Appendix 1 – v 0.8

Customer requirements specification

Multi-channel Continuity automation and playout

NRK-MA3542-22E

[Contractor name]

[Contractor logo]

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Table of Contents

1 INTRODUCTION

This appendix describes the customer's needs and requirements for the service, forming the basis of the performance and deliverables for the Contractor. These specifications include the delivery, operation and maintenance of the Customer's production management solution (hereby referred to as "Solution"). The Customer's technical platform that the Solution must interact with is described in Appendix 3.

The list below gives 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 concerns questions related to the Contractor's high-level solution proposal.
- Chapter 5 describes the Customer's needs and user requirements.
- Chapter 0 describes the Customer's needs and requirements related to the solution architecture.
- Chapter 6 describes the Customer's technical needs and requirements.
- Chapters 8-10 describes needs and requirements related to other subjects; documentation; training; conversion; and requirements related to processing and storage of personal data.

This appendix also includes the following attachments:

- Appendix 1 – Attachment 1-1
- Appendix 1 – Attachment 1-2

The Contractor is required to document compliance with the requirements in Appendix 1 by completing the corresponding Appendix 2 Contractor's solution description and Appendix 2 – Attachment 2.1 Contractor's solution description. The Contractor must:

In Appendix 2, provide for each requirement, including for all user stories, a written description of how the Solution addresses the Customer's requirement. The Contractor is encouraged to add illustrations and screenshots whenever this can help the Customer to a better understanding of how the Solution addresses the requirement. References to general descriptions such as brochures, product magazines and web content is not sufficient as an answer to a requirement. Every requirement must be answered with a specific description in Appendix 2. Any relevant supplementary information can be given as an attachment to the description with clear references.

Additionally, fill out the table in Appendix 2 – Attachment 2-1 Contractor's solution description according to the instructions explained in chapter 1.1 below. It is not a sufficient answer to a requirement or user story to only fill out Appendix 2 – Attachment 2-1. Each requirement must also be answered with a description according to the point above.

Text inserted by the Contractor shall be marked in blue font.

Please note that the requirements classification overrules any inconsistencies with respect to the use of "must"/"shall"/"should" in the requirements description.

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.

If Standard terms and conditions for third-party deliveries are made applicable, these must be described under the relevant section in Appendix 2, with clear reference to which parts of the

delivery they are made applicable. To the extent that they affect the offered performance, this must be clearly stated in the Contractors' reply to Appendix 2 under the relevant section.

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

Any reference to "clause" refers to a section in the main text of the Agreement named "NRK-MA3131-18E_SSA_T_2015_Eng".

1.1 Instructions for filling out Appendix 2 – Attachment 2.1 Contractor's solution description

To document compliance with the requirements in Appendix 1, the Contractor must also fill out the table in Appendix 2 – Attachment 2.1 Contractor's solution description. The table consists of the columns shown in Figure 1 below.

Req. ID	Requirement	Option	PRI	Requirement fulfilment								Reservations	Workaround solution	Comments
				STD	CON	DEV	3RD INT	3RD	FUT	WA	No			

Figure 1: Columns in Appendix 2 Attachment 2.1 Contractor's solution description

Each requirement from Appendix 1 is listed in the "Requirement"-column. The requirements that are part of the scope that comprises the options is marked in the "Option"-column.

How important each requirement is to the Customer is indicated in the "PRI"-column, with "High", "Medium" and "Low" priority.

The Contractor must answer each requirement with a confirmation by marking an "X" in the relevant column under the heading "Requirement fulfilment":

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

b) 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.

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

Regarding the columns under the heading "Requirement fulfilment" the definitions are as follows:

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.

2 BACKGROUND AND PURPOSE

2.1 Background

NRKs current Automation/Playout has reached End Of Life and needs to be replaced and modernized. It has been a stable and reliable installation, but due to its age we are running with a higher risk than desirable. We have major shortages both on support and spare parts. It is based on Legacy integration with stand-alone video servers, routers, graphic generators, vision mixers and is not set to meet the strategic editorial and technical development needed.

Today's workflows are based in the linear world, but we need an operation which can serve a wider publishing strategy. NRK's focus is on online publishing both live and on-demand, beside our linear channels.

Implementation of a new continuity automation and playout solution should contribute to NRK's efforts to reach its strategic objectives. In the long-term strategy for 2021-2024, NRK states three strategic objectives shown in **Feil! Fant ikke referansekilden.** below.

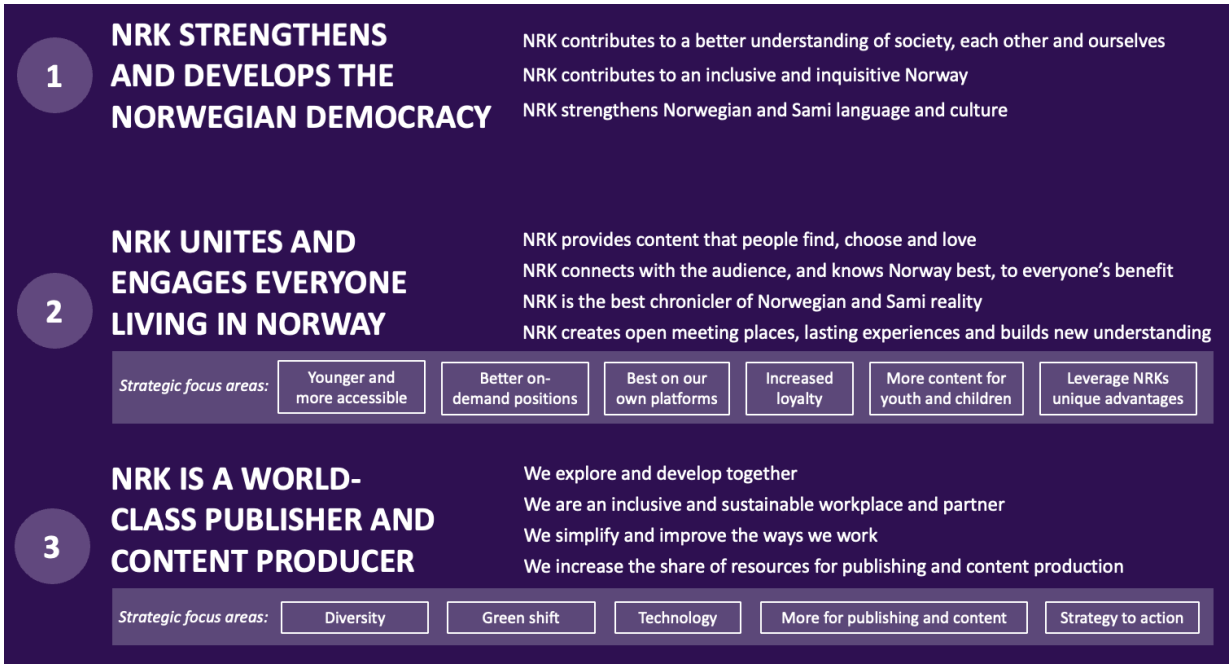


Figure 2: NRK's three strategic objectives in the long-term strategy for 2021-2024

NRK's long-term strategy is based on NRK's role in the Norwegian society, as formulated both through the statutes approved by the Ministry of Culture and through the NRK placard set by the Parliament. Some of the highlights include:

- NRK shall ensure that content and services can be used by everyone regardless of sight, hearing and other cognitive or physical skills.
- NRK has a special emergency response responsibility and will thus facilitate that the government reaches the entire population with information in the event of national crises and disasters.
- NRK shall strengthen the Norwegian and Sami languages, culture and identity

2.2 Main objectives

The main objective for the project is to renew the Presentation suite/Main continuity centre to meet the editorial and technological requirements for NRKs publishing strategy. A new Automation/Playout solution is central to achieving this. The main objectives for the Solution are:

2.2.1 Support editorial innovation and development

Less technical problem solving for the operators

Their focus should be on their editorial tasks. The quality of the user experience will be highly valued and prioritized.

Flexible control of program length and scheduling

Handling live programming and breaking news situations (last second changes)

Location independence

The Presentation suite/Main continuity centre should be placed where it is appropriate from an organizational point of view, and not be bound by technical limitations

2.2.2 Technological renewal and modernization

SW-based solution

We focus on SW-based automation and playout solutions, which is in line with NRKs strategy.

Virtualization

Virtualized systems and infrastructure (data center or cloud) are also an important part of NRKs technological strategy.

Modern software development and operations methodologies

Infrastructure as code, version-controlled configuration, continuous integration/delivery and automatic deployment of both servers and software

API driven

Integration and “developement-friendly”. Use modern API-interfaces and other modern techniques to integrate applications, whenever possible

Prepares for IP transformation

Although the first iteration of the delivery operates on SDI infrastructure, the ability to gradually introduce AVoIP capabilities into the installation is of high importance.

Location independent architecture

NRKs HQ will be relocated in the next years, and the system needs a technological architecture that simplifies the relocation.

2.2.3 Secure service availability

High availability design

High availability design with multiple parallel streams from more than one location will be important to secure NRKs responsibilities as a public broadcaster.

Redundancy and resilience

Across multiple locations, servers and rendering engines, we strive for location independent publishing

Quality

Increased technological quality. Higher degree of flexibility to meet current and future technical standards and formats

3 SCOPE

The customer shall procure a new automation/playout solution using an iterative approach during both design 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.

The 1st main delivery shall be based on SDI as the surrounding infrastructure and is proposed divided in 3 iterations. The level of functionality adapted to each iteration is described in chapter *5 User requirements specific to Automation/Playout*. The solution in this delivery shall be redundant and build in today's HQ.

- 1st Iteration: **NRK 4 - 8** (NRKs streaming/off-loading channels)
- 2nd Iteration: **NRK2 and NRK3/NRK Super** (Primarily pre-programmed playlists)
- 3rd Iteration: **NRK1** (High degree of live programming and last second changes. Requires more complex functionality and integrations)

See 0 for a more detailed description of the channel structure and 5.5 for "every-day" case examples explaining the level of functionality. The matrix in 5.7 shows which iteration the different uses stories belong to.

