies such as rotary or direct current systems may be considered. The comparison and evaluation of the technologies shall be based on latest and non-biased information about available products in the market. Some UPS systems may have technologies allowing energy optimisation at partial load levels and these shall be taken into account as appropriate for the application. This may also be particularly relevant for any UPS system feeding mechanical loads e.g. CRAC/CRAH fans.	New build or retrofit	2
6.1.4	Elimination of Isolation Transformers	Isolation transformers in power distribution to IT equipment down to 120V are typically not required in Europe and should be eliminated from designs as they introduce additional transformer losses unnecessarily.	New build or retrofit	3
6.1.5	Efficient part load operation	Electrical infrastructure should remain energy efficient under partial fill and variable IT electrical loads as described in Practice 3.3.4.	New build or retrofit	3

6.2 Management of Existing Power Equipment

. No	Name	Description	Expected	Value
6.2.1	Reduce engine-generator heater temperature set-point	When using engine heaters to keep generators ready for rapid starts, consider reducing the engine heater set-point. Block heaters for the Standby Generators should be controlled to only operate when the temperature conditions warrant it. Consult manufacturer to understand risk / reliability implications.	Optional	2
6.2.2	Power Factor Correction	Monitor, understand and manage the consequences of the Power Factors of both the Mechanical and Electrical infrastructure and installed IT equipment within the data centre. Poor Power Factor management can lead to higher cable losses and also introduce significant risk to the continuity of power supply. Low cost power supplies often have very poor Power Factors with little or no correction. These can build up to introduce electrical inefficiency and risk. Poor power factor can result in penalties and extra charges imposed by the grid provider. Note: Consider the use of Power Factor Correction where appropriate.	Optional	2

7 Other Data Centre Equipment

Energy is also used in the non data centre floor areas of the facility such as office and storage spaces. Energy efficiency in these areas should be optimised based on relevant building standards, such as relevant EU standards, LEED, BREEAM etc.

7.1 General Practices

These general practices apply to the data floor and may be extended to the remainder of the building if no sustainable building standard is in use.

No	Name	Description	Expected	Value
7.1.1	Turn off Lights	Lights should be turned off, preferably automatically whenever areas of the building are unoccupied, for example switches which turn off lighting a specified time after manual activation. Motion detector activated lighting is generally sufficient to support security camera systems.	Entire Data Centre	1
7.1.2	Low energy lighting	Low energy lighting systems should be used in the data centre. LED lighting is a good example and a simple retrofit.	New build or retrofit	1
7.1.3	Pale coloured fixtures and fittings	Use pale / light colours on walls, floors fixtures and fittings including cabinets etc. to reduce the amount of lighting required to illuminate a data hall and therefore the energy consumed for lighting. This will also ensure good levels of visibility both throughout the hall and within cabinets.	New build or retrofit	1
7.1.4	Energy & temperature reporting hardware	Select Mechanical and Electrical equipment with direct local metering of power usage and/or temperature reporting capabilities (where appropriate), preferably reporting energy used as a counter in addition to power as a gauge. To assist in the implementation of temperature and energy monitoring across a broad range of data centre infrastructure all monitoring devices installed should be able to use existing networks and operate on an Open Protocol basis. This interface protocol should enable all operators' existing monitoring platform to be able to retrieve data from the installed meters without the purchase of additional licenses from the equipment vendor. The intent of this Practice is to provide energy and environmental monitoring of the data centre throughout the entire infrastructure with increasing levels of granularity.	New build or retrofit	3

8 Data Centre Building

The location and physical layout of the data centre building is important to achieving flexibility and efficiency. Technologies such as fresh air cooling require significant physical plant space and air duct space that may not be available in an existing building.

8.1 Building Physical Layout

The physical layout of the building can present fundamental constraints on the applicable technologies and achievable efficiencies.

No	Name	Description	Expected	Value
8.1.1	Locate M&E plant outside the cooled area	Heat generating Mechanical and Electrical plant such as UPS units should be located outside the cooled areas of the data centre wherever possible to reduce the loading on the data centre cooling plant.	New build or retrofit	2
8.1.2	Select or create a building with sufficient 'slab to slab' separation / ceiling height	Where air movement is used to cool the IT equipment, insufficient ceiling height will frequently hamper the use and efficiency of air cooling technologies such as raised floor, suspended ceiling, aisle containment or ducts in the data centre.	New build or retrofit	3
8.1.3	Facilitate the use of "Free Cooling"	The physical layout of the building should not obstruct or restrict the use of free cooling (either air or water), or other equipment with an economisation / free cooling mode.	New build or retrofit	3
8.1.4	Location and orientation of plant equipment	Cooling equipment, particularly dry or adiabatic coolers should be located in an area of free air movement to avoid trapping it in a local hot spot. Ideally this equipment should also be located in a position on the site where the waste heat does not affect other buildings and create further demand for air conditioning.	New build or retrofit	2
8.1.5	Minimise direct solar heating	Minimise solar heating (insolation), of the cooled areas of the data centre by providing shade or increasing the albedo (reflectivity) of the building through the use of light coloured roof and wall surfaces. Shade may be constructed, provided by utilising natural features including "green roof" systems. Effective insulation can be provided by using suitable wall and roof coverings.	New build or retrofit	2

		There should also be no external windows in the data centre to prevent heating from direct sunlight. This is also good practice from a security point of view. Failure to protect against solar heating (insolation) will result in additional cooling requirements.		

8.2 Building Geographic Location

Whilst some operators may have no choice of the geographic location for a data centre it nevertheless impacts achievable efficiency, primarily through the impact of external climate.

No	Name	Description	Expected	Value
8.2.1	Locate the Data Centre where waste heat can be reused	Locating the data centre where there are available uses for waste heat can save substantial energy. Heat recovery can be used to heat residential or office space, industrial spaces, hydroponic farming, swimming pools, fish farms, grain and biomass drying etc.	Optional	4
8.2.2	Locate the Data Centre in an area of low ambient temperature	Free and economised cooling technologies are more effective in areas of low ambient external temperature and or humidity. Note: Most temperature climates present significant opportunity for economised cooling and zero refrigeration.	Optional	4
8.2.3	Avoid locating the data centre in high ambient humidity areas	Free cooling is particularly impacted by high external humidity as dehumidification becomes necessary. Many economiser technologies (such as evaporative cooling) are also less effective.	Optional	1
8.2.4	Locate near a source of free cooling	Locating the data centre near a source of free ground source cooling such as a river or lake etc. subject to local environmental regulation.	Optional	1
8.2.5	Co-locate with power source	Locating the data centre close to the power generating plant can reduce transmission losses.	Optional	1

8.3 Water sources

Data centres can use a significant quantity of water in cooling and humidity control, the use of low energy intensity water sources can reduce the effective energy consumption of the data centre.

No	Name	Description	Expected	Value
8.31	Capture rainwater	Capture and storage of rainwater for evaporative cooling or other non-potable purposes may reduce overall energy consumption	Optional	1
8.3.2	Other water sources	Use of other local non-utility or 'Grey' water sources for evaporative cooling or other non-potable purposes may reduce overall energy consumption	Optional	2
8.3.3	Metering of water consumption	The site should meter water consumption from all sources. The site should seek to use this data to manage and reduce overall water consumption, particularly in areas where fresh water is a scarce resource. Note: Water consumption cannot be directly compared with energy efficiency unless the energy intensity of the water source is understood. Comparing water consumption between buildings is therefore not useful. Note: Reporting should be based on *ISO/IEC 30134-9 (WUE)*	Optional	2

9 Monitoring

The development and implementation of an energy monitoring and reporting management strategy is core to operating an efficient data centre.

9.1 Energy Use and Environmental Performance Measurement

Most data centres currently have little or no energy use or environmental performance measurement capability; many do not even have a separate utility meter or bill. The ability to measure energy use and factors impacting energy use is a prerequisite to identifying and justifying improvements. It should also be noted that measurement and reporting of a parameter may also include alarms and exceptions if that parameter passes outside of the acceptable or expected operating range.

No	Name	Description	Expected	Value
9.1.1	Incoming energy consumption meter	Install metering equipment capable of measuring the total energy use of the data centre including all power conditioning, distribution and cooling systems. This should be separate from any non data centre building loads. Note: This is required for Code of Conduct reporting.	Entire Data Centre	4
9.1.2	IT Energy consumption meter	Install metering equipment capable of measuring the total energy delivered to IT systems. This may also include other power feeds where non UPS protected power is delivered to the cabinets. Note: This is required for Code of Conduct reporting.	Entire Data Centre	4
9.1.3	Room level metering of supply air temperature and humidity	Install metering equipment at room level capable of indicating the supply air temperature and humidity for the IT equipment.	Entire Data Centre	2
9.1.4	CRAC / CRAH unit level metering of supply or return air temperature	Collect data from CRAC / CRAH units on supply and return (dependent upon operating mode) air temperature.	Entire Data Centre	3
9.1.5	Distribution board level metering of Mechanical and Electrical energy consumption	Improve visibility and granularity of data centre infrastructure overheads	New build or retrofit	3

No	Name	Description	Expected	Value
9.1.6	Cabinet level metering of IT Energy consumption	Improve visibility of IT energy consumption by metering at the cabinet level and individual power strips.	Optional	3
9.1.7	Row or Cabinet level metering of temperature	Improve visibility of air supply temperature in existing hot / cold aisle environments to assist in recognising and dealing with air flow management issues and both over-cooling and under-cooling of IT equipment. Note: This would be applicable in both contained and non-contained aisles.	Optional	3
9.1.8	IT Device level metering of temperature	Improve granularity and reduce metering cost by using built in device level metering of intake and / or exhaust air temperature as well as key internal component temperatures. Note: Most new servers provide this feature as part of the basic chipset functionality.	Optional	4
9.1.9	IT Device level metering of energy consumption	Improve granularity and reduce metering cost by using built in IT device level metering of energy consumption. Note: Most new servers provide this feature as part of the basic chipset functionality.	Optional	4

9.2 Energy Use and Environmental Data Collection and Performance Logging

Once data on energy use and environmental (temperature and humidity) conditions is available through the installation of measurement devices it needs to be collected, logged and stored for performance analysis.

No	Name	Description	Expected	Value
9.2.1	Periodic manual readings	As an entry level, energy, temperature and humidity (dry bulb temperature, relative humidity and dew point temperature) should be made available to allow reporting to be performed based on periodic manual readings of measurement and metering equipment. This should occur at regular times, ideally at peak load. Note: Energy reporting is already mandated for Code of Conduct reporting requirements also that automated readings are considered to be a replacement for this Practice when applying for Participant status.	Entire Data Centre	3
9.2.2	Automated daily readings	Automated daily readings enable more effective management of energy use. Note: Supersedes Periodic manual readings.	New build or retrofit	4
9.2.3	Automated hourly readings	Automated hourly readings enable effective assessment of how IT energy use varies with IT workload. Note: Supersedes Periodic manual readings and Automated daily readings.	Optional	4
9.2.4	Achieved free cooling / economised cooling hours	Require collection and logging of full free cooing, partial free cooling and full refrigerant and compressor based cooling hours throughout the year. The intent being to record the amount of time and energy spent running on mechanical refrigerant and compressor based cooling versus the use of free cooling in order to reduce the amount of time spent on mechanical cooling during the year. The site design, cooling system operational set-points and IT equipment environmental control ranges should allow the data centre to operate without refrigeration for a significant part of the year with no	New build or retrofit	4

No	Name	Description	Expected	Value
		refrigeration for the IT cooling load as evaluated against a Typical Meteorological Year for the site. Note: This refers to mechanical compressors and heat pumps, any device which uses energy to raise the temperature of the rejected heat.		

9.3 Energy Use and Environmental Performance Reporting

Energy use and environmental (temperature and humidity) data needs to be regularly reported to be of use in managing the energy efficiency of the facility.

No	Name	Description	Expected	Value
9.3.1	Written Reporting	Minimum reporting consists of periodic written reports on energy consumption and environmental ranges. All written reports and submissions should reference the Category being reported and ensure that the required method of data collection and calculation determined by the Standardised ISO KPIs from the *ISO/IEC 30134* series (or *EN 50600-4-X* equivalent), should be used in all reports, written or otherwise if reported. The Standardised KPIs include PUE, pPUE, REF, ITEESV, ITEUSV, ERF, CER, CUE, WUE. Note: Determining the averaged DCiE or PUE over the reporting period is already mandated by the Code of Conduct reporting requirements. This report may be produced by an automated system. Note: All DCiE and PUE calculations should be completed according to the guidelines set out by *EN 50600-4-2* which is equivalent to *ISO/IEC 30134-2*. *EN 50600-4-2* "Information technology — Data centre facilities and infrastructures — Part 4-2: Power Usage Effectiveness". Note: Different categories of PUE ranging from 0 to 3 representing increasing levels of reporting granularity.	Entire Data Centre	4

No	Name	Description	Expected	Value
9.3.2	Energy and environmental reporting console	An automated energy and environmental reporting console to allow M&E staff to monitor the energy use and efficiency of the facility provides enhanced capability. This supersedes the requirements for Written Reporting. See section 9.3.1 above with regard to correct method of calculation and the use of Standardised ISO/IEC KPIs or European equivalents if reported.	Optional	4
9.3.3	Integrated IT / M&E energy and environmental reporting console	An integrated energy and environmental reporting capability in the main IT reporting console allows integrated management of energy use and comparison of IT workload with energy use. Averaged, instantaneous and working ranges of Standardised ISO/IEC KPIs are reported and related to IT workload. This supersedes Written Reporting and Energy and environmental reporting console. This reporting may be enhanced by the integration of effective physical, logical asset and configuration data. See section 9.3.1 above with regard to correct method of calculation and the use of Standardised ISO/IEC KPIs or European equivalents if reported.	Optional	4
9.3.4	Achieved free cooling / economised cooling hours	Require reporting of full free cooling, partial free cooling and full refrigerant and compressor based cooling hours throughout the year. The intent being to report the amount or time and energy spent running on mechanical refrigerant and compressor based cooling versus the use of free cooling in order to reduce the amount of time spent on mechanical cooling during the year. The site design, cooling system operational set-points and IT equipment environmental control ranges should allow the data centre to operate without refrigeration for a significant part of the year with no refrigeration for the IT cooling load as evaluated against a Typical Meteorological Year for the site. Note: This refers to mechanical compressors and heat pumps, any device which uses energy to raise the temperature of the rejected heat.	New build or retrofit	4