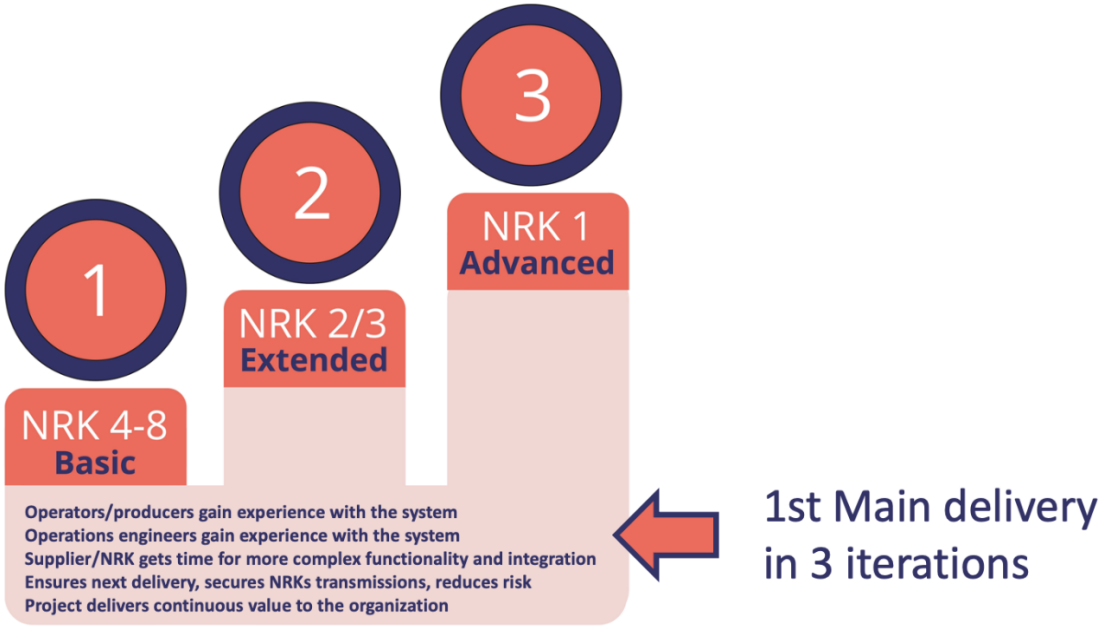


Figure 3: Iterations in 1st delivery

The solution shall include a feature complete development/staging environment which is comparable to the production environment. This environment will be used by operations engineers and developers for test, development and configuration.

The 2nd main delivery includes a plan for multi-site installation based in AVoIP infrastructure.

The strategy for design and build of AVoIP infrastructure is an ongoing process in NRK. Therefore, there are uncertainties regarding the timeframe and standards. Playout on SDI infrastructure needs to be in place first, but the path from SDI to AVoIP must be defined from the automation/playout solution perspective.

As a basic the new automation/playout must be able to deliver a full chain on SMPTE 2110 that can run in parallel with the SDI playout. What implications this entails regarding HW is essential information. Upgrades, HW-changes, licensing.

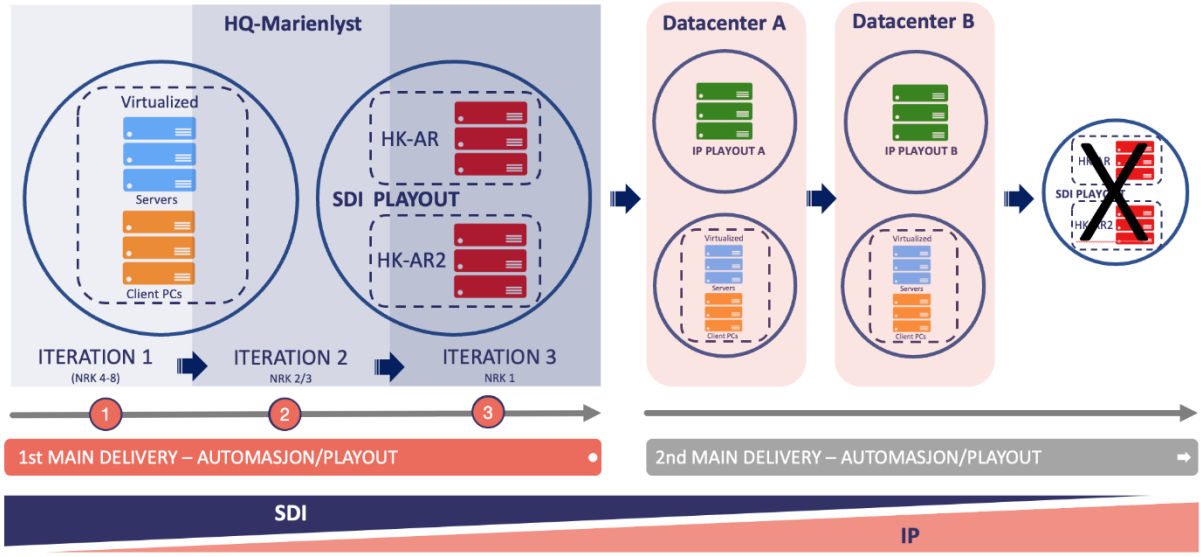


Figure 4: Prepare for IP transformation

3.1 Volumes

The solution must at least handle the following volumes:

Automation/Playout for 3 x "Tier-1" Channels

As described in 5.4.1 Linear channel structure

Automation/Playout for 5 x "Tier-2" Channels

As described in 5.4.1 Linear channel structure

Scalability

In the current situation we have a setup of 3 + 5 (+1) channels, but the volumes and number of channels is dynamic. At times, we will have to scale up the number of streaming channels

Filebased playout vs live

work in progress

3.2 Options

a) *Sign Language Channel*

NRK has one accessibility channel for hard-of-hearing viewers

b) *Disaster Recovery as cloud-only instance*

As discussed in 6.2 Resilience

c) *Streaming/Off-loading channels as cloud-only instances*

As discussed in 6.6 Cloud/hybrid/on-premises solutions. To place the main playout and automation for a public broadcaster in the cloud is a "hard sell". But a hybrid model with NRK 4-8 as cloud-native is interesting to look into as an option

d) Pop-Up channels

Event based channels with “short life”

e) On Site spares of critical components

f) AVoIP

Work in progress

3.3 Business processes not in scope

In a best effort to clarify the process scope, the following list attempts to summarize some business processes that are **not** in scope:

Distribution

Contribution

Media Management (beyond what is needed for the solution to work internally)

Not primarily an IP project, but the transition will occur in the systems lifespan and a new Automation/Playout will be part of NRKs IP transformation process

3.4 Software delivery model

work in progress

3.5 Road-map – future of the product?

work in progress

4 HIGH-LEVEL SOLUTION PROPOSAL

4.1 High-level solution overview

The Contractor shall provide a comprehensive high-level overview of their Solution based on the description of the contract purpose and listed requirements – including options and how they will be offered – if at all. The Contractor must give clear and unambiguous statements about which of the Customer needs and requirements they do not support or cannot deliver.

This high-level solution overview should provide:

A summary of the bid.

A high-level description of the Contractor's software delivery model, including how and where the service is provided as well as a short description of any "contributions" from the Customer in terms of infrastructure or active participation necessary to run the system as a service.

A high-level technical description of the Solution.

Furthermore, the high-level solution overview should emphasise the following subjects:

Performance: How the offered Solution contributes to achieve the main objectives of this procurement (cf. chapter 2.2). Please make unambiguous references to the relevant sections in Appendix 2 that contribute to the achievement of the Customer's objectives.

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.

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 USER REQUIREMENTS SPECIFIC TO AUTOMATION/PLAYOUT

5.1 Reading guidance to chapter 5

Each chapter within chapter 5 begins with a short summary of the Customer's needs related to the process in question followed by a high-level illustration of the main tasks of that process. Following the illustration is a more detailed description of the process in question and its needs, and subsequently a non-exhaustive list of examples of functional requirements for the process.

The latter are phrased as simplified user stories beginning with a role, e.g. "As a Continuity producer …". The roles referred to in these user stories are the most prevalent roles within Presentation suite/Main continuity centre. The wording of a user story cannot be considered literally exhaustive, they are only meant to exemplify functional requirements in a richer context.

5.2 Roles

5.2.1 Continuity producer

The continuity operator mans the Presentation suite/Main continuity centre. They have a significant editorial responsibility as the final publisher and are responsible for how the end product appears to the public.

The tasks include the following

- The continuity operator acts as producer and editor for the entire TV offer
- Composes the front page of NRK TV outside office hours
- Produces and edits parts of the promotion and program presentation
- Maintains daily publication plans and marketing plan
- Responsible for informing the public of changes from the set plan
- Production support for channel hosts, subtitlers and sign language interpreters
- They operate all the technical equipment in the Presentation suite, handling everything from the automation system, vision mixers, router control software, editing software and graphical systems to create the desired product.
- Continuity producers are working in shifts and are present at the Presentation suite/Main continuity centre between 06:00 – 01:00. The playout is unattended at night

5.2.2 Announcer/host

NRK has an on-camera live channel host service. The most important task of the channel hosts is to announce the next program and sell the current and future programs on all platforms.

They compose the NRK 1-experience together with the continuity producer and has a unifying role when major events happen. They are the face of the channel to the public.

The channel hosts plans, schedules and operates playout of branding graphics between shows on NRK1 and do off-tube voiceovers on program-flow elements, like end-credits.

They often use NRK1 to cross-promote NRK content on other channels and platforms (podcasts, radio shows, web articles).

5.2.3 Planner

There are people with the full-time role of handling schedule planning, but the responsibility is divided between several different other roles – depending on time scale.

Mainly 3 levels of planning are defined in NRK.

Long term: Relates to the ordering of programs to the channel. See the big picture. Last up to 6 weeks before publishing. Changes done by the management.

Mid-term: 3 - 6 weeks before publication date. Changes done by the planner.

Short term: 3 weeks before and up to and including time of playout. Changes done by the Continuity producer or the planners manager.

5.2.4 Operations engineers

Operations engineers ensures the stable operation and development of the technical infrastructure underpinning the Presentation suite/Main continuity center. Monitoring, maintenance, bug hunting and fixing, updates and upgrades are handled by the team. They are responsible for planning and design of the technical architecture in the TCR/ Presentation suite-sphere together with suppliers and adjacent departments in NRK.

They are the main support for all playout related equipment and systems in the Presentation suite and are 1st line support contact for the continuity producers.

5.2.5 Developers

NRK has a high degree of developer competence in-house - this has been a proven commitment over several years. It provides continuous added value for the organization to be able to create tailored user experiences and rapid rollout of new workflows. The type of in-house projects spans from user interfaces on top of COTS to complete systems like NORA (Graphics system) and SOFIE (news playout system). In the context of continuity playout, having in-house control of most of the integration points between systems, version-controlled configuration and automated deployment are some of the areas where our developers will contribute.

As an example, the integration between the automation system and the MAM will most probably be facilitated by NRKs own development-teams.

5.2.6 Subtitler

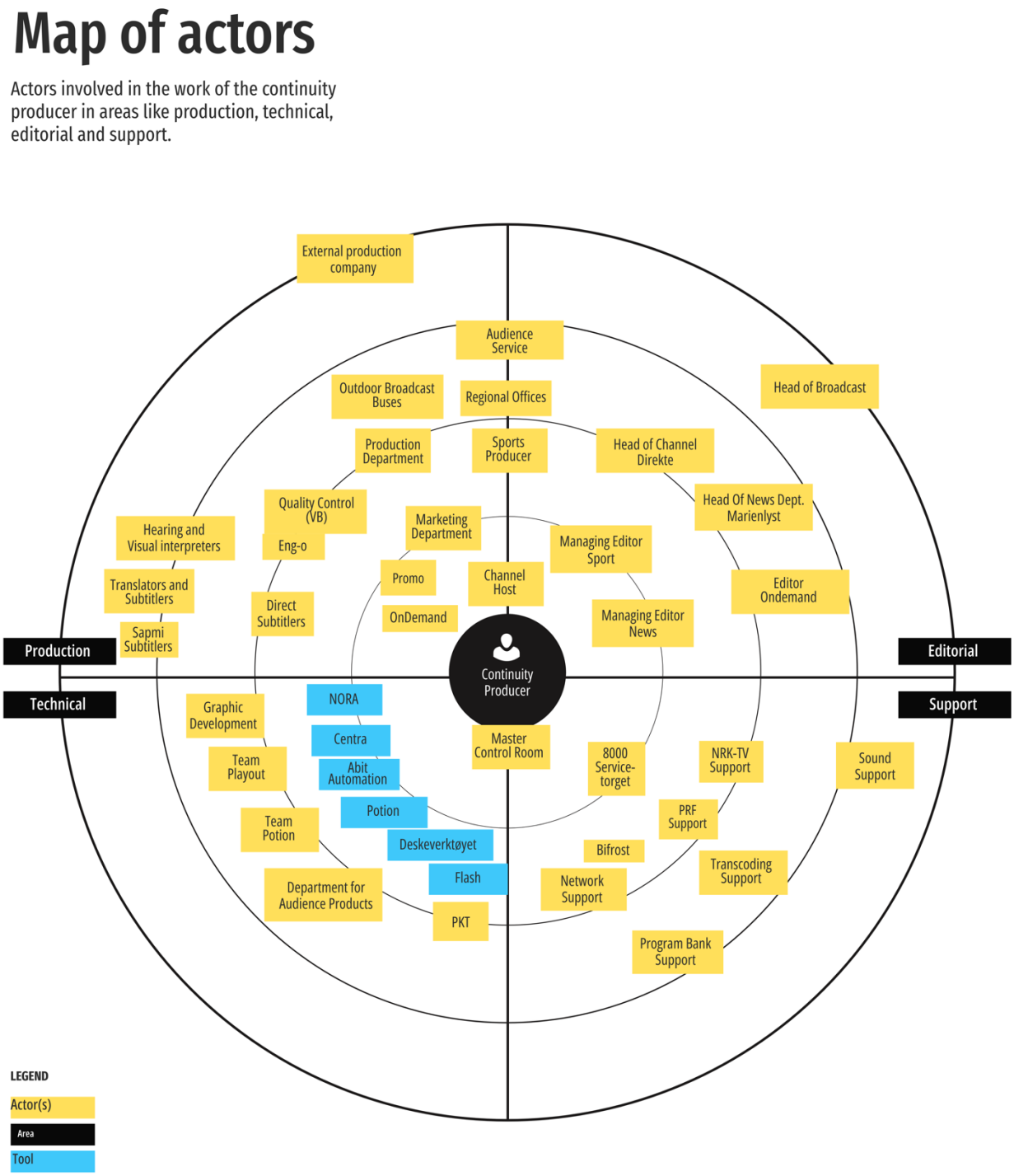
As a national broadcasting company, NRK has a clear social responsibility defined by law with clear requirements for the availability of accessibility services.

Subtitles are an important tool to achieve the goals set in the statutes mentioned in 2.1.

NRK provides subtitles to *live* and *planned productions*. The former type will be provided by a *live subtitler*. The live subtitler writes fast via a program developed by NRK for providing text to live shows. The latter type, planned productions, will be subtitled by a person with a translator background. Where the former has a great need for speed the other has time to add the best quality of text.

The manually written subtitles, both open (for translation of foreign languages) and closed (for hard of hearing) are, together with pre-produced audio description and automated text-to-speech audio tracks, an important part of the accessibility services NRK are required to provide by law.

5.3 Map of Actors



5.4 Glossary

work in progress

Presentation suite/Main continuity centre:

Playout

Transmission Control

Presentation

Playout Centre

Continuity

MCR:

NRK TV: Common name for the TV streaming service of NRK which includes both live, linear channels, recordings and ondemand content. The service is available on multiple user devices such as smart TVs, set-top-boxes, mobile devices and desktop. The NRK TV service is not to be confused with the broadcast linear channels, although they are available in the NRK TV service.

nrk.no : The main web-page for the article-based offerings of NRK

NORA:

SOFIE: News playout systems used in both the regions and Marienlyst
https://www.sofieautomation.com/

5.4.1 Linear channel structure

NRK broadcasts its programmes on the linear channels NRK1, NRK2 and NRK3/Super. In addition, we have 5 streaming/off-loading channels.

NRK 1 is the most popular TV channel in Norway. The market share is about 30 %. The content offered by NRK1 is varied and broad and is intended to give Norwegian people shared understanding and great experiences across news, sport, drama, entertainment and documentaries. Flexible control of program length and scheduling for handling live programming and breaking news situations (last second changes) is of high importance for NRK1, which is an important news source for people in Norway on major events.

During weekdays the regional offices have their own live news broadcasts. Currently there are 10 regional offices transmitting at 19:45-20:00 and 22:55-23:00. *See 5.6.2 Regional switchover and time-sharing of channels* for details.

NRK 2 offers news, debate programmes, documentaries, analyses and cultural programmes. Primarily pre-programmed playlists, however, when major news events occur, it often takes the role as an offloading-channel for NRK1, and this requires a high degree of flexibility.

NRK 3/NRK Super offers movies, humour, lifestyle and music for a younger audience. NRK3 also hosts the children's channel NRK Super. Primarily pre-programmed playlists. NRK3 and NRK Super is co-distributed on the same distribution channel according to a time-sharing schedule:

NRK 3: 19:30 – 04:00

NRK Super: 04:00 – 19:30

NRK 4-8 is the internal names for NRKs streaming/off-loading channels. They are available only in the NRK TV apps, and are shown only as event-based transmissions, not discrete channels. Primarily used for sport, news.

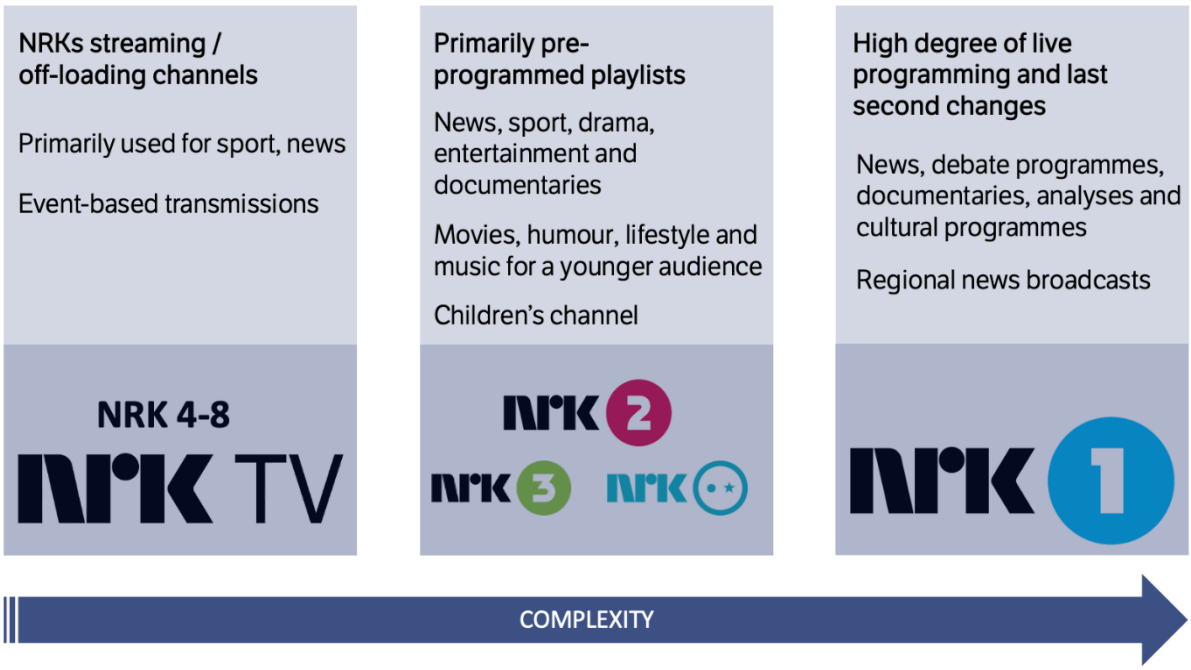


Figure 5: Linear Channel Structure

5.5 Case examples

This chapter contains a selection of "every-day" case examples from the Presentation suite/Main continuity centre. They describe the level of functionality in the different iterations planned for new automation/playout. These are typical scenarios and help to concretize and explain the overall workflow.

It is important for us to see how the different vendors approach this. The user experience and a simplification of the everyday life of the operators is of high importance.

5.5.1 Streaming channels: Flipp Klipp/Nyhetsstrømmen/Sport

NRK has different programs sent purely via its streaming channels. This may be both to off-load the main channels and for providing an extended or uninterrupted viewing experience where programs may not fit in the linear schedule.

In addition to one-off events, examples of regularly scheduled programs are *"FlippKlipp"* and *"Nyhetsstrømmen"*. FlippKlipp is NRK Super's investment in the video website YouTube. As of February 2022, the channel has over 200 000 subscribers. In addition to being broadcast on YouTube, it is also broadcast on a streaming channel so that the content is available via NRK TV. The live content is immediately available as on-demand.

Nyhetsstrømmen is a stream of looped news atoms/stories siphoning of the content created for the regular news shows. Updated throughout the day it gives the users an uninterrupted, continuous update on current news.

The continuity producer will prepare the playout by importing the schedule from What's On into the automation. After importing, the timing of the program is adjusted, and the sources are set. In addition, the continuity producer will publish a poster in advance of the broadcast informing the public about the upcoming program.

At the scheduled time, the continuity producer will remove the poster and start the broadcast followed by adding the NRK-logo and age marking. When the program nears ending, the continuity producer will be ready to stop the broadcast and then publish a poster informing the public that the broadcast has finished.

FlippKlipp

Nyhetsstrømmen

Figure 6: Flippklipp and Nyhetstrømmen

5.5.2 NRK2: Ski jump interrupted by fog

NRK has the rights for a ski-jump event from the venue Holmenkollen. The event is planned on NRK1 from 10:50 to 13:00 (**Feil! Fant ikke referansekilden.**), and this is the slot the programme is given in the transmission schedule in What's On.

As an extra service to viewers of the streaming platforms, the event is also planned on one of the streaming/off-loading channels.