No	Name	Description	Expected	Value
9.3.5	PUE and Partial PUE Reporting	Report Power Usage Effectiveness and partial PUE (PUE and pPUE) according to *EN 50600-4-2 or ISO/IEC 30134-2*. If partial PUE is reported the Standardised KPI should be used. Consider advocating the use of trending rather than hard targets for PUE. This should be based on kW/h consumption and a consistent IT Load. Suggestions for come from EN 50600-5-1 (5.1.3.1)	Optional	4
9.3.6	REF Reporting	Report REF according to *EN 50600-4-3 or ISO/IEC 30134-3*. If REF is reported the Standardised KPI should be used.	Optional	4
9.3.7	ITEEsv Reporting	Report IT Equipment Energy Efficiency for Servers (ITEEsv) according to *EN 50600-4-4 or ISO/IEC 30134-4*. If ITEEsv is reported the Standardised KPI should be used.	Optional	4
9.3.8	ITEUsv Reporting	Report IT Equipment Utilization for Servers (ITEUsv) according to *EN 50600-4-5 or ISO/IEC 30134-5*. If ITEUsv is reported the Standardised KPI should be used.	Optional	4
9.3.9	ERF Reporting	Report Energy Reuse Factor (ERF) according to *EN 50600-4-6 or ISO/IEC 30134-6*. If CER is reported the Standardised KPI should be used.	Optional	4
9.3.10	CER Reporting	Report Cooling Efficiency Ratio (CER) according to *EN 50600-4-7 or ISO/IEC 30134-7*. If CER is reported the Standardised KPI should be used. Consider advocating the use of trending rather than hard targets for CER. This should be based on kW/h consumption and a consistent IT Load. Suggestions come from EN 50600-5-1 (8.13.1)	Optional	4
9.3.11	CUE Reporting	Report Carbon Usage Effectiveness (CUE) according to *ISO/IEC 30134-8*. If CUE is reported the Standardised KPI should be used. Consider advocating the use of trending rather than hard targets for CuE. This should be based on kW/h consumption and a consistent IT Load.	Optional	4

No	Name	Description	Expected	Value
9.3.12	WUE Reporting	Report Water Usage Effectiveness (WUE) according to *ISO/IEC 30134-9*. If WUE is reported the Standardised KPI should be used. Consider advocating the use of trending rather than hard targets for WUE. This should be based on kW/h consumption and a consistent IT Load.	Optional	4

9.4 IT Reporting

Utilisation of the IT equipment is a key factor in optimising the energy efficiency of the data centre. Consider reporting aggregated data relevant to specific internal business needs. This Practice will remain optional while effective open metrics and reporting mechanisms remain under development.

No	Name	Description	Expected	Value
9.4.1	Server Utilisation	Logging and internal reporting of the processor utilisation of the overall or grouped by service / location IT server estate. Whilst effective metrics and reporting mechanisms are still under development a basic level of reporting can be highly informative and should consider energy efficiency. Note: Server Utilisation reporting should be performed according to *EN 50600-4-4 or ISO/IEC 30134-4*.	Optional	3
9.4.2	Network Utilisation	Logging and internal reporting of the proportion of the overall or grouped by service / location network capacity utilised. Whilst effective metrics and reporting mechanisms are still under development a basic level of reporting can be highly informative and should consider energy consumption.	Optional	3
9.4.3	Storage Utilisation	Logging and internal reporting of the proportion of the overall storage capacity and performance utilised (Grouped by service or location). Whilst effective metrics and reporting mechanisms are still under development a basic level of reporting can be highly informative and should consider energy consumption. The meaning of utilisation can vary depending on what is considered available capacity (e.g., ports, raw v. usable data storage) and what is considered used (e.g., allocation versus active usage). Ensure the definition used in these reports is clear and consistent. Note: Mixed incentives are possible here through the use of technologies such as de-duplication.	Optional	3
9.4.4	Business relevant dashboard	Establish sensible and useful business specific metrics and potentially a business relevant efficiency dashboard to accurately reflect, highlight, manage and ideally reduce the overall energy usage required to deliver the IT services defined by specific business requirements.	Optional	3

No	Name	Description	Expected	Value
		Note: This goes beyond Practice 9.3.3 and the metrics chosen as relevant will vary between different businesses.		

10 Practices to become minimum expected

The following Practices are planned to become minimum expected Practices in future updates of the Code of Conduct. The update year of the Code of Conduct in which the Practices will become expected is shown in the table.

No	Name	Description	Expected	Year

11 Items under Consideration

This section contains suggested items that are under consideration for inclusion in the Best Practices once available from sector research and development or standards bodies etc. Routinely updated documents providing a view of the entire data centre standards landscape provided by The CEN/CENELEC/ETSI Coordination Group on Green Data Centres (CEN/CLC/ETSI CG GDC) and can be found at: https://www.cencenelec.eu/areas-of-work/cenelec-sectors/digital-society-cenelec/green-data-centres/

No	Name	Description	Expected
11.1	Further development of software efficiency definitions	There is much research and development needed in the area of defining, measuring, comparing and communicating software energy efficiency. Suggested examples of this are: Software could be made resilient to delays associated with bringing off-line resources on-line such as the delay of drive spin, which would not violate the service level requirements. Software should not gratuitously poll or carry out other unnecessary background "housekeeping" that prevents equipment from entering lower-power states, this includes monitoring functions. This is a specialist area which is being examined in detailed by projects specialising in this field. A watching brief will be maintained and links established to any ongoing projects on the development of metrics and standards in this area, which the Code of Conduct can subsequently reference once published and use to underpin the expectations detailed in sections 4.2.4 and 4.2.5. ISO/IEC JTC1 SC39 has a continuing focus on this area as does the Green Software Foundation. German DE-UZ 215 'Blue Angel' / 'Blauer Engel' – Eco Label for software is also a reference in this respect.	Optional
11.2	EU Eco Design Directive idle state power	Consideration should be given to improving on the requirements of the EU Eco Design Directive idle state power. It is suggested that the idle state power value of new servers shall be 20% less than the value required by the EU Eco Design Directive once the updated version has been published.	Optional

11.3	Use of Hydrogen or other alternative energy sources and storage	Consider use of Green Hydrogen or other energy sources as well as energy storage for baseload generation using fuel cells or other technologies to reduce GHG emissions. This Practice does need additional work to refine both the intent and the ambition. An example is to consider the use of HVO in standby generators and consider developing options involving less carbon output such as Hydrogen, as they become available. Note that this is covered in part by Practice 3.2.11	Optional
11.4	Direct Liquid Cooling	Best Practices for direct liquid cooling solutions are to be suggested and incorporated as developed. See 4.1.14	

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For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

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The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

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NRK

Sjekkliste i forbindelse med overføring av personopplysning til tredjeland.

Checklist in connection with transfer og personal data to a third country.

Fill out the checklist below, or fill out an attachment to the checklist. *Please note that a "transfer" of personal data includes any type of activity whereby the data are made accessible to a recipient located in another country, including where the recipient has access by remote access*

Fyll ut sjekklisten under, eller utarbeid eget vedlegg til sjekklisten. *Vær oppmerksom på at "overføring" av personopplysninger omfatter enhver behandling som innebærer at opplysningene gjøres tilgjengelige for en mottaker i et annet land, herunder for eksempel hvis mottaker har tilgang gjennom fjernaksess*

Q1	ENG: Will the services procured by tenderer/supplier involve that NRK personal data will be transferred to, stored in data centers and/or processed from a location outside the EU/EEA ("a third country")? NO: Vil tjenestene som anskaffes fra leverandør/tilbyder medføre at personopplysninger som tilhører NRK bli overført til, lagret i, eller på annen måte behandlet fra en lokasjon utenfor EU/EØS («et tredjeland»)?	. (Include answer: YES / NO) . (Sett inn svar: JA / NEI)
Q2	ENG: Will the services procured by tenderer/supplier involve that NRK personal data will be transferred to sub-processor/sub-contractor of the tenderer/supplier, located in a third country? NO: Vil tjenestene som anskaffes fra leverandør/tilbyder medføre at personopplysningene som tilhører NRK bli overført til en underdatabehandler/underleverandør av leverandøren/tilbyderen som er lokalisert i et tredjeland?	. (Include answer: YES / NO) . (Sett inn svar: JA / NEI)
Q3	ENG: Will the services procured by tenderer/supplier involve that NRK personal data will be transferred by tenderer/supplier to other recipients than suppliers, located in a third country? NO: Vil tjenestene som anskaffes fra leverandør/tilbyder medføre at personopplysninger som tilhører NRK bli overført av leverandør/tilbyder til andre mottakere enn leverandører som er lokalisert i et tredjeland?	. (Include answer: YES / NO) . (Sett inn svar: JA / NEI)

NRK

Sjekkliste i forbindelse med overføring av personopplysning til tredjeland.

Checklist in connection with transfer og personal data to a third country.

Q4	ENG: Are any of the transferred data stored in datacenters located in a third country? NO: Innebærer noen av dataoverføringene at opplysningene lagres i datasentre som er lokalisert i et tredjeland?	. (Include answer: YES / NO) . (Sett inn svar: JA / NEI)
ENG: In case of "YES" to any of the above Q1 – Q4 please answer the below: NO: Hvis svaret er "JA" på noen av de ovennevnte spørsmålene inntatt som Q1 – Q4 vennligst svar på følgende:		
Q5	ENG: Are the data transfers based on the version EU Standard Contractual Clauses (2021/914/EC) and are all annexes completed? Identify the correct Module of the SCC NO: Er dataoverføringene basert på ny versjon av EUs standardavtaler for overføring (2021/914/EC) og er vedleggene fylt ut? Identifiser den riktige SCC modulen	. (Include answer: YES / NO - if YES, indicate which SCC Module is used) . (Inkluder svar: JA / NEI – viss JA, skriv hvilken EU SCC Modul som benyttes)
Q6	ENG: Are the data transfers based on other transfer, in such case which? • is the country to where data are transferred on the **EU Commissions list of pre-approved countries**? (https://ec.europa.eu/info/law/law-topic/data-protection/international-dimension-data-protection/adequacy-decisions_en) • are the recipient located in the **US and certified according to the EU-US Data Privacy Framework 2023** (see https://www.dataprivacyframework.gov/s/participant-search)? NO: Er dataoverføringene basert på et annet overføringsgrunnlag, i så fall hvilket? • er landet som opplysninger overføres til oppført på **EU Kommisjonens liste over forhåndsgodkjente land**? https://ec.europa.eu/info/law/law-topic/data-protection/international-dimension-data-protection/adequacy-decisions_en	. (Include answer: YES / NO and details about the transfer mechanism and relevant countries to where data are transferred) . (Include answer: YES / NO) . (Inkluder svar: JA / NEI samt detaljer om overføringsgrunnlaget og relevante land som data overføres til)

Sjekkliste i forbindelse med overføring av personopplysning til tredjeland.

Checklist in connection with transfer og personal data to a third country.

	• er mottakere **i USA sertifisert i henhold til EU-USA Data Privacy Framework 2023** (se https://www.dataprivacyframework.gov/s/participant-search)?	. (Inkluder svar: JA / NEI)
Q7	ENG: Will any of the data transfers be made to recipients: - located in **other third countries** (i.e. that are not pre-approved)? - located in the US, and that are **not EU-US Data Privacy Framework certified**, in such case which countries? NO: Vil noen av dataoverføringene skje til mottakere som: - befinner seg **i andre tredjeland** (dvs. som ikke er forhåndsgodkjente)? - befinner seg i USA og som **ikke er sertifiserte under EU-US Data Privacy Framework)?**	. (Include answer: YES / NO) . (Include details on the relevant recipients and their location and certifications) . (Inkluder svar: JA / NEI) . (Inkluder detaljer om relevante mottakere og deres lokasjon og sertifiseringer)
ENG: In case of "YES" to Q7, please answer the below questions *(with regard to data transfers to non-approved countries/ not safeguarded by the EU-US Data Privacy Framework):* NO: Hvis svaret er "JA til spørsmål Q7, vennligst svar på følgende spørsmål (når det gjelder dataoverføringer til ikkje godkjente land/som ikke er beskyttet av EU-US Data Privacy Framework):		
Q8	ENG: Please provide information and/or documentation (e.g. a Transfer Impact Assessment/TIA, including statistics for access to data from authorities etc.) to the conclusions that the transferred personal data are provided with adequate safeguards as required by the GDPR NO: Venligst fremlegg informasjon og/eller dokumentasjon (for eksempel en Transfer Impact Assessment/TIA inkludert myndighets-utleveringsstatistikk mv.) som dokumenteter at overførte opplysninger er gitt det tilstrekkelige vernet som kreves etter GDPR?	.Please provide supplementary comments/documentation) .(Vennligst inkluder supplerende kommentarer/dokumentasjon)

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 2 – Contractor Solution specification

[Contractor name]

[Contractor logo]

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Website: www.nrk.no
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Attachments

Attachment 1 – NRK Device ST2110 ST2059 NMOS Conformance
Attachment 2 - NRK Supplier Security Requirements
Attachment 3 - Best Practice Guidelines for the EU Code of Conduct on Data Centre Energy Efficiency.
Attachment 4 - Checklist transfer to third countries

1. INTRODUCTION

This Appendix contains the Contractor's specification of the solution in accordance with the objectives, needs, requirements and instructions as described and specified by the Customer in Appendix 1.

2. BACKGROUND AND PURPOSE

Please refer to the corresponding chapter in Appendix 1.

3. SCOPE OF THE INGEST SOLUTION PROCUREMENT

Please refer to the corresponding chapter in Appendix 1.

4. HIGH-LEVEL SOLUTION OVERVIEW

[The Contractor's response in accordance with the instructions in Appendix 1 chapter 4 to be inserted here.]

5. HIGH-LEVEL WORKFLOW DESCRIPTION

This section contains the description of a target workflow and functional needs.

5.1. BASIC WORKFLOW

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	With reference to the diagrams and text above, please describe how the Contractor will meet NRKs workflow objectives with specific reference to the encoding to local server storage and dual data centre model.									
2	In the workflow, various possibilities exist to resolve failures (e.g. encode failure, file transfer failure, failure to create MAM placeholders). Please summarise worst case scenarios and how they would be managed within the proposed solution.									

5.2. EXAMPLES OF INGEST SOLUTION USAGE

Please refer to the corresponding section in Appendix 1.

5.2.1. CURRENT USE CASE 1: MANUAL INGEST TASK

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe how the proposed ingest system will meet the different needs and pain points described above									

5.2.2. CURRENT USE CASE 2: INGESTS OF REGIONAL TRANSMISSIONS BASED ON RULESET

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe how the proposed ingest system will meet the different needs and pain points described above									

5.2.3. CURRENT EXAMPLE 3: RECURRING 24/7 SCHEDULES

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe how the proposed ingest system will meet the different needs and pain points described above									

5.2.4. CURRENT EXAMPLE 4: PLANNED EVENT FROM AN EXTERNAL SOURCE

This example covers the recordings of a live sports event for use in sports news coverage. The requirement is to record a sporting event and create highlights at a later time.

The sports news producer goes to an external website which provides information on sporting events of the day. The producer finds the most interesting / relevant event based on editorial needs. They make a note of the event details. The producer will then go to an internal website where they have the ability to make a request for a recording. They need to add a clip title, the channel from which the content originates, the start time and end time.

This request is then added to a task list seen by MCR operators. MCR will set up the route from the source and enter the relevant details in the task list.

The ingest operator will copy / past the clip name to the ingest tool, add the start and end times and find the sources specified by MCR and initiates the recording. The request's status is then manually updated by the ingest operator. This status will be visible to the editorial staff.

Pain points from the above workflow:

- Lack of automation
- Manual operations from multiple teams (Production, MCR, Ingest)

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe how the proposed ingest system will meet the different needs and pain points described above									

5.2.5. FUTURE EXAMPLE 5: RESOURCE MANAGEMENT MODEL

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe how the proposed ingest system will meet the different needs described above									

5.2.6. USER INTERFACES DESIGN PRINCIPLES

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe how the proposed ingest system adheres to these user interface design principles									
2	The Ingest system user interface must be accessible as a responsive web interface.									
3	The Ingest system user web interface should follow proper HTML semantics (e.g., not using table for visual layout)									
4	The Ingest system web interface should support the common browser versions from Edge, Chrome, Firefox, and Safari									
5	The user interfaces should have full UTF-8 or UTF-16 support in order to support all characters required for Norwegian, North Sami, South Sami and Lule Sami									
6	The Ingest system user interface should support role-based access control									
7	The users should have the ability to personalize the user interface for their									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	needs in a flexible way based on their privileges or roles									
8	The Ingest system should meet the latest Web Content Accessibility Guidelines (WCAG) at levels A and AA. Currently, the latest version is WCAG 2.1									
9	Contractor should use the check list W3Cs WCAG-EM or a similar Accessibility Conformance Report (ACR) to document how the Ingest system matches the WCAG 2.1 requirements on levels A and AA									

5.3.INGEST SCHEDULING

Please refer to the corresponding section in Appendix 1.

5.3.1. CRASH RECORD

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	An operator must be able to manually trigger a recording event through the user interface. In this scenario, the crash record is triggered immediately.									
2	The operator is responsible for the metadata input and the integral ingest									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	scheduling system should be able to register the asset in the MAM									
3	The integral ingest scheduling system should be able to either be routed manually using the BCS, or trigger a BCS route while crash recording									
4	The integral ingest scheduling system should provide the ability to follow the crash record in a nearfield monitor.									

5.3.2. SCHEDULE AN EVENT IN THE INGEST SYSTEM

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	An operator must be able to manually schedule a single event through the user interface. In this scenario, the recording is triggered at the time desired by the user.									
2	The user interface must provide customisable fields to support metadata entry. The operator is responsible for the metadata input and the integral ingest scheduling system will register the asset in the MAM.									
3	Scheduled recordings should be generated and be visible on a port and time frame user interface									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
4	The integral ingest scheduling system should support manually routed inputs (where an operator uses the BCS to route a source to an ingest server input), and automated routing (where the ingest system triggers a BCS route when a recording starts).									
5	The system should allow an operator to manually schedule a recurring event through the user interface. In this scenario, the recordings are triggered at a user specified date/time and repeat interval and will continue until a user specified end date or indefinitely.									
6	The system should support the creation of templates with pre-defined metadata for different events, which can be easily recalled. For example, following a naming convention.									

5.3.3. SCHEDULE AN EVENT IN THE RESOURCE MANAGEMENT SYSTEM

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The ingest solution must provide a northbound API to enable ingest jobs to be created/updated/deleted by an upstream resource management system in which bookings are created and managed.									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
2	The northbound API should allow the format of incoming flows to be set. The format may differ between jobs for example 1080i/25 SDR, 1080p50 HDR, 2160p50 HDR.									

5.3.4. CLIP PLAYBACK

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The system should provide functionality to playout ingested files and ongoing ingests.									
2	The system should support a pass-through mode, which it can delay a feed by a user defined time offset.									
3	The system should provide the ability for a user to review growing files, create, replay and publish sub-clips.									
4	The system should provide tools to review and annotate growing files. It should be possible to publish the captured data.									
5	The system should provide tools to create and play a basic playlist from clips and subclips.									
6	The system should provide the ability to overlay static graphics over content being played out.									

5.3.5. INGEST SCHEDULING USER INTERFACE

Please refer to section 5.2.6 User interface design principles for technical requirements for the user interface.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The system should support both graphical and text-based display formats. In either format: • previous, current, and new schedules should be represented and be visually distinct. • current and future schedules will appear as indefinite unless/until an end time is added, or the scheduled event is manually ended. • current schedules should be visually distinguishable from future and past schedules. • individual schedules in a concurrent series of the same connection must be distinguishable. • failed schedules must be visibly distinguishable from successful schedules. the current time should be graphically displayed via a progress bar or similar.									
2	The UI should provide a list-based view (vertical view of ingest jobs associated with an ingest channel).									
3	The graphical display should be in the form of linear timelines relating to ingest resources. The current time should be indicated on the timelines. It should be possible to:									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	• filter the visible ingest resources by type (user defined) • filter the visible ingest resources by upcoming events. • zoom the visible time frame in and out. • scroll the visible time frame forward and backward. • Search for a given event on the timeline. • Search for a given port on a timeline. Show the source for a given event on the timeline.									
4	There should be customizable metadata fields that would allow for metadata from the scheduling interface to be mapped to other systems (i.e. MAM/PAM)									
5	The system should allow for 3rd party web components to be available in the scheduler, i.e. to allow for searching MAM for placeholders or adding metadata.									
6	The ingest UI should provide a thumbnail view of active ingest feeds.									
7	The ingest UI should provide audio metering for ingest feeds.									
8	The ingest UI must allow a user to manually create/update/delete jobs.									
9	The ingest UI should provide users with an overview of system, ingest server, ingest channel health.									
10	The ingest UI should allow users to play back and preview ingested files.									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
11	The ingest UI should enable active ingest jobs to be shortened or lengthened.									

6. SOLUTION ARCHITECTURE REQUIREMENTS

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The Ingest system must have no single point of failure in the system core.									
2	The Ingest system must not rely on a single instance of a database.									
3	The Ingest system should be able to merge configuration changes which will be applied without disrupting existing operation and ongoing ingests. For example, adding/removing/reconfiguring ingest servers and inputs/outputs.									
4	The ingest system should have a persistent store for scheduled ingest jobs, such that in the event of an outage, system state can be recovered.									
5	Each Ingest system instance must be able to function autonomously.									
6	The ingest system must support setup of SMTPE 2022-7 redundant streams across two networks fabrics.									
7	System must support automatic re-establishing of connections after an error									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	on underlying infrastructure such as network or storage.									
8	Ingest servers must have separate network interfaces for control (x2 interfaces) and ST 2110 flow exchange (x2 interfaces).									
9	Control (e.g. IS-05 subscription requests) and monitoring communication (e.g. ST 2110 endpoint status) should not be conveyed to a device by the media exclusive (AVoIP) network, even if the communication involves routing of signals to/from that device, unless there is no alternative.									
10	Supplier to describe how solution can deliver resilient feed capture within a datacentre and between data centres. Example include: a) Concurrent capture of a live feed to two servers within one datacentre b) Concurrent capture of a live feed to a single server within both datacentres c) Concurrent capture of a live feed to two servers within both datacentres The description should highlight any integration requirements for external systems (e.g. Resource Management, BCS, MAM).									
11	Please state if there are parts of the system that has quorum requirements – i.e., if there are a minimum number of nodes that									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	need to be healthy for a cluster to be available, and how this may affect deployment strategies and requirements.									
12	Please make sure that it is clearly stated what parts of the system hold local (and authoritative) state – i.e., what part of the system holds data that has to survive a re-installation/re-deployment, and thus needs traditional backup.									
13	Please describe suggested backup strategies (database backups, snapshots etc) for the stateful instances, and any if any operational considerations must be taken (downtime, failover etc) for backing up or restoring the system to a previous state.									
14	Please describe other solution resilience strategies both within a datacenter and across datacenters.									

7. TECHNICAL REQUIREMENTS

7.1. PHYSICAL INTERFACES

All equipment shall be installed in NRKs data centers and must comply with the hardware requirements as specified below.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The equipment should be mountable in 19in racks.									
2	The Contractor should specify the dimensions of the equipment (WxDxH).									
3	The Contractor must specify the total physical space in terms of rack units									
4	The Contractor must specify the total maximum and average power consumptions of the system (excluding client pc's).									
5	The Contractor must specify the required cooling capacity to cool the entire system (excluding client pc's).									
6	Specify any operational environmental requirements (temperature/humidity) for the equipment									
7	Due to various requirements from our data center providers, NRK needs to know how you require airflow and any special needs regarding mounting and cooling.									
8	All equipment must bear the CE marking for declaration of conformity and meet the current applicable EU directives.									
9	All hardware delivered with the system should have hot-swappable dual power supplies (where applicable).									
10	All equipment must be operating at nominal 230 VAC, 50Hz.									
11	All hardware with network connectivity should have dual network ports for redundancy.									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
12	All network connectivity over 1Gb should be presented as SFP or QSFP cages to enable patching to ToR switches using copper DAC or fibre MPO cables. Please list supported optics and DAC cables. Please also highlight any limitations (e.g. unsupported brands).									
13	All 1Gb or below network connectivity should be presented on RJ45 connectors.									
14	All equipment must meet the current RoHS directive.									
15	Provided hardware should have a suitable cable management solution									
16	Provided hardware should come with an out of band management module (iLO, iDRAC, IPMI or similar)									

7.2.CONTROL STANDARDS

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The Ingest system must support NMOS IS-04 for device registration									
2	The Ingest system must support NMOS IS-05 for connection management									
3	The Ingest system should support NMOS IS-07 for event and tally									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
4	The Ingest system should support NMOS IS-08 for audio channel mapping									
5	The Ingest system should support NMOS IS-09 for system parameters									
6	The Ingest system should support NMOS IS-10 for authorization									
7	The ingest system must provide an open API for control of ingest and player ports									

7.3.PLATFORM AND OPERATIONAL ENVIRONMENT

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The Ingest system must support one or more of these runtime environments in preferred order: Running as a container Running as a Linux service Running as a Windows service Running as a Windows Gui application is not an acceptable runtime environment									
2	It should be possible to deploy the ingest system software on virtual machines where applicable									
3	The ingest system should be deployable on virtual machines or the public cloud (e.g. to support the capture of NDI or ARQ based formats such as SRT and RIST).									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
4	The Ingest system should support the following log configurations based on the runtime environment: When running as a container, writes logs to standard out/standard error When running as a Linux service, writes logs either to standard out/standard error or directly to journal When running as a Windows service, writes logs to the Windows event log									
5	The Ingest system should support providing runtime metrics using Prometheus. If Prometheus is not supported, describe the supported runtime metrics system(s).									
6	The Ingest system should support OpenTelemetry.									
7	The Ingest system should support patching and upgrades without downtime when run in a HA configuration.									
8	NRK has standardized on preferred HP and Dell servers. If the ingest system is running on COTS hardware, please list hardware manufacturers.									

7.4.CONFIGURATION

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe what deployment technologies and strategies the system may support, including both initial installation and subsequent updates and upgrades.									
2	The Ingest system should have a complete REST or GraphQL API for configuration, providing at a minimum: • Adding, removing, and modifying ingest channels Modifying software components									
3	The Ingest system should have support for configuration using Ansible or Terraform with an Ansible module or Terraform provider supported by the Contractor.									
4	The Ingest system should support administrator-configurable webhooks to interact with other generic APIs (e.g., on status updates).									

7.5.MEDIA FORMATS

7.5.1. LIVE CAPTURE FORMATS

Please refer to the corresponding section in Appendix 1 and associated-Attachment 1-2 NRK Device ST2110 ST2059 NMOS Conformance - v3.5"

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Must support the frame-accurate capture of live feeds, based on timing information in an ingest job									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
2	Audio and video must be synchronous									
3	Should support the capture of SRT encapsulated flows									
4	Should support the capture of RIST encapsulated flows									
5	Should support the capture of NDI flows									
6	Should support the capture of SDI flows									
7	Must support the capture of SMPTE ST 2110-20/30/40 flows									
8	Should support the capture of SMPTE ST 2110-22 flows (JPEG-XS encoded video)									
9	Should support audio only capture of SMPTE ST 2110-30 flows									
10	Must support the capture of up to 16 audio channels per ST 2110 video flow									
11	Should support the capture of up to 32 audio channels per ST 2110 video flow									
12	Should support ST 2110-30 Conformance Level C (support for 125uS packet timing)									
13	Must support the capture of up to 4 x ST 2110-30 audio flows per ST 2110 video flow									
14	Should support different channel counts and packet timing per ST 2110-30 flow. (Future Dolby Atmos requirements are driving this)									

7.5.2. RESOLUTION AND FRAMERATE

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Must support the input and encoding of 1080i25 SDR									
2	Must support the input and encoding of 1080p25 SDR									
3	Must support the input and encoding of 1080p25 HDR									
4	Must support the input and encoding of 1080p50 SDR									
5	Must support the input and encoding of 1080p50 HDR									
6	Must support the input and encoding of 2160p50 HDR									
7	Please attach an overview of supported resolutions, framerates, audio and video formats and wrappers									

7.5.3. WRAPPERS, CODING AND AUDIO

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Must support capture to MXF OP1a									
2	Must support capture to MXF OP Atom									
3	Must support capture to Quicktime									
4	Must support capture to MPEG									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
8	Must support AVC Intra encoding									
9	Must support XAVC Intra encoding									
10	Must support ProRes 422 encoding									
11	Must write frame accurate timestamp into wrapper, where this is supported by the wrapper									
12	Must write accurate media format information into wrappers									
13	Must support the capture of uncompressed audio as linear PCM 48kHz, 24bit as an AES3 stream, within an MXF wrapper									
14	Must support the capture of uncompressed audio as linear PCM 48kHz, 24bit as a BWAV file									
15	Must support AAC audio									

7.5.4. PROXIES AND THUMBNAILS

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Should support capture of a thumbnail image at a customizable resolution and offset. Please specify which formats are supported.									
2	Should support capture of multiple images at a customizable time interval to enable									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	an NRK's service to create a preview of the stream (filmstrip).									
3	Proxy encoding must output discrete audio and video files.									
4	Must support capture of proxy files with the native resolution and framerate.									
5	Must support h.264 with AAC audio and mp4 wrapper for low bitrate proxy files.									
6	Should support h.265 with AAC audio and mp4 wrapper for low bitrate proxy files.									
7	Must update mp4 moov atom as the file grows to facilitate browse of growing proxy files									

7.6.DEVELOPMENT ENVIRONMENTS

[The Contractor's response to be inserted here.]