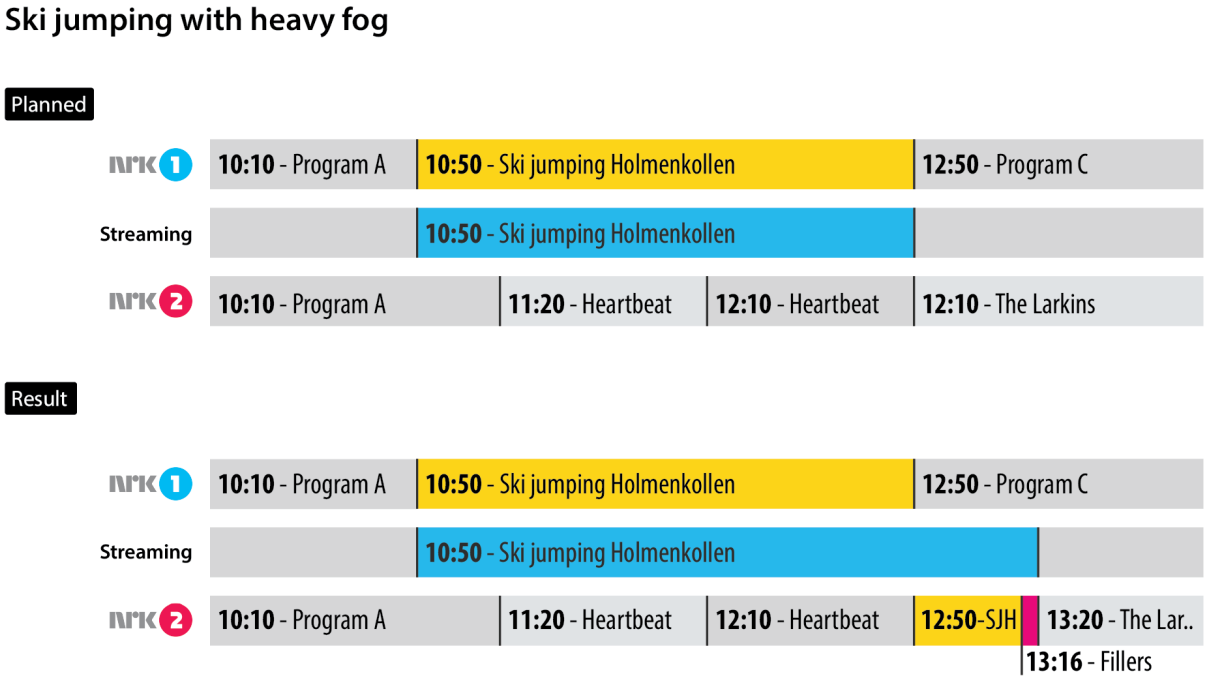


Figure 7: Ski jump interrupted by fog

Based on prior experience, the continuity producer knows that this is a typical open-end event, where there are several circumstances (like the weather) that may affect the competition and thus the actual end-time. Today the forecast warns of fog, not uncommon at the venue, and this will typically result in delays for events like ski jump.

During the competition, and if possible, well in advance of the next program, the continuity operator will look for a way of extending the transmission either on the same channel or any of the other main channels. The program following the ski jump competition on NRK1 should preferably not be moved, so the operator makes space on NRK2 for the continuity of the original programme and moves the rest of the schedule on NRK2 accordingly. The changes must be made in What's On as well in the automation system, since What's On is the source of truth for the EPG-information that flows to the distributors.

Since the actual end time of the ski jump is not known in advance, the operator prepares some teasers and other short programmes in the schedule of NRK2 to work as flexible.

As the end-time of the program slips, the continuity operator tries to estimate the number of fillers needed to get the next scheduled program on-air at a predictable time, adding or removing them from the playlist based on information and estimates from the sports production unit.

Before, during and for a time after the channel jumping (move from NRK1 to NRK2) the viewers are informed of the changes in the schedule by information crawls on both NRK1 and NRK2, explaining the reason behind the changes and where to find the rest of the ski jump competition.

5.5.3 NRK1/2: News event on NRK2 with prime time shows on NRK1

"Mesternes mester" is a popular entertainment program broadcast on NRK1 where former Norwegian sports stars participate in an informal competition for the title "*Champion of Champions*". The program is popular, and the season's final had 1.2 million viewers in 2022.

In an imaginary situation where an incident with important news value occurs, assessments are made by the continuity producer as to whether the news department should be given air-time and eventually on what channel.

The alternatives can vary from breaking into the broadcast of *"Mesternes mester"* on NRK1, clear space for a news broadcast on NRK2 or run it as a pure stream-only event.
Any significant change of schedule or interruption of scheduled programming should be announced through graphics – including informing the audience watching the season's final on NRK1 that there is an extra news broadcast on NRK2. A news item on a Friday night must be of high and important news value for continuity producer to significantly alter the broadcast schedule on any linear channel.

In the illustrated case, the continuity producer has chosen to cut into the program *"En blekksprut i huset"* (blue box) on NRK2, not disrupting the schedule on NRK1. The broadcaster will have regular contact with the news department during such an event and will clarify in advance how much time they need. This is admittedly an estimate and may vary. This uncertainty thus requires a tool that makes it possible to quickly select different solutions to best manage the broadcast schedule. The news broadcast can be very short, and then it may be relevant to return to the program that was cut. If the news broadcast lasts longer, then there is a need to inform the public about changes in the broadcast schedule and cancelled programs. Any mayor change should ideally also be mirrored to What's On, as this will update the EPG data for the distribution chain.

Like in the open-ended ski-jump example above, during the news broadcast there is need for the ability to quickly select fillers and promos (from a curated list) that can fit to make a smooth transition to the next scheduled program.

Figure 8: Friday evening with breaking news

5.5.4 NRK1: Normal but busy Saturday night with live shows

Weekends are important for NRK. In the illustrated case the evening consists mainly of sports, news and lastly entertainment.

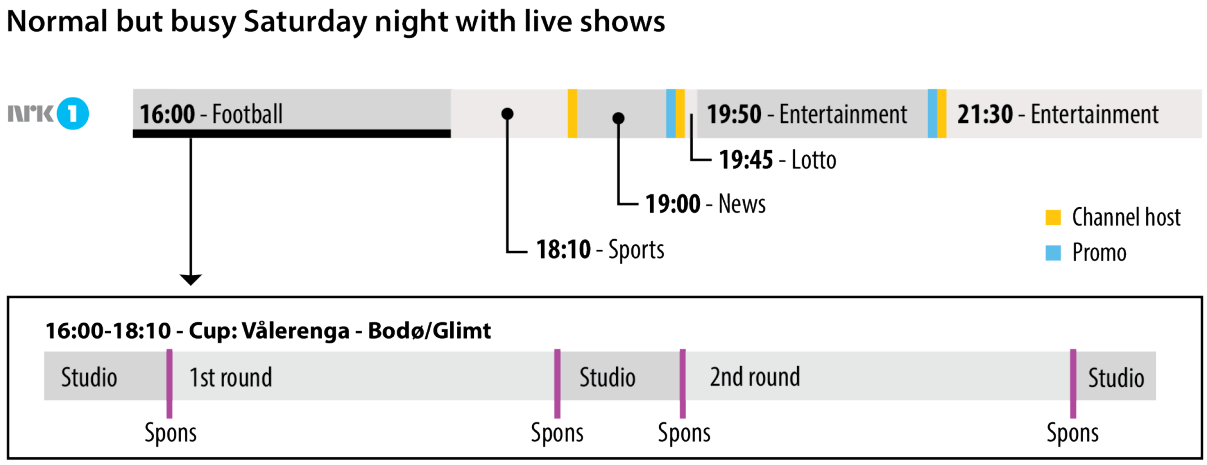


Figure 9: NRK1: Normal, but busy Saturday night with live shows

The first part of the afternoon / evening is scheduled with sports. NRK's access to receive sponsorship income is necessary to be able to compete for the purchase of certain types of sports rights. For the football match the continuity producer needs to run sponsor ads ("spons") at specific times. There are a set of rules dictated by law, e.g. no motion, only logos, maximum time of exposure. In the illustrated case the continuity producer will run the ads before and after each round, a total of 4 runs. It is important that the advertisement will appear as close as possible to the actual sport.

When the football match and athletics are done, the channel host will be given air-time and advertise what is scheduled this evening on NRK and then introduce the next program which is the Saturday news, *Lørdagsrevyen*. When the news ends, the continuity producer will run promos for coming content on the channel. After the promos the channel host will announce that next up is Lotto followed by the first entertainment program for the evening, *Alle mot 1*.

When the first entertainment program is done, the continuity producer will run promos selling content followed by the channel host talking about the next entertainment program, *Kåss til kvelds*.

A normal, but busy Saturday night at NRK1 is filled with transitions between programs, promos, channel hosts and sponsorships.

5.6 User stories

These user stories are meant to exemplify functional requirement.
The Contractor is asked to describe, in written form and with an illustration, how the solution will support the functionality described.

5.6.1 Schedule and playlist import, export and manipulation

5.6.1.1 Quality control of coming schedules

a) *As a continuity producer, I need to be able to verify playout of the programs planned in What's On, so that I can do quality control, check timecodes, preview transitions, adjust secondary events and in/out-points in the schedule days before the schedule is to go on air.*

Today this is done by exporting the schedule from What's On, importing it on a spare automation channel and going through the playlist in the automation system with manual update of in/out-timecodes in What's On. It requires a lot of manual steps, and a lot of context switching back and forth between What's On and the automation system.

5.6.1.2 Daily, continuous transfer of schedules

a) *As a continuity producer, I want to get the schedule from What's On for a given channel and day/time-period imported into the currently active playlist for the channel without disrupting the ongoing schedule, so that I may get the planned content on air.*

Today this is done through trigging export of a channel/time-span combination in What's On followed by an import into the currently active playlist in the automation system. Any overlap or duplications must be deleted manually. Please describe any automation or functionality that could make the flow of changes from the scheduling system to the automation system easier, less error prone but at the same time safe (i.e. prevent accidental replacement of manually adjusted events in the automation).

5.6.1.3 Playlist manipulation and functionality for a live program schedule

a) *As a continuity producer, I want newly added events to be cued and ready for playout with minimal delay and latency so that I may handle live show transitions with high accuracy.*

The main channels are heavily curated with several live events during the day. Please describe the latency from manually adding a file or live element to the actual element is available for take in different file/live combinations.

This user story has a corresponding requirement in the requirement list at Feil! Fant ikke referansekilden.Feil! Fant ikke referansekilden.

b) *As a continuity producer, I want manual take of file and live events to happen with minimal delay and latency so that I may handle live show transitions with high accuracy.*

The main channels are heavily curated with several live events during the day. Please describe the latency from doing a "take" to the actual element is on air in different file/live combinations.

This user story has a corresponding requirement in the requirement list at Feil! Fant ikke referansekilden.Feil! Fant ikke referansekilden.

c) *As a continuity producer, I want to be able to interrupt planned, already started programs with other elements/programs/events, and then afterwards be able to go back to resume the originally planned program, so that I may handle breaking news and unplanned intermissions without manually re-adding the rest of the interrupted event and corresponding secondary events.*

Today they have to re-add the original event using a new program-id and adjust the in-point in order to playout the rest of the interrupted program.

d) *As a continuity producer, I want to be able to switch the live source of a program/event currently on air in the automation, so that I may handle unplanned problems with the incoming signal without having to duplicate or change the scheduled program or routing incoming signals manually.*

Today this is done by using manually routed source lines from MCR, so that the operators may change the source-routing without using the automation. But this requires an extra step of pre-planning.

e) *As a continuity producer, I want to be able to preview and possibly change the source of a playlist element before it goes on air, so that I may quickly correct a live or file source.*

f) *As a continuity producer, I want to have one or more readily available multiple, sortable, searchable shortlists, shotboxes or playlists with multi-purpose teasers, promos and other content, so that I may quickly fill gaps or re-schedule slots in the playlist with appropriate content.*

The main channels are sometimes heavily curated before and after live-events in order to hit pre-announced time-slots – especially when breaking or other live events disrupts the planned schedule. When this happens, the continuity operators must be able to find relevant available content – often matching certain constraints on content type or media duration. Please describe how secondary events may follow or automatically be added when this type of content is added to a playlist, and what metadata fields imported from What's On may be displayed in the lists.

g) *As a continuity producer, I need to be able to program event-timings such as manual take, on-time, hold etc so that I can handle complex schedules with mixed live and pre-programmed content.*

Please describe the timing types available and their typical use for different live/file-combinations.

h) *As a continuity producer, I need to be able to search and find media in the MAM and/or scheduling system (What's On) and quickly add it to playlist or shortlists.*

Please see the notes on integration and involvement of NRKs developers on this type of MAM/What's On integration in chapter 7.117.11

i) *As a continuity producer, I need to be able to quickly search and find media assets in the scheduling system (What's On) without media, so that I may assign this product/media-id to a new live event.*

In breaking-news scenarios it is important to quickly go to live while simultaneously have the event recorded and attached to a new, valid asset ID in the scheduling system.

Please see the notes on integration and involvement of NRKs developers on this type of MAM/What's On integration in chapter 7.117.11

j) *As a continuity producer, I want to be able to make manual notes on the individual events in the playlist, so that I remember important details about upcoming elements.*

5.6.1.4 Secondary events and signalling

Generally, we want as much of the pre-planning as possible to be done in the scheduling system, but with the ability to create and modify secondary events locally in the automation system. Please make sure to describe the support of secondary events, what they may control and how they may be extended to support future and custom workflows.

Keep in mind our focus on the availability of public APIs, extension-points, events and hooks.

a) *As a continuity producer, I want pre-planned secondary events to follow from the scheduling system into the automation playlist on import, so that I don't have to manually add them after import.*

b) *As a continuity producer, I want to be able to manually add, edit and remove secondary events in the automation playlist – both the locally created and any imported from the scheduling system.*

c) *As a systems developer I want to be able to control external systems through custom secondary events, so that I may solve future workflows in a way that is visible and controllable by the continuity operators.*

Please describe what possibilities exists for doing HTTP-calls or other API operations through secondary events, and what type of information, metadata and user interface elements these events may show to the user.

d) *As a continuity producer I want certain elements to automatically get some pre-defined secondary events, like "live"-graphics, logo/bug-graphics or other general control-events.*

Describe how this may be solved by a rule-based approach (if available), through rules in the scheduling system, by external integrations (listening on playlist-change events and adding the secondary events through APIs) or by other means.

5.6.2 Regional switchover and time-sharing of channels

As described in the channel structure in 0, NRK currently has two types of break-away:

One is the reginal offices live news broadcasts during the evening, where it usually is no main transmission and all regions replace/break in with their own live signal. The regional offices don't have their own continuity playout, but run the news shows from local news playout systems (Sofie).

This is currently signalled from the central automation by inserting a specially named event, and an NRK-developed service monitor the playout flow events (Cue, Take ++) for this pattern and handle the switchover on SDI-level.

The other is the daily time-sharing of NRK3/NRK Super (childrens channel) where there is a regular switch-over at 04:00 and 19:30. This is mainly handled by hard coded (time-based) convention in the NRK TV app (and change of logo in the shared playlist/channel in the automation system). There is currently only one signal offered to the traditional DVB-distributors, played out by the same channel in the automation.

a) *As a continuity producer, I would like to have a strongly defined concept of break-away for regional transmissions visible in the automation system, so that I may easily control the*

start/stop of the break-away and handle schedule changes and exceptions to the rules more easily.

Please describe a possible solution, even if it differs from how this is currently solved, including any technologies that may be used for this type of signalling (like SCTE-35/224).

b) *As a continuity producer, I would like to have a strongly defined concept of break-away/time sharing for the NRK3/NRK Super channels, so that I may more easily adjust the timing of the switchover.*

Please describe a possible solution, even if it differs from how this is currently solved, including any technologies that may be used for this type of signalling (like SCTE-35/224).

5.6.3 Media and MAM-integration

NRK has Tedial Evolution as its main MAM, but with an internally developed platform-layer on top for metadata, job control and integration. The integration between the automation system and the MAM will be facilitated by NRKs own development-teams.

This user story has a corresponding requirement in the requirement list at 7.11.1

a) *As a continuity producer, I want to be able to adjust the in- and out-points of file-based content, so that I may trim the transitions in and out of the program.*

The in- and out-points should follow through from the scheduling system, but the operators may need to adjust them after import. Please describe how this may be done with or without preview playout of the media in question, and how this information may flow back to the scheduling system if need be.

b) *As a continuity producer, I want the automation system to automatically fetch media from the main MAM-system whenever a program/teaser/promo/file is needed in a playlist – whether it is inserted manually or through playlist import, so that I don't have to manually trig transfer of media.*

As afore mentioned, this integration will probably be to an intermediate service developed by NRK, so the exact interface may be designed in cooperation with NRK, but please describe when and how the automation system may send these requests.

Describe the user experience include transfer status and progress on these retrievals.

c) *As an operations engineer I want the system to do automatic housekeeping of internal media caches (if present), so that I don't have to manually herd the media storage.*

Please describe any automatic housekeeping capabilities, including how emergency shortlist/shotbox-media may be kept online even when not currently scheduled for playout.

d) *As a continuity producer I want to be able to put late-arriving file-based media on air quickly, without having to wait for file transfer.*

Please describe any capabilities the system has for playing growing files while in transfer, or to play files directly from network attached storage (typically the SMB/NFS-based storage of NRKs main MAM-system) if provided the file paths.

e) *As a continuity producer, I want to be able to play all video formats currently in NRKs archive in the same playlist.*

Please see **Feil! Fant ikke referansekilden. Feil! Fant ikke referansekilden.**.

f) *As a continuity producer, I want to be able to override the aspect ratio of file based elements.*

Please describe any capabilities the system has for adjusting the aspect ratio of playlist elements. If the file contains wrong meta data within the essence header this needs to be corrected on playout

The archive includes both SD 4:3, SD 16:9 anamorphic and HD (and beyond) 16:9 media.

5.6.4 Recording

a) *As a continuity producer, I want programs to be flagged for recording based on playlist metadata, so that I don't have to manually mark live-programs for recording.*

Today all non-file-events with duration over 1 minute (to avoid channel host entries) are recorded. Please describe possible solutions for a rule-based approach based on metadata in the playlist from the scheduling system, like live/not-live attributes etc.

b) *As an operations engineer I need to be able to configure where in the chain the recordings are done, typically clean-feed (before any graphics layers) and with programme graphics (see* Feil! Fant ikke referansekilden. *Overview of graphic elements), so that I may store material for both re-runs and as source material.*

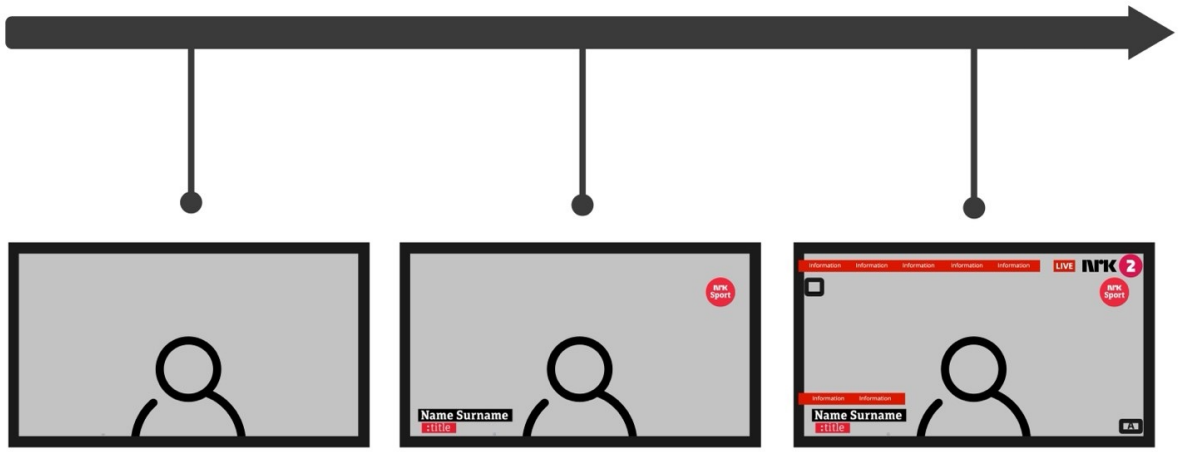


Figure 10 - Recording products

c) *As a continuity producer, I want to be able to easily see what programs are scheduled for recording, what name/id the program will receive upon recording and easily toggle recording for a particular program on and off, so that I may control what live-programs are recorded.*

d) *As a continuity producer, I want recorded content to be automatically transferred to the MAM-system for ingest as default, preferably through API-integration and not watchfolders, so that I may get all recorded programs ingested into the MAM and be confident that the files are actually picked up and processed.*

Ideally recorded content should start transfer to the MAM during the recording, so that the media may be available as growing files.

e) *As a continuity producer, I sometimes want to cancel a recording – even after it has started.*

f) *As a continuity producer, I sometimes want to adjust in- and out-points of recordings – after they have ended.*

Ideally recorded content should start transfer to the MAM during the recording, so that the media may be available as growing files.

In- and out-points in the automation system will most of the time be in context of automation playout, and a sync back to the MAM/scheduling system is not desired. However, for content that origins in the automation system (recordings), a way of pushing/syncing metadata (like updated in-/out-points) to the MAM and/or scheduling system would be helpful.

Please see the notes on integration and involvement of NRKs developers on this type of MAM/What's On integration in chapter 7.117.11

g) *As a continuity producer, I want to be able to change the name and/or id of a recording either before event-start or during the event, so that manually inserted live-events may get connected to a valid programme/media asset in the MAM and scheduling system upon transfer of the media and later reconciliation of the playlist.*

h) *As a continuity producer I want to be able to playout files while they are recorded, so that I may put on air time-shifted programs on another channel/port.*

5.6.5 Audio

a) *As a continuity producer, I want to be able to adjust the audio levels and balance between announcer/host and program sound (live or preproduced)*

b) *As a continuity producer, I want to be able to adjust the audio levels and balance with physical faders and/or touch-screen faders.*

Today this is done with physical faders directly adjusting audio levels in the vision mixer. Please describe what type of hardware integration you have that may provide this.