7.7.CHANGES TO THE TECHNICAL PLATFORM

[The Contractor's response to be inserted here.]

8. API'S AND INTEGRATIONS

8.1. API

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The system must provide access to all vital functionality in the business layer like record scheduling and media handling through a public API.									
2	The APIs must be thoroughly documented.									
3	The data model in use by the API should be documented and include formal schema definitions.									
4	Usage of the API must be covered by the support level agreements.									
5	The API and documentation must be kept up to date when new features are added to the system so that requirements #2 and #3 are always fulfilled.									
6	If the API is exposed through one or more HTTP REST-like endpoints, they should use proper HTTP methods and response codes (i.e. errors should be in the 400-500 range etc).									
7	Access to the API should at a minimum be controlled by the same authorization and authentication mechanisms (built-in/LDAP/Azure AD etc) as present in the user interface.									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
8	The API authentication should offer single sign on through Azure AD supported authentication protocols.									
9	The API should allow external systems to subscribe to events affecting assets in the system (like creation, modification, etc) through persistent callbacks, message queues or other event systems. I.e. messages should be guaranteed to be delivered at least once on a persistent level.									
10	The system-provided user interfaces should rely on publicly exposed and documented APIs									
11	Responsiveness of the API should not be linked to the responsiveness or availability of the ingest/workflow/playout-capabilities; it should not be possible to affect the stability of ingest or playout due to excessive use of the API by an ill-behaving client.									
12	The Ingest system must provide a northbound API, preferably using modern REST-like interfaces.									
13	Please describe which standards are in use by the API for date, time and duration, i.e. ISO8601.									
14	Please provide API documentation if it is publicly available.									

8.2. INTEGRATIONS

Please refer to the corresponding section in Appendix 1.

#	Integration	Integration proposed: A, B or C
1	Media Asset Management (MAM)	
2	Broadcast Control System (BCS)	
3	Enterprise Resource Management system	
4	Platform Monitoring and Control System (PMCS)	
5	Security Incident and Event Management system (SIEM)	
6	Configuration Deployment Pipeline (CDP)	
7	NAS Storage	
8	AVoIP Device Integration Standards	

8.2.1. MEDIA ASSET MANAGEMENT (MAM)

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe what type of hooks, callbacks, events and APIs are available to handle automatic query, fetch or push of media files and technical metadata from the Ingest system to the MAM system.									

8.2.2. BROADCAST CONTROL SYSTEM (BCS)

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	With reference to the diagram above, please describe the way in which the Contractor would implement an integration with the Nevion BCS / VimBiz resource management system in a 'Device-centric' model.									
2	With reference to the diagrams above, please describe the way in which the Contractor would implement an integration with the Nevion BCS / VimBiz resource management system in a 'Content-centric' model.									
3	With reference to the diagrams above, please describe the way in which the Contractor would implement an integration with the Nevion BCS in the absence of any resource management system.									
4	The ingest system must provide a Southbound API to a BCS system to make routes.									
5	The ingest system must support NMOS IS-05 to enable the BCS to make connection requests.									
6	The ingest system provider should be willing to implement a driver to integrate with NRK's chosen BCS system to make routes.									
7	It should be possible to change a source while recording. This might be necessary if there's a fault with a source.									

8.2.3. ENTERPRISE RESOURCE MANAGEMENT SYSTEM

Please refer to the corresponding section in Appendix 1. For more information about the different approaches to integration, please revisit 8.2.2 “Broadcast Control System (BCS)”.

#	Requirement	Requirement fulfilment								The Contractor’s Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	Please describe the way in which the proposed ingest system may integrate with an enterprise resource management system									
2	Please describe any existing integrations the Contractor has with enterprise resource management system products									

8.2.4. PLATFORM MONITORING AND CONTROL SYSTEM (PMCS)

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor’s Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The ingest system should provide reporting on physical system health, e.g. power supply, fans, etc									
2	The ingest system should provide reporting on physical network connectivity									
3	The ingest system should provide reporting on PTP status									
4	The ingest system should provide flow subscription status									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
5	The ingest system should provide operation system reporting									
6	The ingest system should provide Application layer reporting e.g. recording status									
7	The ingest system should provide network data, e.g. packet counts and loss for 2110 NICs									
8	For all of the above, please provide a full list of what parameters are reported and how this information is returned to the monitoring platform									
9	Please list any other reporting tools provided by the ingest platform									

8.2.5. SECURITY INCIDENT AND EVENT MANAGEMENT SYSTEM (SIEM)

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The ingest system should be able to send security logs to a remote SIEM (Security Incident and Event Management) system									

8.2.6. CONFIGURATION DEPLOYMENT PIPELINE (CDP)

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The ingest system should be highly configurable via a programmatic API.									
2	Please describe what is configurable programmatically and what is not and describe what is configurable as a service and what is not.									
3	Please describe how configuration changes are made to your system and what the service impact is.									

8.2.7. NAS STORAGE

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The solution must be able to transfer growing mezzanine, proxy and thumbnail files to a NAS volume.									
2	The solution must be able to concurrently transfer growing mezzanine, proxy and thumbnail files to two NAS volumes (one in each datacentre).									
3	The solution must support the SMB3 protocol to integrate with the NAS. Please state which version(s) of the SMB and other protocols are supported.									
4	Please describe the mechanisms and protocols the proposed solution would use for writing growing files to NAS storage volumes. This should include how fault									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	conditions are handled (e.g. failed transfer to one volume).									
5	Please describe any storage latency requirements for the proposed solution.									

8.2.8. AVOIP DEVICE INTEGRATION STANDARDS

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The ingest system must comply with the standards described in Attachment 1 NRK Device ST2110 ST2059 NMOS Conformance.									

9. CLIMATE AND ENVIRONMENTAL REQUIREMENTS

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The products must have long expected lifetime in order to reduce the need for replacement and avoid creating waste. E.g. how the product has been tested for durability. Please state the projected product life.									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
2	After the warranty on the equipment has expired, NRK should be able to receive components and documentation for all equipment in order to repair it themselves. Please detail your spares policy.									
3	The equipment should meet energy efficiency standards to minimize power consumption during operation. Please attach relevant energy performance certificates.									
4	Please describe the Energy efficiency performance of the proposed ingest solution. (see section 4.1.1 for further information)									
5	Equipment should be purchased that allows for operation within ASHRAE Class A2. If no equipment can be procured which meets the operating temperature and humidity range of Practice 4.1.3 (ASHRAE Class A2), then equipment supporting ASHRAE Class A1 at a minimum may be procured. (see section 4.1.2 for further information).									
6	Equipment provided by the Contractor should be able to operate and be within warranty for the full ASHRAE Class A2 allowable temperature and humidity range. (see section 4.1.3 for further information).									
7	The Contractor should supply at minimum the total system power for a range of temperatures covering the full allowable inlet temperature range for the equipment at 100% load on a specified recognised									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	benchmark such as Linpack. (see section 4.1.6 for further information).									
8	The Contractor should provision power and cooling only to the planned power draw of the IT equipment as configured (based on the components actually installed), rather than the Power Supply Unit (PSU) size or nameplate rating (see section 4.1.9 for further information)									
9	The Contractor should comply with the EU Eco Design Directive and Lot 9 amendments to EU Commission regulation for servers and online storage systems (see section 4.1.10 for further information).									
10	The Contractor should offer equipment with power and inlet temperature reporting capabilities, preferably reporting energy used as a counter in addition to power as a gauge. Where applicable, industry standard reporting approaches should be used such as IPMI, DMTF Redfish and SMASH (see section 4.1.11 for further information).									
11	The Contractor should offer equipment containing high efficiency AC/DC power converters. These should be rated at 90% power efficiency or better across the range of loads expected for the equipment to be installed (see section 4.1.15 for further information).									
12	The manufacturer should have a take-back program for old equipment promoting responsible disposal and recycling. The equipment should be designed for easy									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	disassembly, recycling, and proper disposal at the end of its lifecycle. Manufacturers should have clear guidelines for handling electronic waste (e-waste).									
13	Packaging materials: the equipment should have minimal packaging, recyclable materials, and reduced plastic content.									
14	Transporting and logistics should be environmentally friendly.									
15	Describe how the manufacturer works systematically to minimize the environmental impact of its solutions.									

10. BILL OF MATERIALS - PROPOSED SW AND HW

The Contractor shall in Appendix 2 provide an overview of the hardware and software included in the provided solution.

10.1. SOFTWARE

The Contractor shall in Appendix 2 provide an *overview* of the software included (as well as standard software and/or open-source software) in the provided solution, including which license terms apply for such components, cf. section 12.5.2. The actual terms shall be presented in Appendix 10.

Please address which part of the scope (cf. section **3.1.**) the software is supporting.

[The Contractor's response to be inserted here.]

10.2. HARDWARE

The Contractor shall in Appendix 2 provide an *overview* of the hardware included in the provided solution, including which license terms apply for such components.

Please address which part of the scope (cf. section **3.1.**) the hardware is supporting.

[The Contractor's response to be inserted here.]

11. INFORMATION SECURITY AND PERSONAL DATA PROTECTION (CF. CLAUSES 9.2 AND 9.3)

11.1. SECURITY

Please refer to the corresponding section in Appendix 1, incl. NRK's Supplier Security Requirements as specified in Attachment 2.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The Ingest system should support single sign on using oauth2/openid and/or SAML.									
2	The Ingest system can use either Active Directory or Azure Active Directory for users and groups. If the Ingest system has its own internal user and group database, the Ingest system should support provisioning users and groups using SCIM.									
3	The Ingest system should support role-based access control.									
4	Communication between the users and the Ingest system should be encrypted using TLS1.3 or higher.									
5	Security logs from the Ingest system should include the following information:									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	Log in information Audit logs for changes done by users Audit logs for changes done by administrators Audit logs for changes done via API User and group synchronization									
6	The Ingest system should be able to send security logs to a remote SIEM (Security Incident and Event Management) system. Currently NRK uses Azure Sentinel.									
7	The Ingest system should support API access using supplier specific access tokens or OAuth2.									
8	The Ingest system should support RBAC for API access.									
9	The provider should provide a SBOM for the Ingest system. Please refer to chapter 10.1									
10	The provider has a Responsible Disclosure Policy.									
11	The provider should have security.txt implemented to allow security researchers to easily report security vulnerabilities.									
12	The provider should have a defined patch strategy with specific time frames for when patches are provided, differentiated by severity levels of the security issue.									
13	Any passwords used by service users or for accessing administrative interfaces should be editable by the customer. There should be no usage of default passwords.									
14	The ingest system must support multifactor authentication using an									

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
	authenticator app and/or smart card or FIDO security key									

11.2. PERSONAL DATA PROTECTION

Please refer to the corresponding section in Appendix 1.

#	Requirement	Requirement fulfilment								The Contractor's Solution Description
		STD	CON	DEV	3RD INT	3RD	FUT	WA	NO	
1	The Contractor shall explain how their obligations under Clause 9.2 on ensuring the confidentiality and integrity of the Customer's data, are handled.									
2	The Contractor shall describe how satisfactory processing, including information system and security measures in line with the personal data protection regulations will be achieved and performed.									
3	The supplier is asked to fill in the attached checklist with comments so that NRK can assess if a data processing agreement is required, and consequently ensure that the correct data processing agreement is applied.									

12. OTHER REQUIREMENTS

12.1. PROJECT IMPLEMENTATION METHODOLOGY (CF. CLAUSE 2.3.3)

The Contractor shall describe the proposed method and approach for the project including how the method facilitates user involvement.

[The Contractor's response to be inserted here.]

12.2. DOCUMENTATION (CF. CLAUSE 2.3.6)

The Ingest system including customisations and configurations must be documented so that the Customer has the necessary and correct documentation available in all areas of the Ingest system. The documentation shall facilitate effective use, training, further development, and service of the Solution. The Ingest system shall be provided at least with the following documentation:

12.2.1. DETAILED SPECIFICATION - DESIGN DOCUMENTATION

If relevant, the Ingest system is provided with a detailed specification document that is developed during the specification phase. This design document is a description of how the processes and requirements are to be fulfilled in the new solution. The document describes how to solve the desired functionality and the guide to those who will configure and complete the solution for NRK's use.

The Contractor shall state as part of the Appendix 4 relevant activities needed that will be documented as part of a specification document.

[The Contractor's response to be inserted here.]

12.2.2. TRAINING MATERIAL

The Contractor will provide training material. The training material must be adapted to the individual user group and must be written in Norwegian or English.

[The Contractor's response to be inserted here.]

12.2.3. USER DOCUMENTATION

The Ingest system is provided with NRK-specific user documentation that is:

- Provided in a common electronic format.
- Adapted to different user groups, including advanced users, such as superuser, system managers, and end-users.

[The Contractor's response to be inserted here.]

12.2.4. DOCUMENTATION OF INTEGRATIONS

The Ingest system is provided with technical documentation in English describing public API, integrations, and APIs specific to NRK (interfaces, methods, etc.).

[The Contractor's response to be inserted here.]

12.2.5. FUNCTIONAL SYSTEM DOCUMENTATION

The Ingest system is provided with functional documentation in English describing configurations and setup, including functional design for any customizations.

[The Contractor's response to be inserted here.]

12.2.6. TECHNICAL SYSTEM DOCUMENTATION

The Ingest system comes with a technical system documentation in English, describing logical service and information architecture, security, and access architecture (ADFS, etc.), provisioning and orchestration functionality and procedures.

[The Contractor's response to be inserted here.]

12.2.7. INSTALLATION AND MAINTENANCE DOCUMENTATION

The Ingest system comes with installation and maintenance documentation in English. This requirement applies only to on-premises-solutions.

[The Contractor's response to be inserted here.]

12.3. TRAINING (CF. CLAUSE 2.3.7)

12.3.1. TRAINING METHOD

The Contractor shall plan and develop a training program, including training material, and train NRK in the use of the Ingest system. The training shall ensure that NRK can perform qualified testing of the Ingest system and start using the Ingest system properly and efficiently.

All user groups shall receive training. The training shall be designed appropriately for each specific user group. Training methods shall be described.

[The Contractor's response to be inserted here.]

12.3.2. DESCRIPTION OF TRAINING COURSES

Training material shall as a minimum be in English or Norwegian and have use cases that are relevant for the different user groups.

The Contractor shall describe how the training will be for the different target groups. The description shall at minimum include the following:

a) Objective of the training
b) Training content
c) Expected benefits from completing the training
d) Training style
e) Duration

[The Contractor's response to be inserted here.]

12.4. OPTIONS

The Contractor is kindly requested to describe the possible delivery of the options listed below in Appendix 2. Predictable pricing methods and principles to be stated in Appendix 7. NRK reserves the right to increase capacity and improve scale by using other sources and agreements. E.g. acquiring compatible hardware from other sources or using cloud providers which NRK already has agreements with.

After deployment, the solution must be able to scale-out in response to future needs. Currently we do not expect the system to scale-out more than 76 x video inputs per datacentre.

NRK envisions that the ingest solutions scale and capacity may be increased dynamically and seamlessly.

A. Event-based capacity increase

Events such as e.g. broadcasting the Olympic Games may require increased capacity of ingest inputs and video formats, e.g. UHD for a limited period. NRK envisions that this could be achieved, but not limited to, in the following ways:

- Renting or leasing equipment from the Contractor to be installed in NRKs existing data centers.
- Utilizing public or private cloud services for temporarily capacity increase.

B. Permanent scale-out

To cover future ingest requirements, permanent scale-out of the solution may be required. NRK envisions that this could be achieved, but not limited to, in the following ways:

- Procuring equipment from the Contractor to be permanently installed in NRKs existing data centers.
- Gradually utilizing public or private cloud services for permanently capacity increase.

C. Possible future extensions

With reference to functional items not included in the initial scope, cf. section 3.1 above, NRK request the Contractor to describe which kind of functional support that may be offered to support those possible options. Prices and pricing principles to be stated in Appendix 7.

[The Contractor's response to be inserted here.]

12.5. RIGHT OF OWNERSHIP AND RIGHT OF DISPOSAL (CLAUSE 10.5.2 AND 10.2.2)

The Ingest system is an essential component in the Customers broadcast production platform, and the Customer foresees a long-term partnership with the Contractor for the service.

However, the broadcast industry may be subject to future changes; bankruptcy and merges may occur, the Supplier or its subcontractor may discontinue their solution/service etc, affecting the Supplier to deliver according to this Agreement.

Depending on which part in the delivery chain that may be affected, measures may imply inter alia.

- Access to the source code of the ingest solution, hereunder any code specifically developed by the Contractor for NRK.
- Access to expertise for the ingest solution is offered for a sufficient period of time, including overview of other companies with necessary competence of the solution offered.

- A fulfilment of the obligations in the contract with an alternative ingest system.
- Parent or solidary guarantee for continued services/deliveries.

In those circumstances where the Customer is entitled to have such arrangements put in place, the Party that obtain access to the source code shall have an expanded right of disposal that covers the right to use, copy, modify and develop the solution itself, or with the aid of a third party, to the extent necessary to achieve the purpose of the procurement. The measures must last until NRK has obtained a new service. Thus, the Supplier is required to suggest and describe in a binding manner in Appendix 2 appropriate measures that satisfactorily secures the Customer's interests according to which the Customer shall be notified if events described in the General Contract Terms clause 10.2.2 may occur. Any related third-party terms should be described, and prices be included in Appendix 7.

[The Contractor’s response to be inserted here.]

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 3 – Customer technical platform

[Contractor name]

[Contractor logo]

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Table of Contents

1 INTRODUCTION

This Appendix contains a description of the Customer´s technical platform the proposed solution must interact with.

Any changes to the Customer´s technical platform must be specified in Appendix 2 to be valid and priced in Appendix 7.

The Customer assumes that the Contractor will make the necessary enquiries regarding the Customer existing infrastructure in order to commit to this contract and provide the necessary equipment and software.

The new Ingest system will be one of the building blocks in the modernised production platform (MPP). NRK is in parallel running tender processes for new WAN solution, network equipment for the new media network, and initiating other necessary tender processes – meaning that the future landscape is not finally shaped at this stage.

Please refer to SSA-T Appendix 1 for detailed description of the Customer's needs and requirements related to the Ingest solution.

2 CURRENT STATE

The current ingest solution is based on sQ video servers from Grass Valley. In the regional offices, these servers are used for video ingest only, and editing is done in Adobe Premiere. The news production in the main site is utilizing the Quantel suite of products for fast turnaround video editing and playout. The fast turnaround editing/playout workflow is out of scope for this procurement.

Every regional office and the main site have its own separate ingest installation and storage. The MAM is responsible for registering and triggering the workflows for ingest of the growing files, which are then searchable and movable across sites.

The software used for scheduling is Capture Manager from Tedial. This system is tightly integrated with the MAM, as they are both from the same vendor. There is also an integration with our current broadcast control system, VSM from Lawo, which allows users to make routes in the Capture Manager scheduling interface.

The MAM-installation is a part of a larger file-based production platform developed by NRK ("The Program Bank"), with a host of integrations with both third-party software and services, and NRK-developed systems and applications. Users are not interacting with any of the third-party MAM interfaces, but are searching and trigger appropriate workflow using an in house developed MAM front end called Potion.

The underlying MAM powering parts of the production platform is Tedial Evolution. It supplies workflow engines, an online/offline storage system (AST) with archiving/offlining, transfer to/from regional offices and housekeeping of local production storage.

It is also worth mentioning that there is a multitude of different ingest applications in the regional offices that complement the sQ and Capture Manager solution. These are used to expand the capacity and cater for special workflows in the regions, like for Visual Radio. The visual radio ingests are simple in the form of static routes and no integration with BCS or the MAM, but they have a high degree of automation. Ingests are automatically triggered once a radio studio goes live.

2.1 Temporary data centres

NRK is in the process of sourcing the new external data centers. However, the data centers will not be available for delivery scope 1, thus the equipment will be installed in temporary data centers. Ideally, we would like to deploy the ingest solution in an environment that simulates the dual center model.

NRK has a temporary data center near the headquarters in Oslo, however NRK does not have an equivalent data center in the middle part of Norway. We may use the temporary data center in Oslo for deployment and verification of the scope 1 delivery. This implies that factors such as latency between the data center may differ from the final future solution. We expect the temporary data centers to fulfill standard data center requirements such as cooling, power supply etc.

2.2 Domain concepts

The current integrations between all the systems in the Program Bank and other third party systems are relying on some common conventions and data-fields.

Some of the most important common domain concepts in use today are:

Domain concept	Description
Media ID / MAM ID	Unique GUID generated by the MAM or by other third-party systems. Each technical version of a clip will have its own unique 128-bit GUID. Example: 12n81e6f-49ae-508f-8c2a-60e3a4e09b02
Clip name	Human readable ID identifying a video (or audio) clip/media in the Program Bank. Unique throughout the Program Bank services (uniqueness automatically enforced by the central services upon name collision). Conventions dictate that programs have a stricter structure than raw material and news items. Example program: NNFA21042024AH Example raw material: haaland-interview-200424
Clip descriptive title	Human readable string suitable for free-text search in archive and (for some material) for publishing to viewers. Not unique. Examples: Leka kåret til geologisk nasjonalmonument Dagsrevye Ođđasat - nyheter på samisk
Media file name / file path	Source filenames may or may not be similar or equal to the Clip Name. Source file paths may point to several different storage locations.
Job ID	Internal and some third-party systems have unique IDs for jobs like transcoding, publishing, and file movement. These IDs are used in events and for polling status of the jobs and tracking correlation across systems.

3 FUTURE TECHNICAL ENVIRONMENT

Fuelled by several factors, NRK is currently in the process of performing a business transformation from SDI and AES3 broadcast technologies to native AV over IP services (AVoIP). The AVoIP model will form the standard model for real-time broadcast activities at all sites.

This business transformation is being co-ordinated by a company-wide programme, referred to as MPP – Modernisation of the Production Platform (MPP). In addition to the transformation to AVoIP, the MPP programme aims to centralise production processing resources in external datacentres, and to lay the groundwork for integrating public cloud services into broadcast workflows.

The new ingest solution is a part of the MPP-programme and will have a limited dependency on integrating with the current platform. Below are parts of the relevant building blocks of the modernized platform the solution needs to interact with.

3.1 Media Asset Management system (MAM)

NRK is currently using Tedial Evolution v5. However, when the ingest solution is being implemented, NRK may upgrade to a later version of Evolution or migrate to Tedial's new product, smartWork.

Potion is an abstraction layer and a modern web-based frontend application on top of the MAM system. Potion consists of a suite of applications for ingest, capture and publish of live web streams, a video content search engine, and the Metadatabank where descriptive metadata is stored.

See "NRK-2024-295 SSA-T App 01" chapter 8.2.1 for details and requirements.

3.2 Broadcast Control System (BCS)

The ingest system will integrate with the BCS for scheduling software to make routing requests and for the BCS system to make NMOS IS-05 connection requests. NRK has recently awarded the BCS contract to Sony Nevion. This project is in an early stage but will be implemented with the ingest solution.

See "NRK-2024-295 SSA-T App 01" chapter 8.2.2 for details and requirements.

3.3 Enterprise resource management system

VimBiz by Vimsoft is a broadcast resource management system that will handle production- and resource planning. NRKs current ingest solution does not integrate with VimBiz or other resource management systems. As part of this project, feasibility and usability of an integration between the ingest scheduling tool and VimBiz will be explored.

See "NRK-2024-295 SSA-T App 01" chapter 8.2.3 for details and requirements.

3.4 Platform Monitoring and Control System (PMCS)

The PMCS will collect log and event data from applications, services, networks, and devices within the modernised production platform.

See "NRK-2024-295 SSA-T App 01" chapter 8.2.4 for details and requirements.

3.5 SIEM (Security Incident and Event Management) system

SIEM software products and services are used to combine, analyze and report on data on security information and event. NRK is currently using Azure Sentinel.

See "NRK-2024-295 SSA-T" App 01 chapter 8.2.5 for details and requirements.

3.6 Configuration Deployment Pipeline (CDP)

The MPP platform is an IT platform for media production. It will be operated based on DevOps practices. Configuration will be managed within a Git repository and CI/CD tools such as GitHub Actions, and automation tools, such as Ansible, will be used to automate the process of deploying devices and configuration.

See "NRK-2024-295 SSA-T App 01" chapters 7.4 and 8.2.6 for details and requirements.

3.7 NAS Storage

Real-time media devices to send and receive media flows. Our current NAS storage consists of multiple Dell EMC Isilon installations. There is one large system in our main site (Marienlyst) and several smaller ones in our district offices. Protocols used are SMB and NFS, but there is also limited use of S3 compatible protocols and web APIs.

See "NRK-2024-295 SSA-T App 01" chapter 8.2.7 for details and requirements.

3.8 AVoIP Device Integration Standards

NRK endeavours to be a driving force in the utilization of a standards driven IT-centric production platform. To support this strategy the Ingest system should prioritise standards over vendor specific solutions.

See Attachment 1: "NRK Device ST2110 ST2059 NMOS Conformance"

See "NRK-2024-295 SSA-T App 01" chapter 8.2.8 for details and requirements.

3.9 Data centres

Hardware and equipment related to the modernized production platform is expected to be installed in external datacentres.

See "NRK-2024-295 SSA-T App 01" chapter 5.1 and 6.1 for dual DC description.

See "NRK-2024-295 SSA-T App 01" chapter 7.1 for details and requirements.

3.10 Technical requirements

See "NRK-2024-295 SSA-T App 01" section 7 for the Customers' technical requirements for the Ingest system.

3.11 Non-linear editing (NLE)

NRK will be using Adobe Premiere Pro as the NLE. It is expected that Premiere Pro will run on physical workstations housed in the data centres and accessed via KVM. It may be the case that some edit functionality is also provided on virtual machines.

It is not anticipated that the ingest solution will have a direct integration with the current post-production tools, however NRK is considering a PAM solution for post-production. This solution might include a web editor which make use of growing proxies and files from the ingest solution. It is possible that with a future PAM solution it could be beneficial with some degree of integration, like scheduling control.

These details are under consideration and for information only, and not current requirements.

3.12 Clients

Clients should be able to run on a browser-based web interface**.**

See "NRK-2024-295 SSA-T App 01" section 5.3 User interface design principles for requirements.

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 4 – Project and progress plan

[Contractor name]

[Contractor logo]

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1 INTRODUCTION

This Appendix contain the Contractor's project and progress plan for the deliverables as specified by the Customer in Appendix 1 (hereunder the expectations to include the Customer in the implementation project) and described by the Contractor in Appendix 2.

The delivery scope 1 and 2, as described in Appendix 1 are considered as partial deliveries.

The plan should appreciate the Customer's preference to maintain a certain momentum in the project through a progressive plan to accommodate delivery scope 1.

The description must be sufficiently detailed so that the Customer can prepare and provide the specified competence and capacity at the specified time.

Text inserted by the Contractor should be marked with blue font.

2 CONTRACTOR PROJECT AND PROGRESS PLAN

The Contractor must prepare an overall project and progress plan, which describes what the implementation phase (including installation) of a standard setup of the solution looks like with time estimates and dependencies.

The plan must include:

- Implementation strategies and approach
- Implementation steps, including high-level activities and associated deliverables.
- Risk elements in the plan that can affect price, timeline and quality.
- Dependencies linked to the execution of the implementation steps.
- Prerequisites that must be in place before the implementation steps can be started.
- Customer's participation in the implementation phase; roles and any associated competencies requirements for personnel

The Contractor is asked below to describe his project and progress plan in accordance with the above. Concrete deliveries must be specified, and the activities must be estimated and timed. Any partial deliveries and requirements for the Customer's participation must be stated in connection with relevant phases and activities. See also the general contract terms sections 2.1 – 2.4.

It is desirable that the phases correspond to the general contract terms, as suggested by the Customer below. The plan is adapted to the extent of integrations, possible customizations and configuration as described in Appendix 2.