This user story has a corresponding requirement in the requirement list at 7.4

5.6.6 Signal-monitoring, preview and quality control

a) *As a continuity producer, I want to preview and pre-listen to live-sources, video and audio files planned in the schedule, so that I may be confident in what will be broadcast when the event goes on air.*

Please describe the level of preview available –for files and live sources – both in the client or on full playout ports, and what type of secondary events, transitions etc are previewed.

b) *As a continuity producer or operations engineer, I want to monitor the signal in the playout chain at arbitrary point, enabling me to identify any signal or quality problems related to individual processing steps in the chain.*

Please also describe what type of signal level and monitoring analysers (like spectrum-, phase-, audio level etc) are available built-in.

c) *As a continuity producer I want to have the most important countdown clocks for the main readily available in the user interface, so that I may follow countdown to next program, countdown to next element with any errors (missing media, subtitles).*

Today it is also possible to show countdown to an arbitrary selected element in the playlist, making it easy to follow the time left to secondary elements or programs further down in the playlist than just the next element.

d) *As a continuity producer I want to have the most important countdown clocks for the main channels available on separate, physical displays, so that I may follow countdown to next program even when not in front of the main client.*

Today the countdown to the next event on the main channels are available on physical displays driven by LTC in several locations and rooms in the Presentation suite area. Please describe possible solutions to providing this type of physical display of internal clocks and countdowns.

5.6.7 System-monitoring, events and alarms

a) *As a continuity producer, I want an easily readable overview of any media or content related anomalies or errors in the system, such as missing or invalid media, missing subtitle files or loss of incoming video/audio, so that I may focus on issues that require my attention instead of wasting time on everything that is working and playing out as intended.*

This user story has corresponding requirements in the requirement list at 7.10

b) *As an operations engineer, I want to get early warnings and alarms for anomalies and system errors – preferably through established services for systems monitoring and maintenance, so that I may tend to the system and maintain system stability without having to manually check dashboards.*

NRK currently uses several monitoring protocols, technologies, and systems, including SNMP, Prometheus, Grafana, Icinga, CheckMK and Splunk On-Call for metric aggregation, alerting and notification-handling. Please describe both internal alert functionality and how these alerts may be passed on to external systems.

c) *As an operations engineer, I want logs to be externally available for aggregation or automatically sent to log analysis services like Kibana or Grafana Loki, so that I may consolidate, search and compare logs across the whole system.*

5.6.8 Multi-channel user experience

a) *As a continuity producer I want an easily accessible overview/timeline of at least all the main channels in the system, so that I may at a glance verify the schedule and state of what is currently playing out.*

b) *As a continuity producer I want to be able to copy or move programs between channels, so that I may easily offload programs (including any secondary event and subtitle information) on other channels in case of breaking news or live show running late*

c) *As a continuity producer I want to be able to easily switch between controlling different channels – either directly in the client or by switching user interface – so that I may control several channels form same physical location.*

d) *As a continuity producer or operational engineer I want the number of automation and playout channels to be flexible – either as a built in feature or through automated instantiation and provisioning, so that I may add short lived channels when the need arises without having to run a purchase process.*

We do not expect hardware to be instantiated from nothing, but would like to hear how the system handles scaling, for instance of AVoIP-output only channels.

5.6.9 Master control surfaces

a) *As a news room producer, I want to be able to get the news studio on-air during night time in case of breaking news situations. The Presentation suite/Main continuity centre is unattended in the period between 01:00-06:00.*

Pleas describe possibilities for simplified user interfaces adapted to special tasks or alternative ways of solving this.

b) *If the system includes any master control surface capabilities, please describe the functionality – including any dynamic user interface controls (information feedback from integrated system), macros, automation, salvos or scripting if available.*

5.6.10 Accessibility services

a) *As a continuity producer, I want the subtitle file information from the scheduling system to follow through to playout events, so that subtitles are automatically played back by the Polistream system.*

b) *As a continuity producer, I want to be able to preview video with subtitling planned in the schedule, so that I may be confident in that the correct subtitles goes on air in sync with the video.*

Today this is done by manually loading the subtitle file (CHK) in Poliscript, routing a free playout port on the Harmonics servers to the monitors in a suite with Poliscript installed (so that the VITC of the video may be decoded and forwarded to the right machine), and starting playback of the relevant program on the playout port.
Although a very manual process, it makes it easy for the continuity producers to do adjustments to the CHK-file and do QA on the playback of the file and video on the same type of system that is going to play out the final result.

We want to keep most of this workflow, and since the routing may be done manually by our routing control software, the only requirement to be able to solve this will be the ability to manually playout a program of interest to a free playout port with VITC intact.

c) *As a continuity producer, I want the subtitle file information from the scheduling system to follow through to playout events, so that subtitles are automatically played back by the Polistream system.*

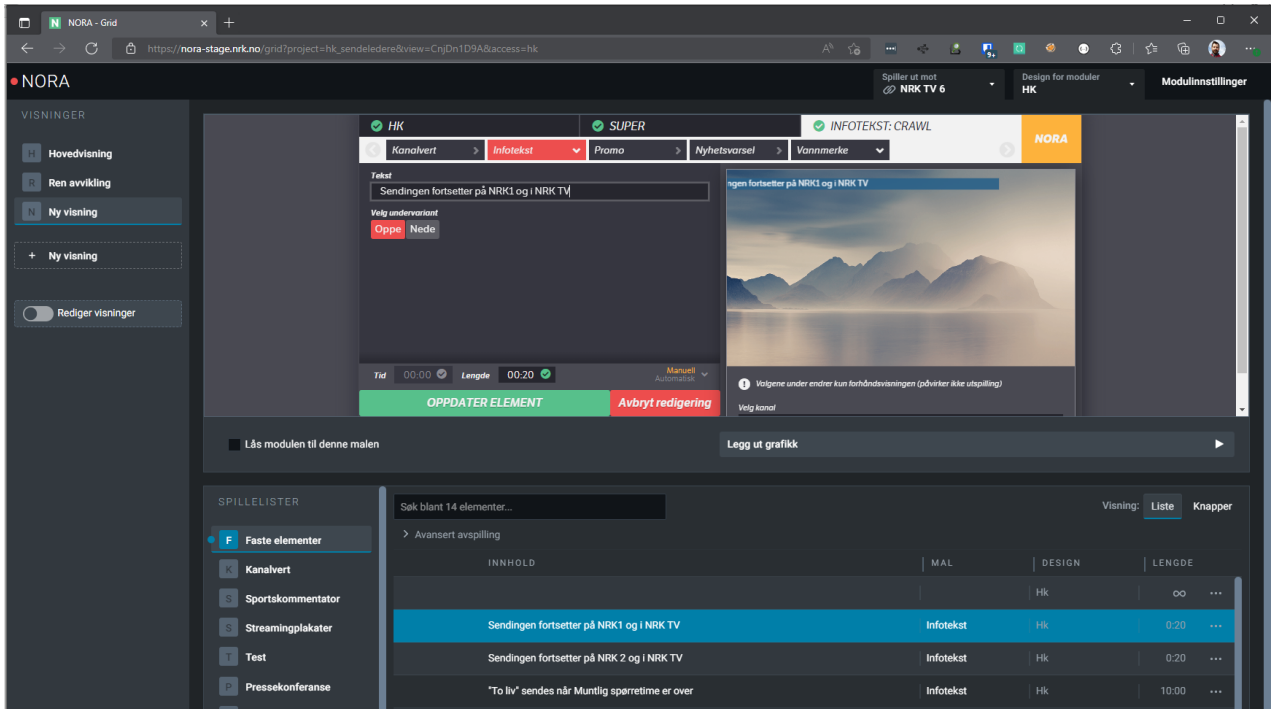
d) *As a continuity producer, I want to easily add, edit and remove subtitle file association, so that I may fix file name errors, switch file associated with a program or remove the subtitle from playout.*

e) *As a continuity producer, I want the changes I make to a subtitle entry to be effectuated by the system and sent to the subtitling system, even if the program has already started, so that I may fix or adjust subtitle associations even while the event is playing out.*

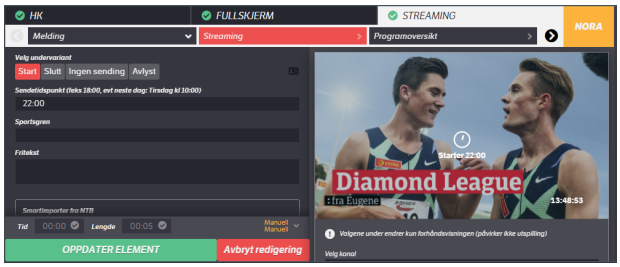
f) *As a continuity producer, I want the system to show whether subtitle files are missing or present and detect if they appear – even after a program has started playing out, so that a late-arriving subtitle file may be played out as soon as it arrives.*

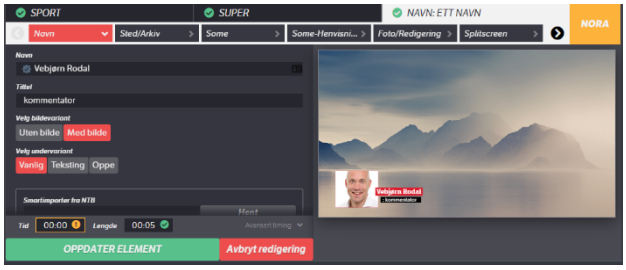
5.6.11 Graphics

At NRK, all live on-screen graphics aired in news/sports shows, a lot of specialized election and show graphics and all manual graphics (lower thirds, info crawls ++) handled by the continuity operators are currently created, controlled and rendered by NRKs own graphics system NORA.



It is a HTML5/javascript based render-engine running in on-prem Kubernetes, with a browser-based control surface and integrations against SOFIE, ENPS, Viz and internal sources of truth, like the person-lookup services in the Authority Registry and the internal image bank Kaleido.





This winter it was put into production in the Playout suites for manual graphics, replacing an aging Chyron installation. In the playout chain we are using Linux-based CasparCG-installations outputting key/fill over SDI that is put on air using DSKs by the vision mixers currently in use by the automation/playout system.

Although NRK is open for suggestions and examples of other graphical solutions, it is believed that the added value of using the same system generating for close to all other graphics output at NRK, with an extensive HTTP-based rest-like API for automation both of templates, content, integration and playout control, is so huge that our current intent is to use NORA for graphics in a future installation as well.

This chapter will therefore briefly describe the type of graphics templates currently in use and the suppliers are asked to mainly focus on how this may fit with the type of secondary events or plugin capabilities available. As with other specialized integrations, we expect our in-house developers to be involved in making the new system and NORA interact – but we are of course depending heavily on the availability of proper APIs and extension points in the automation system to do so.

Depending on the possibilities in the new system, compositing may be done through software rendering of the HTML5-pages by a compatible chromium instance in the directly in playout chain or through NDI, SDI or other video key/fill pairs. Regardless it will require keying through an equivalent of a down stream keyer in the playout chain – controllable both automatically by secondary events and by manual interface interactions by the continuity operators.

5.6.11.1 Some graphics layers and templates in use

As we hope to be able to key all graphics as part of the software playout chain, the different layers/order of keyers are important for the recording of clean-feed and finished composition.