As a minimum, the following must be described and scheduled (including milestones) and where expected participation from the Customer must also be specified, scheduled and estimated:

1) The preparation phase (cf. General Contract terms section 2.1)
2) The specification phase (cf. General Contract terms section 2.2)
    - Please describe which part of the deliverables that need to be further detailed.
3) The development phase (cf. General Contract terms section 2.3) including migration, training and documentation.
    - please address each of the integrations specifically.
4) The acceptance test phase (cf. General Contract terms sections 2.4.1 – 2.4.6)
    - The length of the acceptance test must be sufficient for a complete test of the solution to be carried out in a proper manner.
5) The commissioning phase (cf. General Contract terms section 2.4.7); preparations for commissioning and commissioning (start of approval period)
6) Delivery date (after 3 months approval period)

Please be advised that the plan should include the necessary preparatory activities for utilisation of the support and maintenance service required to the commencement of the acceptance test period.

If one or more phases or proposed activities above is assessed not relevant or not applicable for each delivery scope, this should be explained.

Please summarize your overall plan in the table below.

Phase	Delivery scope	#	Milestones	Customer Suggested Date	Contractor Suggested Date
Preparatory	Contract	MS-START	Preparation completed; project start up	Nov	Date
	Delivery Scope 1	MS1-01	Detailed progress plan	Nov	Date
Specification		MS1-02	Detailed specification approved (clause 2.2.2)	Nov	Date
Development		MS1-03	Installation, development and integrations activities	Dec-Feb 25	Period from – to
Acceptance test		MS1-04	Solution ready for Acceptance test (clause 2.4.2)	Feb	
		MS1-05	Acceptance Test approved (clause 2.4.6)	Mar	Date
Approval		MS1-06	Commissioning	See MS2-05	See MS2-05
Preparatory	Delivery Scope 2	MS2-01	Detailed progress plan	Apr	
Specification		MS2-02	Detailed specification approved (clause 2.2.2)	Apr	Date
Development		MS2-03	Installation, development and integration activities	Q2	Period from – to
Acceptance test		MS2-04	Solution ready for Acceptance test (clause 2.4.2)	Q2/3	Date
		MS2-05	Acceptance Test approved (clause 2.4.6)	Q2/3	Date
Approval		MS2-06	Commissioning Go-Live (including scope 1)	Q3/4	Date
	Scope 1+2	MS-FINAL	Delivery Date (MS2-05 + 3 months)	Q1-26	Date

[Contractor's response to be inserted here]

3 GUIDELINES AND PROCEDURES FOR THE DETAIL SPECIFICATION PHASE

The Contractor can propose guidelines and routines for the detail specification phase, adapted to the scope of any customizations. Please read clause 2.2.1.

[Contractor's response to be inserted here]

4 LIQUIDATED DAMAGES (CF. CLAUSE 11.5.2)

Based on the Contractor's suggested implementation strategies and approach, the Customer will assess as part of the negotiation which of the milestones described in clause 11.5.2 will be subject to liquidated damages.

The Contractor may suggest milestones which he believes should be subject to liquidated damages.

[Contractor's response to be inserted here]

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 5 – Testing and approval

[Contractor name]

[Contractor logo]

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Switchboard: +47 23 04 70 00
Website: www.nrk.no
Norwegian Business Registration NO976 390 512

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1 INTRODUCTION

This Appendix contains further provisions regarding testing and approval and the parties' obligations in relation to testing and approval of the delivery as described in Appendix 2 in accordance with the needs and requirements in Appendix 1.

The Contractor shall respond to the requirements at the bottom of each section. If some of the requirements are not met, please explain why and any alternative solution.

Text inserted by the Contractor should be marked with blue font.

2 PARTIAL DELIVERIES (CF. 2.1.4)

The implementation of the project will be done as work packages/partial deliveries. Each work package will have an individual test plan and approval period.

3 CONTRACTOR'S TESTING

The Contractor must describe how the system/solution as a total delivery has been tested, approved and prepared for handover to the Customer. Furthermore, the Contractor must describe how each delivery has been tested upon handover to the Customer and which tests must be carried out at the Customer's premises.

The Contractor must assess the need to provide information on test methodology and type of tests based on the degree of adaptation of the software. If the delivery consists exclusively of not-customized software, the Contractor must describe which quality standards apply to the delivery.

The Contractor should describe which quality characteristics the delivery has been tested against. These can be functional tests, security tests, performance tests, etc. At a minimum, the Contractor should state whether the system/solution has been tested according to international standards such as ISO/IEC 25010 or ISO 29119.

Furthermore, the Contractor should describe which tests must be carried out after installation at the Customer's place, prior to the Customer Acceptance test. These can be, for example, system tests, system integration tests and acceptance tests.

Contractor's response:

4 ACCEPTANCE TEST

The Contractor must suggest how he can assist the Customer in carrying out an acceptance test, which must be carried out at the Customer's premises, and which is relevant to verify that the delivery fits into the Customer's system platform and is in accordance with the purpose and description in Appendix 1 and Appendix 2. This may be specific tests beyond what the Customer himself defines in his acceptance test plan.

The Acceptance test shall comprise software, hardware and equipment that form part of the deliverables and should include the following tests:

- Installation test.
- Function test.
- Integration test.
- Review of all documentation.
- Test of operating procedures, including recovery procedures.
- Volume, capacity and response time test.
- Security review.

The Contractor must indicate which obligations the parties must have, including which activities they must be responsible for, which may be;

- The Contractor's assessment of the Customer's acceptance test plan and deadline for feedback.
- Preparation of test documentation.
- Execution of the tests when the delivery is to be tested on the Customer's system platform.

The Contractor must also state whether carrying out testing requires specific types of tools that are not part of the delivery.

As a criterion for starting the acceptance test, there must be no known A and B errors.

Contractor's response:

5 COMMISSIONING

The details of responsibilities for assisting NRK with the commissioning will be discussed during the specification phase.

However, NRK expects that the Contractor will be present on-site at least during the very first commissioning to assist in any unforeseen events that may occur.

Furthermore, we see it as an important success criterion that relevant personnel from the Contractor is available for remote assistance at every commissioning event during the solution roll-out.

Contractor's response:

6 PROCEDURE FOR REPORTING AND HANDLING OF ERRORS

The Contractor must describe appropriate procedures and routines for the Customer can report errors and how the Contractor will handle and follow up such reports. The procedure must be used as a basis for handling errors during the acceptance test, the approval period, and the warranty period.

Contractor's response:

6.1 Requirements for the correction of errors

All errors must be categorized according to A, B and C errors as defined in general contractual wording, clause 2.4.5.

6.2 Procedure for reporting and handling of errors

Short response- and solution time is an expectation from the Customer. The table below describes NRKs' preferred response and resolution times.

The Contractor may change (highlighted yellow) in the tables below.

Level	Category	Response time error correction		Expected solution time	
		Acceptance test	Approval -/ Guarantee period	Acceptance test	Approval -/ Guarantee period

Level	Category	Response time error correction		Expected solution time	
A	Critical error	1 hour	Cf. SSA-V Appendix 5	4 hours	Cf. SSA-V Appendix 5
B	Serious error	3 hours		1 day	
C	Less serious error	6 hours		5 days	

Contractor's response:

7 APPROVAL PERIOD

NRK will test the functionality as it is delivered. However, for some of the work packages, it might be relevant to perform load tests, meaning we might expose the work package to a number of users in production or simulated testing.

If otherwise is not agreed, the Contractor is responsible for executing volume, capacity, and response time tests. The Contractor shall execute these tests as a part of the system test before handing over to NRK acceptance tests. Test results from the tests shall be presented to and approved by NRK.

During the approval of each partial delivery, NRK will perform realistic testing of redundancy and functionality level adapted to each delivery. Details will be discussed and agreed upon during the specification/design phase, if relevant.

During final approval, NRK will perform realistic testing of redundancy and disaster recovery. Details will be discussed and agreed upon during the specification/design phase, if relevant.

In addition to the provisions that follow from clause 2.5.2 of the general contractual wording, the following applies for the final approval:

Errors reported during the approval period must be rectified continuously and by the end of the approval period, however, so that a month's continuous operation without A or B errors is achieved. If such errors occur during the last month of the approval period, the approval period must be extended accordingly.

Contractor's response:

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 6 – Administrative Provisions

[Contractor name]

[Contractor logo]

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1 INTRODUCTION

This Appendix is used to list all of the routines for the contractual relationship and cooperation between the parties.

The Contractor should respond to the requirements at the bottom of each section. If some of the requirements cannot be met, explain why and alternative solution(s).

Text inserted by the Contractor should be marked in blue font.

2 THE REPRESENTATIVES OF THE PARTIES (CLAUSE 1.4)

Authorised representatives of the parties:

2.1 NRK representatives

Representative name	Position	Role
		Project owner: the representative who is authorised to act on behalf of the party in matters relating to this Agreement
		Contact person for technical matters
		Contact person for contractual matters
		[Other, if relevant]

[NRK information to be filled in upon the conclusion of the Agreement]

2.2 Contractor representatives

Representative name	Position	Role
[Name]	[Position]	The representative who is authorised to act on behalf of the party in matters relating to this Agreement
[Name]	[Position]	Contact person for technical matters
[Name]	[Position]	Contact person for contractual matters
[Name]	[Position]	[Other, if relevant]

Changes of authorised representatives of the Contractor shall be notified one month in advance in writing. The Contractor should ensure transfer of knowledge and competence.

3 PROJECT ORGANIZATION (CLAUSE 2.1.2)

The Contractor shall outline a proposal for project organisation structure, governance model and plan for quality assurance for the implementation project. Identify all projects, sub projects and relevant teams, in addition to roles, responsibilities and authority for the Contractor resources.

The description shall be outlined according to defined project phases and comprise number of project resources (full time equivalents) from the Contractor, including any sub-contractors, and assumed NRK resources. The Contractor shall propose the needed competency profiles needed at NRK for the implementation project.

The governance model shall outline the Contractor's recommended governance forums (for example reference group(s), steering group, etc.), what roles/functions to be included in the forums and recommended reporting and meeting structure. The Contractor shall also outline the recommended governance model for documents and change control.

The Contractor shall assume that the NRK headquarter in Oslo is project headquarter and outline the need for on-site or off-site collaboration. Please see Appendix 7, section 6 regarding travel expenses.

The Contractor's proposal on governance model and work plan must be adapted to secure involvement of key personnel and minimize time and cost for travel. Effective collaboration tools (e.g. video conferencing, SharePoint, etc.) should be leveraged and be part of the Contractor's response to project organization and governance.

All personnel intended to perform work under this contract shall sign an NDA.

Contractor's response:

4 PROJECT DOCUMENTATION (CLAUSE 2.1.3)

The Contractor shall specify relevant project documentation, routines for status reporting, and routines for the registration and follow-up of non-conformance, additions and agreed amendments, etc.

Status report shall describe as a minimum:

- Overall status
- Progress according to plan (Progress on deliverables)
- Risk assessment and actions to mitigate
- Issues for clarification and decision
- Staffing/resources

Contractor's response:

5 REQUIREMENTS AS TO THE RESOURCES AND EXPERTICE OF THE CONTRACTOR (CLAUSE 5.2)

A resume of the key qualifications for the Contractor's project manager and other key personnel for the performances under SSA-T including those who will be responsible for training, shall be listed below.

Name	Position/role	Competance/Experience	CV #

The Contractor shall present a CV for all personnel, adapted specifically for their prospected role in this project, where relevant competency (education, certifications, etc.) and experience is documented.

Contractor's response:

6 USE OF SUBCONTRACTORS (CLAUSE 5.3)

Subcontractor is defined as party performing work in this Contract. In this context, subcontractor is also understood to include the manufacturers of the ingest solution and specific ingest hardware components.

The subcontractors carrying out work and/or deliveries under the Agreement are to be listed in the table below. It must be stated which deliveries are carried out by the individual subcontractor.

It is a prerequisite that the subcontractor who the Contractor has relied on in the qualification is to carry out the intended tasks and that the subcontractor is listed in the table below. Further the declaration of commitments shall be listed as attachment to this Appendix.

If the Contractor change subcontractors, the Contractor must document approval procedures for the use of such subcontractors, prior to the change.

All personnel intended to perform work under this contract shall sign an NDA.

Name	Organisation number	Delivery area
[company name]		

In addition, if the Contractor will use of personnel from subcontractors in the implementation project, they shall be listed her.

Name	Position/role	Competence/Experience	CV #

The Contractor shall present a CV for all personnel, adapted specifically for their prospected role in this project, where relevant competency (education, certifications, etc.) and experience is documented.

7 COOPERATION WITH THIRD PARTIES (CLAUSE 5.4)

If the Customer finds it necessary to have the Contractor to cooperate with the Customer's third party to fulfil the contract, this will be handled case by case and be remunerated according to hourly rates in Appendix 7.

Based on the Contractor solution and as part of the negotiations, the Customer may add third parties in the table below before the conclusion of the Agreement.

Name	Organisation number	Delivery area
[company name]		

8 AUDIT (CLAUSE 2.3.5)

NRK reserves the right to perform audits according to General Contract Terms with a prior notice of two (2) days.

9 WAGES AND WORKING CONDITIONS (CLAUSE 5.5)

The Contractor shall confirm compliance with the Contractor's obligations as stipulated in clause 5.5 of the Agreement (Wages and working conditions).

Contractor’s response:

10 INDEPENDENT EXPERT (CLAUSE 16.3)

Should there be a need for an independent expert, the nature of this expert will be determined based upon the issues that need resolving.

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 7 – Total price and pricing provisions

[Contractor name]

[Contractor logo]

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1 INTRODUCTION

This Appendix contains all prices and detailed conditions for the consideration the Customer must pay for the Contractor's deliverables under the Agreement.

All functionality described in Appendix 2 and other deliverables as described in Appendices 4-6 will automatically be considered included in the prices unless otherwise explicitly stated in this Appendix.

Any special payment schemes, discounts, advances, payments on account or deviant payment dates shall also be stated as part of the basis for the total price.

Any other listing of prices shall be specified separately. It must be listed whether the price is per unit or per month, year, agreement period, etc.

If the parties agree on anything that is not stipulated in the Agreement concerning consideration, then this shall be specified in this Appendix.

All references marked CF <number> or clause <number> refers to the Development and Customization Agreement (SSA-T).

The Customer requires that the Contractor answers every section in this document consecutively. Text inserted by the Contractor should be marked in blue font.

Submission of a calculation basis (excel)

The Customer will for the tender stage provide an excel sheet for the Contractor to fill in based on the format of the tables in this Appendix. This Appendix 7 will be updated not entailing the price tables as part of the tender stage. The calculation basis (excel) will be used in the negotiations to ensure that the Customer understands the content of the prices.