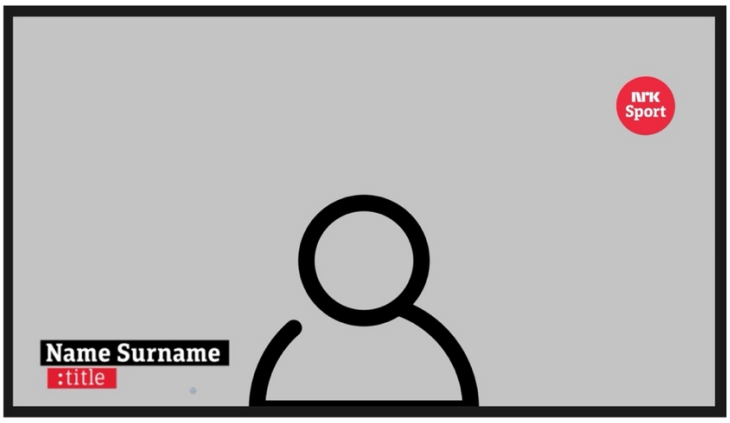


Figure 11 Program branding

Program branding

Contextual information/Lower thirds.

Often part of the incoming signal, but sometimes done in continuity playout to offload sport/news studios.

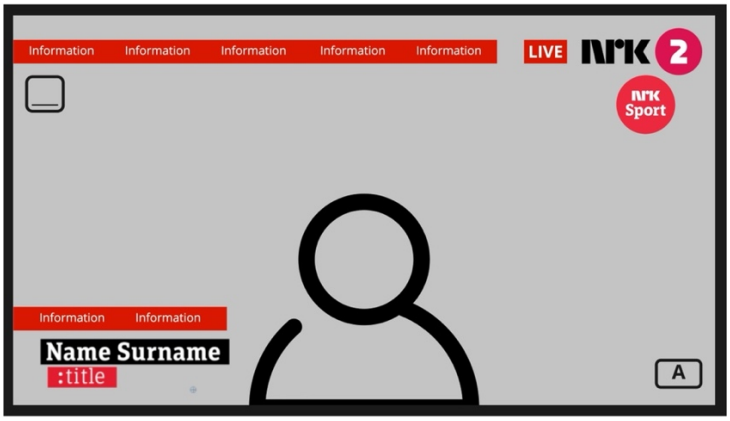


Figure 12 Channel Graphics (Includes channel branding and Info Graphics)

Channel graphics

Channel branding/logo
Info graphics
Age marking
Accessibility services information

Part of the channel identity and not supposed to be part of the live-recording of the current program.

Figure 13 Full screen info-posters

Full screen info-posters

Different types of full-screen posters typically used before and after programs on streaming-channels. Uses graphics from the Kaleido image origin system.

Figure 14 Full screen program rundown

Full screen program rundown

Typically running during night-time or off-hours.

This is currently not generated by NORA, but will probably be moved there eventually.

Figure 15 On-screen channel host

On-screen channel host

This is currently not generated by NORA, but will probably be moved there eventually. The channel host has a specialized user interface for fetching and preparing the rundown, and highlights using a small remote.

Live video with graphics overlay currently composited by the vision mixer in the chain based on external graphics sources.

End-credit squeezeback

This is currently not generated by NORA, but will probably be moved there eventually.

The currently played out source is squeezed by DVE, overlayed full screen graphical background – potentially with third graphical layer on top. Currently composited by the vision mixer in the chain based on external graphics sources.

Please describe how this may be composited in the playout chain with an external graphics system (HTML5, NDI, SDI) in combination with any internal DVEs.

5.6.11.2 Control of graphic elements

The NORA graphics-system has a rich API, and since it is able to render the graphics in a web-browser (or chromium instance), we are interested in exploring how NORA may be integrated with the user interface of the new automation system.

As a minimum we expect to be able to integrate in such a way that the automation system may key in the graphics system and trig pre-created templates (like age-information, accessibility services logos or live-bugs), and have these events represented as secondary events.

a) *As a continuity producer, I need a good view of the planned, automatic graphics in the timeline and the state of the down stream keyers at any time.*

   This typically refers to the automatically cued graphics, like age-markings, live-bug.

b) *As a continuity producer, I need to be able to manually put graphics sources on and off air, and a clear view of the state of the keyers*

   Some of the graphics will be handled completely manually, without any scheduling og pre-planning. In these situations the continuity producer will prepare the graphics in NORA, put the keyers on air, and press “take” in NORA, running the animations and graphics.

c) *As a continuity producer, I want secondary events from the scheduling system to control graphical elements like live-bugs and age rating logos.*

   These should be created based on metadata in the imported schedule or by rules in the automation system (again based on data from the schedule) and should control playout of pre-defined templates in NORA.

d) *As a continuity producer, I would like to be able to create NORA-rendered graphics event on the timeline, and fill in metadata based on templates.*

   Please describe any support for tight integration of external graphical systems, including the possibility for third party modules/panels/extensions to the automation-client user interface.

5.7 Matrix - Case examples vs User stories

	Iteration 1 Streaming Channels	**Iteration 2** NRK2/3	**Iteration 3** NRK1
5.6.1 Schedule and playlist import, export and manipulation			
5.6.1.1 Quality control of coming schedules			
a) As a continuity producer, I need to be able to verify playout of the programs planned in What's On, so that I can do quality control, check timecodes, preview transitions, adjust secondary events and in/out-points in the schedule days before the schedule is to go on air.		X	X
5.6.1.2 Daily, continuous transfer of schedules			
a) As a continuity producer, I want to get the schedule from What's On for a given channel and day/time-period imported into the currently active playlist for the channel without disrupting the ongoing schedule, so that I may get the planned content on air.	X	X	X
5.6.1.3 Playlist manipulation and functionality for a live program schedule			
a) As a continuity producer, I want newly added events to be cued and ready for playout with minimal delay and latency so that I may handle live show transitions with high accuracy.	X	X	X
b) As a continuity producer, I want manual take of file and live events to happen with minimal delay and latency so that I may handle live show transitions with high accuracy.	X	X	X
c) As a continuity producer, I want to be able to interrupt planned, already started programs with other elements/programs/events, and then afterwards be able to go back to resume the originally planned program, so that I may handle breaking news and unplanned intermissions without manually re-adding the rest of the interrupted event and corresponding secondary events.		X	X
d) As a continuity producer, I want to be able to switch the live source of a program/event currently on air in the automation, so that I may handle unplanned problems with the incoming signal without having to duplicate or change the scheduled program or routing incoming signals manually.	X	X	X
e) As a continuity producer, I want to be able to preview and possibly change the source of a playlist element before it goes on air, so that I may quickly correct a live or file source.	X	X	X
f) As a continuity producer, I want to have one or more readily available multiple, sortable, searchable shortlists, shotboxes or playlists with multi-purpose teasers, promos and other content, so that I may quickly fill gaps or re-schedule slots in the playlist with appropriate content.		X	X
g) As a continuity producer, I need to be able to program event-timings such as manual take, on-time, hold etc so that I can handle complex schedules with mixed live and pre-programmed content.	X	X	X

h) As a continuity producer, I need to be able to search and find media in the MAM and/or scheduling system (What's On) and quickly add it to playlist or shortlists.		X	X
i) As a continuity producer, I need to be able to quickly search and find media assets in the scheduling system (What's On) without media, so that I may assign this product/media-id to a new live event.		X	X
j) As a continuity producer, I want to be able to make manual notes on the individual events in the playlist, so that I remember important details about upcoming elements.		X	X
5.6.1.4 Secondary events and signaling			
a) As a continuity producer, I want pre-planned secondary events to follow from the scheduling system into the automation playlist on import, so that I don't have to manually add them after import.		X	X
b) As a continuity producer, I want to be able to manually add, edit and remove secondary events in the automation playlist – both the locally created and any imported from the scheduling system.	X	X	X
c) As a systems developer I want to be able to control external systems through custom secondary events, so that I may solve future workflows in a way that is visible and controllable by the continuity operators.	X	X	X
d) As a continuity producer I want certain elements to automatically get some pre-defined secondary events, like "live"-graphics, logo/bug-graphics or other general control-events.	X	X	X
5.6.2 Regional switchover and time-sharing of channels			
a) As a continuity producer, I would like to have a strongly defined concept of break-away for regional transmissions visible in the automation system, so that I may easily control the start/stop of the break-away and handle schedule changes and exceptions to the rules more easily.			X
b) As a continuity producer, I would like to have a strongly defined concept of break-away/time sharing for the NRK3/NRK Super channels, so that I may more easily adjust the timing of the switchover.		X	
5.6.3 Media and MAM-integration			
a) As a continuity producer, I want to be able to adjust the in- and out-points of file-based content, so that I may trim the transitions in and out of the program.As a continuity producer, I want to be able to adjust the in- and out-points of file-based content, so that I may trim the transitions in and out of the program.		X	X
b) As a continuity producer, I want the automation system to automatically fetch media from the main MAM-system whenever a program/teaser/promo/file is needed in a playlist – whether it is inserted manually or through playlist import, so that I don't have to manually trig transfer of media.	X	X	X
c) As an operations engineer I want the system to do automatic housekeeping of internal media caches (if present), so that I don't have to manually herd the media storage.		X	X
d) As a continuity producer I want to be able to put late-arriving file-based media on air quickly, without having to wait for file transfer.		X	X
e) As a continuity producer, I want to be able to play all video formats currently in NRKs archive in the same playlist.		X	X
f) As a continuity producer, I want to be able to override the aspect ratio of file based elements.		X	X