1.1 Currency

The prices may be quoted in a preferred currency; Norwegian kroner (NOK), US Dollar (USD), British Pounds (GBP) or EURO (EUR) (etc), exclusive of value-added tax but inclusive of customs duties and other indirect taxes.

NRK will pay in the same currency as quoted, thus reservations regarding currency fluctuations are not permitted.

The Contractor shall specify which currency the proposal or parts thereof is quoted in.

Contractor's response:

1.2 Incoterms

The hardware shall be delivered according to DDP INCOTERMS 2020.

1.3 Payment models for the delivery

CAPEX / OPEX

The Customer's preferences for payment model under this agreement is;

CAPEX

Hardware cost and implementation cost (project cost).

OPEX

SW License as a recurring price (annual subscription).

However, the Contractor may also price HW and implementation as OPEX. If so, this must be stated specifically in relation to each pricing table below. The final model will be decided upon during the negotiations.

1.3.1 Target prices for implementation work

The Customer may see the benefit of using a target price model for project implementation based upon estimates in the project plan (Appendix 4). The terms of the target price model is as follows:

Deviation	Invoiced if exceeded (x%)	Invoiced at savings (y %)
< 9 %	100 %	0 %
10 % < 19 %	80 %	20 %
20 % < 29 %	70 %	30 %
> 30 %	60 %	40 %

Explanation:

- If the solution is established with hourly consumption above the estimates that form the basis of the target price (adjusted for any agreed change orders), and excesses are the Contractor's responsibility, the Contractor can invoice a maximum of x percent of the Contractor's hourly price for the number of hours that constitute the excess.
- If the solution is established with hourly consumption below the estimates that form the basis of the target price (adjusted for any agreed change orders), the Contractor can invoice a maximum of y percent of the Contractor's hourly price for the number of hours that make up the savings.

2 CONSIDERATION – PART 1 (CLAUSE 8.1)

The Contractor shall specify all prices that are necessary to realize the solution required in Appendix 1 and offered in the Appendices 2, 4 through 6.

2.1 Price Software / Licenses

For software licenses, including third-party licenses, prices are stated in the associated table in the excel sheet. Please specify which variables (license type) the prices are based on (site license, number of environments/users, etc.)

It is expected that further details regarding sw/licenses shall be detailed in the submitted excel form.

Software license (name/version) - scope 1	3.party? (Y/N)	License type (site, users, etc)	Unit price	Quantity	Total price yearly cost
TOTAL LICENSES PRICE YEARLY COST					

Any prerequisites for and limitations in the Customer's right of disposal, cf. section 10.2.1 of the general agreement text, must be stated.

Contractor's response:

Any time limitations in the Customer's right of disposal to standard software, cf. section 10.5.2 of the general agreement text, must be stated. Such limitation is only applicable if the Contractor deliver the licenses as a one-time-cost and not as a recurring cost.

Contractor's response:

The Contractor must clearly describe any deviations between the provisions in the Contractor's or third party's license conditions regarding right of disposition and the general agreement text's provisions regarding right of disposition.

Contractor's response:

2.2 Price Hardware

Hardware prices are stated in the associated table in the excel sheet.

It is expected that further details regarding HW per iteration and environment is detailed in the submitted excel form.

If the proposed HW is regarded as commercial off the shelf (COTS), the Customer is free to use their existing agreements to acquire the products.

Hardware (Product name) - scope 1	Type of HW	Unit price	Quantity	Total price
TOTAL HARDWARE				

2.3 Implementation cost

The implementation prices are stated in the associated table in the excel sheet.

Stage/activity	Quantity (hours)	Sum
Detail planning scope 1		
Detail specification scope 1		
Development, Customization, Configuration, Testing		
Integrations		
Documentations		
Training		
Project management and quality assurance		
[Extra travel expense – cf. section 6 below]		
Total implementation cost scope 1	**[tot. hours]**	**[tot. cost]**
Average hourly price used as basis for target price cf, section 1.4.2	**[tot cost / tot hours]**	

2.3.1 Integration cost

The record shall contain the total of integration work. See SSA-T Appendix 1, section 8.1 for the 3 different cases of integration. The Contractor must in Appendix 2 describe which type of integration (A, B or C) the integration is based on. Further the Customer asks the Contractor to detailing cost calculations for the integrations in the submitted excel form and explicitly state whether the integration work is performed by the Contractor as a bear responsibility in respect of results and progress, and which shall be delivered as additional services (contribution obligation). This information will be a starting point to be detailed further in the negotiations.

2.3.2 Training cost

This record must contain what the Contractor believes is the required training for the Customer to test and use the system as intended. For additional trainings courses, please price this in section 5.

2.3.3 Documentation

Included in the price is an unlimited number of copies of the documentation for use in his own business, related to the solution delivered by the Contractor (cf. 10.4.1).

2.4 Upgrades to Customer platform

If the Customer's technical platform needs to be upgraded to enable the Customer to utilize the deliverables, the Contractor shall point this out in Appendix 2 and price the needed upgrades in the associated table in the excel sheet.

The Customer reserves the right to use their existing agreements for the purchase of equipment and software to upgrade the technical platform.

Contractor's response:

Hardware / Software (Product name)	Type of HW/SW	Unit price	Quantity	Total price

2.5 Total Prices Scope 1

This total price table shall compile the prices from the chapters above for prices for scope 1

Planning scope 1				
Scope 1				
Staging environments (As described in Appendix 1 sec. 7.6)				
	SW	HW	Implementation	Total
Upgrades to Customer technical platform (if applicable) (cf. section 2.4)				
TOTAL PRICE				

3 CONSIDERATION PART 2 (CLAUSE 8.1)

The Contractor shall specify all prices that are necessary to realize the solution required in Appendix 1 and offered in the Appendices 2, 4 through 6.

The scope 2 delivery shall be described, including a migration plan of servers from temporary to permanent data centers and description of work packages, prerequisites, and necessary hardware/software

3.1 Price Software / Licenses

For software licenses, including third-party licenses, prices are stated in the associated table in the excel sheet. Please specify which variables (license type) the prices are based on (site license, number of environments/users, etc.)

It is expected that further details regarding sw/licenses shall be detailed in the submitted excel form.

Scope 2	3.party? (Y/N)	License type (site, users, etc)	Unit price	Quantity	Total price yearly cost
TOTAL LICENSES PRICE YEARLY COST					

Any prerequisites for and limitations in the Customer's right of disposal, cf. section 10.2.1 of the general agreement text, must be stated.

Contractor's response:

Any time limitations in the Customer's right of disposal to standard software, cf. section 10.5.2 of the general agreement text, must be stated. Such limitation is only applicable if the Contractor deliver the licenses as a one-time-cost and not as a recurring cost.

Contractor's response:

The Contractor must clearly describe any deviations between the provisions in the Contractor's or third party's license conditions regarding right of disposition and the general agreement text's provisions regarding right of disposition.

Contractor's response:

3.2 Price Hardware

Hardware prices are stated in the associated table in the excel sheet.

It is expected that further details regarding HW per iteration and environment is detailed in the submitted excel form.

If the proposed HW is regarded as commercial off the shelf (COTS), the Customer is free to use their existing agreements to acquire the products.

Hardware (Product name) - Scope 2	Type of HW	Unit price	Quantity	Total price

Hardware (Product name) - Scope 2	Type of HW	Unit price	Quantity	Total price
TOTAL HARDWARE				

3.3 Implementation cost

The implementation prices are stated in the associated table in the excel sheet.

Stage/activity	Quantity (hours)	Sum

Stage/activity	Quantity (hours)	Sum
Detail planning scope 2		
Detail specification scope 1		
Development, Customization, Configuration, Testing		
Integrations		
Documentations		
Training		
Project management and quality assurance		
[Extra travel expense – cf. section 6 below]		
Total implementation cost scope 2	**[tot.hours]**	**[tot.cost]**
Average hourly price used as basis for target price cf, section 1.4.2	**[tot cost / tot hours]**	

3.4 Upgrades to Customer platform

If the Customer's technical platform needs to be upgraded to enable the Customer to utilize the deliverables, the Contractor shall point this out in Appendix 2 and price the needed upgrades in the associated table in the excel sheet.

The Customer reserves the right to use their existing agreements for the purchase of equipment and software to upgrade the technical platform.

Hardware / Software (Product name)	Type of HW/SW	Unit price	Quantity	Total price

3.5 Total Prices Scope 2

This total price table shall compile the prices from the chapters above for prices for scope 2.

Delivery	SW yearly cost (cf. section 3.1)	HW one time cost*) (cf. section 3.2)	Implementation one time cost*) (cf. section 3.3)	Total price
Planning scope 2				
Scope 2				
	SW	HW	Implementation	Total
Upgrades to Customer technical platform (if applicable) (cf. section 3.4)				
TOTAL PRICE				

4 CONSIDERATIONS OPTIONS

4.1 Options asked by the Customer

4.1.1 Event-based capacity increase

Please describe how a time-limited increased capacity can be priced as an option.

Contractor's response:

4.1.2 Permanent scale-out

Please describe how a permanent scale-out/increase of capacity can be prices as an option.

The Contractor is asked to suggest a predictable and transparent pricing model for purchasing software/hardware, which may provide a basis for supplementary purchases. For example:

[Global price list – % discount + % profit margin = Customer price]

Contractor's response:

4.2 Additional options

Please list any additional options, such as extra training. The options shall be described in Appendix 2.

Contractor's response:

Additional options	Unit price	Quantity	Total price

4.3 Options offered by the Contractor

[If options are offered by the Contractor]

5 HOURLY RATES

For any additional work, changes, and further development beyond what is included in the project delivery, hourly rates for the personnel offered must be stated by filling in the associated table in the excel sheet.

The following categories must be used:

- Junior (0-4 years of relevant experience in the field)
- Senior (5-10 years of relevant experience in the field)
- Expert (10+ years of relevant experience in the field)

Role / Category	Junior	Senior	Expert
Project manager	[redacted]		
Solution manager/architect			
Developer/customization/test			
Test assistance			
Training			
On-site assistance implementing new standard versions.			

6 TRAVEL EXPENCES

The Customer will cover travel costs (travel and accommodation, diet) in relation to necessary trips to the Customer's premises in Oslo in the following way:

NRK covers

- travel cost based on lowest price available (economy class i.a)
- Up to NOK 2000 per day for hotel / diet

A budget of NOK 500.000 has been set aside for scope 1 and 2 to ensure the necessary Contractor / sub-contractor presence in the project phase. If the Contractor believes they will exceed this budget, the extra cost must be added to the project price, cf. sections 2.3 and 3.3 above.

The Customer will cover travel and accommodation, cf. bullets above for work that comes in addition to planned project implementation, approved through change requests or options.

The parties must agree on the degree of prior approval, follow-up and documentation of the travel cost as part of the start-up of the project.

Travel time is not subject to remuneration.

7 PRICE ADJUSTMENTS (CLAUSE 8.5)

The Rate Card is subject to annual index adjustment as stipulated by the Statistics Norway's retail index (the main index).

8 INVOICING (CLAUSE 8.2)

Payment plan

The Customer prefers the following payment plan.

Hardware, software and project costs are invoiced on account at the following milestones as defined in Appendix 4:

Delivery Scope 1:

- Installation: 40% (MS1-03)
- Acceptance test approved: 40% (MS1-05)

Delivery Scope 2:

- Installation: 40% (MS2-03)

- Acceptance test approved: 40% (MS2-05)

Delivery Date: (MS2-FINAL) 20% of total contract cost.

Accrued travel costs are specified and invoiced at each milestone.

Contractor's response or counter proposal:

8.1 Invoicing

All deliveries are to be invoiced according to price terms as given from this Agreement.

The Contractor cannot add additional fees to the invoices, such as ordering fees, invoice fees or any similar fee.

Payment terms are 30 days credit. Paying the invoice, does not involve approval of the delivery.

All invoices must come directly from the Contractor. Invoices from subcontractors will not be accepted unless specifically agreed in each case.

Invoices that are not issued correctly will be returned and claimed credited.

The price also includes necessary meeting activities under this Contract, insurances, and courier mail.

Any pre-payments require a Bank Guarantee.

Invoices shall (unless otherwise agreed) be sent electronically in standard format EHF (electronic trading format).

Electronic invoices shall be addressed to the respective organization and the following VAT number: **[TO BE INSERTED UPON CONTRACT SIGNATURE]**

All invoices must be marked with contract number **[TO BE INSERTED UPON CONTRACT SIGNATURE]**

In addition to the mandatory requirements of the EHF format, NRK AS requirements for the content of the following data elements:

- Your reference "AccountingCustomerParty / Party / Contact / ID"
  Data element must contain the name of the person who ordered the goods / services.
- Order number "OrderReference / ID"
  Data element must contain NRK purchase order number if specified, and contract number.
- Appendix "AdditionalDocumentReference / Attachment / EmbeddedDocumentBinaryObject"
  Attachments shall be of the format PDF or TIF and should be embedded in the XML document.
  If possible, we also want the invoice attached as an appendix. This ensures a better view of the invoice in our invoice processing system.

The invoice must also meet the following requirements:

1) The invoice must be numbered and dated
2) The invoice must contain information on:
   a) Seller's name, address and organization (including VAT when the Contractor is VAT registered)
   b) Buyer's name and address
   c) Clear description of what is delivered
   d) Quantity or scope of the supplied
   e) Price (specified tax base and tax amount)

f) Delivery Time and place of delivery

2) Invoices should be addressed to

[TO BE INSERTED UPON CONTRACT SIGNATURE]

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 8 – Changes to the general contractual wording

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[Contractor logo]

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1 CHANGES TO THE GENERAL CONTRACTUAL WORDING

Changes to the general contractual wording shall be set out here unless the general contractual wording refers such changes to a different Appendix.

Changes can be made to all the clauses in the Agreement, even where there is no clear reference to the fact that changes can be agreed. Changes to the contractual wording shall be specified here so that the wording of the general contractual wording remains unchanged. It must be stated clearly and unequivocally which clause or clauses in the Agreement have been changed and the result of the changes.

The Contractor should, however, be aware of the fact that deviations, reservations or changes to the Agreement in connection with the submission of a tender may result in rejection of the tender by the Customer.

2 AGREED CHANGES INITIALISED BY THE CUSTOMER

Amended text; deleted text marked with ~~strike-through~~, new text in red.

Clause	Original text	Comments/shall be replaced by
2.5.3, last paragraph	The Customer's approval shall not prevent the Customer from demanding during the warranty period, the rectification of errors and defects that the Customer did not discover during the approval period, or errors that have not been rectified by the Contractor during the approval period.	*[Amended text]* The Customer's approval ~~shall~~ does not prevent the Customer from demanding the Contractor to rectify errors and defects during the warranty period that~~, the rectification of errors and defects that~~ the Customer did not discover ~~and could not be expected to discover~~ during the approval period, or to rectify errors or defects ~~that have~~ not ~~been~~ rectified by the Contractor during the approval period.
3.2, 2nd paragraph	However, the Contractor shall not be obliged to carry out additional work that represents, in aggregate, a net addition of more than fifteen (15) per cent to the original contract price, other than in the case of a disputed change order pursuant to clause 3.8.	*[The paragraph is deleted in its entirety]*
3.2, new last paragraph		*[New last paragraph]* Changes and additions to the Agreement can be made during all contract stages. The right to agree upon changes that are not a consequence of changes in legal requirements, do not go beyond what can be agreed upon within the legal framework of the procurement rules.
3.6, first paragraph, first sentence	If the parties agree that there is a change, but disagree on the effect of such change as far as the contract price is concerned, the Customer shall pay a preliminary consideration, calculated pursuant to the rules set out in clause 3.5.	*[Amended text]* If the parties agree that there is a change, but disagree on the effect of such change as far as the contract price is concerned, the Customer shall pay a preliminary consideration, corresponding to the undisputed part of the consideration calculated pursuant to the rules set out in clause 3.5.

Clause	Original text	Comments/shall be replaced by
3.8, 3rd and 4th paragraph	Even if the change order is disputed, the Contractor shall perform what has been ordered in return for the Customer paying a provisional consideration corresponding to half of the amount to which the Contractor believes it is entitled. If the Contractor does not demand a decision concerning the disputed change pursuant to clause 3.9 of the Agreement within three (3) months after the consideration has been paid, or if the work is deemed to fall within the scope of the Agreement, the provisional consideration shall be set off against the consideration due upon the next payment milestone. If the work is deemed to be a change, the fixed consideration for the change, adjusted for the provisional consideration, shall be incorporated into the ordinary payment plan. The Contractor may contest the duty to perform the work by requesting a ruling from an independent expert or mediator or institute legal proceedings or submit the dispute for arbitration in order to have its claim resolved with final effect, cf. chapter 16. Such a request must be submitted without undue delay after the Customer has provided notice that the change is disputed. The Contractor shall bear the risk associated with any delays that may occur due to the postponement of the work, if it is determined that the work falls within the scope of the Agreement.	*[Both paragraphs are deleted in its entirety]*
3.8, new 3rd paragraph		*[New paragraph]* Although the change order is disputed, the Contractor has a duty to perform the work provided the Customer provides a guarantee. The guarantee requirement does not apply if the Customer is a Norwegian public enterprise.
8.4, 1st paragraph	If overdue consideration, with the addition of late payment interest, has not been paid within thirty (30) calendar days of the due date, the Contractor may send a written notice to the Customer, stating that the Agreement will be terminated for breach, unless settlement has taken place within sixty (60) calendar days of receipt of such notice.	*[Amended text]* If a non-disputed overdue consideration, with the addition of late payment interest, which in total is considered to be material, has not been paid within thirty (30) calendar days of the due date, the Contractor may send a written notice to the Customer, stating that the Agreement will be terminated for breach, unless settlement has taken place within sixty (60) calendar days of receipt of such notice.
11.1, last paragraph	The Customer shall submit a written complaint without undue delay after the breach of contract has been discovered or ought to have been discovered.	*[Amended text]* The Customer shall submit a written complaint within reasonable time ~~without undue delay~~ after the breach of contract

Clause	Original text	Comments/shall be replaced by
		has been discovered ~~or ought to have been discovered~~.
11.2, last paragraph	No damages or other remedies for breach of contract may be claimed for circumstances that have not been notified at the latest prior to the expiry of the warranty period. Nevertheless, this shall not apply to any liability for damages imposed in relation to a third party in respect of defects in title pursuant to clause 13.4.	*[Amended text]* No damages or other remedies for breach of contract may be claimed for circumstances that have not been notified at the latest prior to the expiry of the warranty period. Nevertheless, this shall not apply to any liability for damages imposed in relation to a third party in respect of defects in title pursuant to clause 13.4, nor shall it apply in the case of gross negligence or wilful misconduct on the part of the Contractor.
13.2, last paragraph	If the defect in title cannot be resolved as stipulated in paragraph three, the Customer shall stop any further use of the solution and delete the relevant software component.	*[The paragraph is deleted in its entirety]*
15.7	**Explanation:** **NRK is obliged to follow the Act on the transparency of businesses and work with basic human rights and decent working conditions (Åpenhetsloven LOV-2021-06-18-99).** **The following text is therefore taken in its entirety:**	*[New clause]* **Contract performance clauses for safeguarding basic human rights in the supply chain** The Contractor shall, for the duration of the contract period, comply with clauses 1-4 of this clause. The contractual performance clauses are based on the United Nations Guiding Principles on Business and Human Rights (UNGP) and the OECD Guidelines for Responsible Business Conduct with due diligence as method. These frameworks both recommend due diligence as the preferred method for identifying, preventing, mitigating, and accounting for how businesses address their actual and potential adverse labour and human rights impacts in their own operations and in the supply chain. The requirement in this contract is applicable to the Contractor and all its subcontractors. The Contractor has an obligation to communicate the requirements all its subcontractors, and to contribute to compliance with the requirements in the supply chain. **1. Compliance with international conventions and the national legislation in the country of production.** The goods and services delivered under this contract shall be produced under conditions that are consistent with the

Clause	Original text	Comments/shall be replaced by
		requirements specified below. The requirements apply in the Contractor's own operations and in the supply chain. The requirements include: • The ILO Core Conventions on forced labour, child labour, discrimination, freedom of association and the right to collective bargaining: No. 29, 87, 98, 100, 105, 111, 138 and 182[1]. • Where conventions 87 and 98 are restricted by national law, the employer shall facilitate, and not hinder, the development of alternative forms of independent and free workers' representations and negotiations. • The UN Convention on the Rights of the Child, article 32. • National legislation on labour rights in the country of production. Particularly relevant matters are 1) wage and working hours 2) occupational health and safety; 3) regular employment conditions, including contracts of employment; 4) statutory insurance and social schemes. Where international conventions and national legislation differentiate, the highest standard shall apply. **2. Policies and routines for due diligence** To fulfil the requirements in contract clause 1, as well as to prevent and manage any deviations from the requirements, the Contractor shall upon contract commencement, or no later than 6 months after the commencement[2], have adopted policies and routines for due diligence. This means that the Contractor shall, in cooperation with its stakeholders, identify, prevent, mitigate and accounting for how it addresses the actual and potential adverse impacts on human and labour rights as set out

[1] https://www.ilo.org/global/standards/introduction-to-international-labour-standards/conventions-and-recommendations/lang--en/index.htm

[2] Contractors subjected to compliance with the Norwegian Transparency Act[2], shall have adopted policies and routines for due diligence when signing the contract.

Clause	Original text	Comments/shall be replaced by
		in clause 1 in its own operations and in the supply chain. In line with the OECD due diligence guidance stakeholders, and especially affected rights holders, must be involved. Most salient risk, regardless of where it is occurs in the supply chain, should be prioritised first. The due diligence shall, as a minimum, consist of: 2.1 One or more publicly available policies adopted by the Board of Directors. The content of these policies shall, as a minimum, include a commitment to comply with the contract requirements in clause 1, in the Contractor's own operations and in the supply chain. One or more employees at management level shall be responsible for compliance and continuously report the due diligence progress to the Board of Directors. The Contractor shall have routines to embed and follow up on the policy for responsible business conduct in its own operations and in the operations of subcontractors in the supply chain. 2.2 Due diligence routines for undertaking regular risk analyses in own business and in the supply chain. This involves mapping and assessing the risk of breach of the requirements in clause 1. 2.3 The due diligence routines shall describe the measures implemented by the Contractor to cease, prevent and mitigate, with regards to adverse impacts on human and labour rights as set out in clause 1, in their own operations and in the supply chain. 2.4 The Contractor shall describe the routines to control and ensure that the measurements are carried out with efficient results. 2.5 The Contractor shall publicly disclose available information on the due diligence routines in their own operations and in the supply chain. This includes how the risk of breaches of the contract clause 1, and how the potential adverse impacts in its own operations and in the supply chain, are addressed.

Clause	Original text	Comments/shall be replaced by
		2.6 If the Contractor has caused adverse impacts, the Contractor shall address such impacts by providing for, or cooperating to provide for, remediation and compensation to the victims. **3. Contract follow-up** The Contractor shall ensure compliance with the requirements in clause 1 and 2 in its own operations and in the supply chain. If the Contractor is made aware of conditions in the supply chain that are in breach of clauses 1 and 2, the Contractor shall inform the Contracting Authority without undue delay. The Contracting Authority may require that compliance is documented by one or more of the following means: 3.1 Adopted policies and routines, cf. clause 2. 3.2 An overview of production units in the supply chain for selected risk products, and/or components and/or raw materials, determined by the Contracting Authority. 3.3 A completed Self-assessment questionnaire, sent by the Contracting Authority, within six weeks, unless the Contracting Authority has set a different deadline. 3.4 A risk assessment, and a report on how adverse impact is accounted for and managed. 3.5 Participation in follow-up meetings with the Contracting Authority, and with any other relevant stakeholders. 3.6 Provision of report(s) relevant to the requirements in clause 1 and 2. 3.7 An assessment and/or audit of the requirements in clauses 1 and 2 at the Contractor. 3.8 An assessment and/or audit of the requirements in clauses 1 and 2 in the supply chain. The contract follow-up is managed by the Contracting Authority or by other public organisations with whom the Contracting Authority collaborates. The Contracting Authority reserves the right to share the audit reports and other contract follow-up information with other

Clause	Original text	Comments/shall be replaced by
		public organisations, under duty of confidentiality. **4. Sanctions** In case of any contract breaches of clauses 1-3, or incomplete documentation, the sanction provisions in the main contract apply with the following additions and clarifications. The Contracting Authority can: 4.1 Require rectification: The Contractor shall provide a Corrective Action Plan (CAP) for when and how the contract breaches are to be rectified. The rectifications shall be reasonable in relation to the nature and extent of the breaches. The CAP shall be presented within four weeks. For serious breaches a shorter deadline may be required. The Contracting Authority shall approve the CAP and authorise the documented rectifications. 4.2 Implement a temporary suspension in all or part of the delivery when the Contractor does not meet the requirement to submit a CAP or the CAP is not complied with. During temporary suspension, replacement purchases made from another contractor will not be considered a breach of contract. Under temporary suspension, any purchase from an alternative contractor will not be considered as a breach of the contract. 4.3 Require that the Contractor change sub-contractor(s): Upon serious breach of the contract, reoccurring serious breaches, or if the CAP is not adhered to. This shall be done at no cost to the client. 4.4 Termination of the contract: Upon serious breach of the contract, reoccurring serious breaches, or if the CAP is not adhered to.
15.8		[New clause] **Confidentiality declaration, police certificate and clearance**: The Customer may, at commencement or during the contract period, find it necessary to require a non-disclosure agreement and/or police certificate from the

Clause	Original text	Comments/shall be replaced by
		Contractor's and any subcontractors' personnel. The required confidentiality declaration(s) and police certificate(s) must be obtained by the Contractor as soon as possible. The Customer reserves the right to refuse to use personnel who cannot provide or have a police certificate or who have not signed a non-disclosure agreement. The Contractor is then obliged to provide other personnel with the required certificates and declarations mentioned above. If during the agreement there is a need for access to information that is graded in accordance with security act of 6 January 2018 no. 24 § 5-3, the personnel who need such access must be security cleared and/or authorised, in accordance with the applicable provisions for this at all times. If there is a need for logical access to an object and/or infrastructure worthy of shielding, access clearance or extended access clearance may be required for the personnel in accordance with the applicable provisions for this at all times. Where a non-disclosure agreement, police certificate, security clearance and/or authorization is required, it is a prerequisite that this has been approved by the Customer before relevant personnel can start work.

3 AGREED CHANGES INITIALISED BY THE CONTRACTOR

Amended text; deleted text marked with ~~strike-through~~, new text in blue.

Clause	Original text	Comments/shall be replaced by

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 9 – Changes subsequent to the conclusion of the Agreement

[Contractor name]

[Contractor logo]

Norwegian Broadcasting Corporation Ltd. (NRK)

Bjørnstjerne Bjørnsons plass 1

N-0340 OSLO, Norway

Switchboard: +47 23 04 70 00

Website: www.nrk.no

Norwegian Business Registration NO976 390 512

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1 INTRODUCTION

This Appendix documents changes in the delivery subsequent to the conclusion of the Agreement.

The Contractor shall maintain a directory of the changes on an ongoing basis, which directory shall form SSA-T Appendix 9, and shall without undue delay provide the Customer with an updated copy thereof.

2 DOCUMENTATION OF THE CHANGE (CLAUSE 3.4)

Change no.	Description	Effective date	Archive reference

Solution for new Ingest System of Media Assets

NRK 2024-295

SSA-T Appendix 10 – Licence terms and conditions for standard software and free software

[Contractor name]

[Contractor logo]

Norwegian Broadcasting Corporation Ltd. (NRK)

Bjørnstjerne Bjørnsons plass 1

N-0340 OSLO, Norway

Switchboard: +47 23 04 70 00

Website: www.nrk.no

Norwegian Business Registration NO976 390 512

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1 INTRODUCTION

Copies of the licence terms and conditions for standard software and free software shall be inserted here in Appendix 10.

The Contractor shall fill in relevant information. Text inserted by the Contractor should be marked with blue font.

2 LICENCE TERMS AND CONDITIONS FOR STANDARD SOFTWARE AND FREE SOFTWARE (CLAUSE 5.1)

To the extent that standard software included in the deliverables must be delivered under standard licence terms and conditions, this shall be explicitly stated in a separate chapter in SSA-T Appendix 2, and copies of the licence terms and conditions shall be appended here in Appendix 10.

Attachment no.	Software/licence	Comments

3 GENERAL PROVISIONS PERTAINING TO FREE SOFTWARE (CLAUSE 10.7.1)

If free software is to be used in connection with the deliverables, the Contractor shall prepare an overview of the relevant free software. The overview shall be included as a separate chapter in SSA-T Appendix 2. Copies of the applicable licence terms and conditions for the relevant free software shall be appended here in Appendix 10.

Attachment no.	Software/licence	Comments