5.6.4 Recording			
a) As a continuity producer, I want programs to be flagged for recording based on playlist metadata, so that I don't have to manually mark live-programs for recording.As a continuity producer, I want programs to be flagged for recording based on playlist metadata, so that I don't have to manually mark live-programs for recording.	X	X	X
b) As an operations engineer I need to be able to configure where in the chain the recordings are done, typically clean-feed (before any graphics layers) and with programme graphics (see Feil! Fant ikke referansekilden. Overview of graphic elements), so that I may store material for both re-runs and as source material.	X	X	X
c) As a continuity producer, I want to be able to easily see what programs are scheduled for recording, what name/id the program will receive upon recording and easily toggle recording for a particular program on and off, so that I may control what live-programs are recorded.	X	X	X
d) As a continuity producer, I want recorded content to be automatically transferred to the MAM-system for ingest as default, preferably through API-integration and not watchfolders, so that I may get all recorded programs ingested into the MAM and be confident that the files are actually picked up and processed.	X	X	X
e) As a continuity producer, I sometimes want to cancel a recording – even after it has started.	X	X	X
f) As a continuity producer, I sometimes want to adjust in- and out-points of recordings – after they have ended.	X	X	X
g) As a continuity producer, I want to be able to change the name and/or id of a recording either before event-start or during the event, so that manually inserted live-events may get connected to a valid programme/media asset in the MAM and scheduling system upon transfer of the media and later reconciliation of the playlist.	X	X	X
h) As a continuity producer I want to be able to playout files while they are recorded, so that I may put on air time-shifted programs on another channel/port.	X	X	X
5.6.5 Audio			
a) As a continuity producer, I want to be able to adjust the audio levels and balance between announcer/host and program sound (live or preproduced)	X	X	X
b) As a continuity producer, I want to be able to adjust the audio levels and balance with physical faders and/or touch-screen faders.	X	X	X
5.6.6 Signal-monitoring, preview and quality control			
a)As a continuity producer, I want to preview and pre-listen to live-sources, video and audio files planned in the schedule, so that I may be confident in what will be broadcast when the event goes on air.	X	X	X
b) As a continuity producer or operations engineer, I want to monitor the signal in the playout chain at arbitrary point, enabling me to identify any signal or quality problems related to individual processing steps in the chain.	X	X	X
c) As a continuity producer I want to have the most important countdown clocks for the main readily available in the user interface, so that I may follow countdown to next program, countdown to next element with any errors (missing media, subtitles).	X	X	X
d) As a continuity producer I want to have the most important countdown clocks for the main channels available on separate, physical displays, so that I may follow countdown to next program even when not in front of the main client.		X	X
5.6.7 System-monitoring, events and alarms			

a) As a continuity producer, I want an easily readable overview of any media or content related anomalies or errors in the system, such as missing or invalid media, missing subtitle files or loss of incoming video/audio, so that I may focus on issues that require my attention instead of wasting time on everything that is working and playing out as intended.	X	X	X
b) As an operations engineer, I want to get early warnings and alarms for anomalies and system errors – preferably through established services for systems monitoring and maintenance, so that I may tend to the system and maintain system stability without having to manually check dashboards.	X	X	X
c) As an operations engineer, I want logs to be externally available for aggregation or automatically sent to log analysis services like Kibana or Grafana Loki, so that I may consolidate, search and compare logs across the whole system.	X	X	X
5.6.8 Multi-channel user experience			
a) As a continuity producer I want an easily accessible overview/timeline of at least all the main channels in the system, so that I may at a glance verify the schedule and state of what is currently playing out.		X	X
b) As a continuity producer I want to be able to copy or move programs between channels, so that I may easily offload programs (including any secondary event and subtitle information) on other channels in case of breaking news or live show running late		X	X
c) As a continuity producer I want to be able to easily switch between controlling different channels – either directly in the client or by switching user interface – so that I may control several channels form same physical location.	X	X	X
d) As a continuity producer or operational engineer I want the number of automation and playout channels to be flexible – either as a built in feature or through automated instantiation and provisioning, so that I may add short lived channels when the need arises without having to run a purchase process.	X		
5.6.9 Master control surfaces			
a) As a news room producer, I want to be able to get the news studio on-air during night time in case of breaking news situations. The Presentation suite/Main continuity centre is unattended in the period between 01:00-06:00.			X
b) If the system includes any master control surface capabilities, please describe the functionality – including any dynamic user interface controls (information feedback from integrated system), macros, automation, salvos or scripting if available.	X	X	X
5.6.10 Accessibility services			
a) As a continuity producer, I want the subtitle file information from the scheduling system to follow through to playout events, so that subtitles are automatically played back by the Polistream system.		X	X
b) As a continuity producer, I want to be able to preview video with subtitling planned in the schedule, so that I may be confident in that the correct subtitles goes on air in sync with the video.		X	X
c) As a continuity producer, I want the subtitle file information from the scheduling system to follow through to playout events, so that subtitles are automatically played back by the Polistream system.		X	X
d) As a continuity producer, I want to easily add, edit and remove subtitle file association, so that I may fix file name errors, switch file associated with a program or remove the subtitle from playout.		X	X
e) As a continuity producer, I want the changes I make to a subtitle entry to be effectuated by the system and sent to the subtitling system, even if the program has already started, so that I may fix or adjust subtitle associations even while the event is playing out.		X	X
f) As a continuity producer, I want the system to show whether subtitle files are missing or present and detect if they appear – even after a program has started playing out, so that a late-arriving subtitle file may be played out as soon as it arrives.		X	X

5.6.11 Graphics			
5.6.11.2 Control of graphic elements			
a) As a continuity producer, I need a good view of the planned, automatic graphics in the timeline and the state of the down stream keyers at any time.	X	X	X
b) As a continuity producer, I need to be able to manually put graphics sources on and off air, and a clear view of the state of the keyers	X	X	X
c) As a continuity producer, I want secondary events from the scheduling system to control graphical elements like live-bugs and age rating logos.	X	X	X
d) As a continuity producer, I would like to be able to create NORA-rendered graphics event on the timeline, and fill in metadata based on templates.	X	X	X

6 SOLUTION ARCHITECTURE REQUIREMENTS

The Contractor shall provide a description on how their Solution would comply with the different aspects of the architecture requirements listed under this chapter. The purpose of the architecture requirements is to ensure that the new Solution will operate smoothly within the Customer's complex landscape of:

Information objects

Business processes

Organizational structures and roles

6.1 Separation of user interface and computing

It is an important premise for the planned moving of headquarters that all user interfaces – including client instances, monitoring, physical interaction surfaces and panels – may be separated from the compute and infrastructure part of the installation.

Even if the first installations will be on-prem, we envision a gradual move of infrastructure out to external datacentres and/or cloud services, all while keeping the very high service availability and quality required by a public broadcaster.

Please keep this in mind while designing the solution, and describe how this may be solved, either by inherent capabilities of the system or by leveraging infrastructure like virtual desktops, zero-clients and general virtualized infrastructure or other techniques for creating a location-agnostic multi-site installation.

6.2 Resilience

A high service availability is mandatory, however in a more software based and defined installation this may sometimes be achieved in different ways than the traditional main/backup setup.

Although there are different SLA and availability requirements for the primary channels and the streaming channels, please suggest and discuss the systems resilience strategies, what type of outage, failure and emergency situations are mitigated with the different possible configurations (1:1, 1:N etc), and if there are any added value or benefits in running all channels with same resilience/redundancy strategy.

Please also discuss any disaster recovery strategies available – including ones with reduced service level and features (like compressed cloud-only instances) – and in what type of outage, failure and emergency situations (network, power, hardware breakdown, security breaches etc), they may and may not help.

6.3 Installation and deployment strategies

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 setup both infrastructure, servers and software through the use of terraform, ansible, salt, puppet or other provisioning and configuration technology enabling version controlled environment.

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

Please describe what deployment technologies and strategies the system may support, including both initial installation and subsequent updates and upgrades.

6.4 Stateful and stateless components, backup

With the wish for automated deployment and provisioning in mind, please make sure that it is clearly stated what parts of the system holds 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.

Please describe suggested backup strategies (database backups, snapshots etc) for the stateful instances, and any if any operational considerations have to be taken (downtime, failover etc) for backing up or restoring the system to a previous state.

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.

6.5 Information architecture

6.5.1 Data model

The current integration between Whats'On (scheduling), the current automation (Abit Present-It) and the current MAM (Tedial) is relying on some common conventions and data-fields.

See Appendix 3 for more information about the integration between the different systems at NRK.

Both the scheduling system and the program bank has complex data models, but some of the most important common domain concepts in use today are:

Programe ID / Product ID	Unique human readable ID identifying a product (in What's On) / program. A program may have several technical versions (with/without graphics, recording in OB-van vs recording in playout etc). Generated by What's On.
Media ID / MAM ID	Unique GUID generated by the MAM for each technical version of a program. This is what should identify media instances in playlists from the schedule system, and is used to request/query media from the Program Bank. Example: 6e6852274a284a86a3ffe1ae0c441496

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: NNFA21062222AH Example raw material: helsedirektøren-til-dagsrevyen-270221
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.
Reconcile key	Unique GUID created by What's On to uniquely identify a specific instance of a program withing a schedule/transmission. Used when reconciling as-run-logs back to the scheduling system.

6.6 Cloud/hybrid/on-premises solutions

Cloud services are a vital part of and underpin a lot of NRKs services to internal users and public viewers. However, as stated in 2.1- Background, NRK has some very clear responsibilities as a public broadcaster concerning being able to handle critical broadcasts in case of national emergencies.

Combined with a 12-15PB archive of historical programmes and broadcasts actively in use, there are several political, technical, practical and security related hurdles that has to be cleared in order to put the main playout and automation of a public broadcaster in the cloud, or even have vital parts of it depending on the availability of foreign services.

Even though we don't believe it is viable to select a solution with a strict and absolute dependency on cloud services at this point in time, we do not plan to automatically exclude solutions that include such elements.
However a very clear discussion of how this will affect the total availability/uptime budget, including failure modes on cloud-service downtime/relocation/failover will be needed for such a solution to be considered.

7 TECHNICAL REQUIREMENTS

How well the Solution fits into the Customer's current technical platform has implications for how well or smoothly it supports business processes across applications, how it is perceived by users and how many IT-manhours are required to operate and maintain the Solution and the overall technical platform. The Customer can only tolerate so many problematic workarounds on the technical side before the Solution is unfit for the Customer. Thus, this chapter is intended to ensure a good fit. See also Appendix 3.

7.1 Physical interfaces

#	Requirement description	Priority
1	The equipment should be mountable in 19in racks	
2	The Supplier should specify the dimensions of the equipment (WxDxH)	
3	The Supplier must specify the total physical space in terms of rack units (excluding client pc's).	
4	The Supplier must specify the total maximum and average power consumptions of the system (excluding client pc's).	
5	The Supplier must specify the required cooling capacity to cool the entire system (excluding client pc's)	
6	All devices (including auxillary devices) part of the delivery should be listed in the bid	
7	Specify any operational environmental requirements (temperature/humidity) for the equipment	
8	Specify airflow and any special needs regarding mounting and cooling	
9	All equipment must bear the CE marking for declaration of conformity and meet the current applicable EU directives.	
10	All equipment must meet the current RoHS directive.	
11	Please describe the different possible physical SDI input/output configurations (max/min number of in/out-ports)	
12	Please describe supported SDI interfaces and connectors (optical and/or electrical)	
13	Physical connectors should not be on breakout cables	
14	All media interfaces should be according to relevant SMPTE and AES/EBU standards	
15	The system should support a minimum of input and output of 4 audio stereo pairs using AES3, AES67/SMPTE 2110-30, or MADI. Please describe alternatives and recommendations	
16	All hardware delivered with the system should have hot-swappable dual power supplies (where applicable)	
17	All equipment must be operating at nominal 230 VAC, 50Hz.	
18	All hardware with network connectivity should have dual network ports for redundancy	

7.2 Timing, latency and tolerances

#	Requirement description	Priority
1	Please describe the minimum duration file based elements can have in the timeline/playlist	
2	The cue time for a newly added element (i.e. how long after a locally available media file is added to the playlist before it is available for playout) should not exceed 3 seconds	
3	The take time for a cued/next-element (i.e. the time it takes from a manual "take" by keyboard, user interface, external signal) to the element it taken on air should be consistent and not exceed 1 second	
4	Please describe the timing characteristics of the system; does adding/removing processing elements in the playout chain change timing or delay through the system	
5	Please describe limitations on last-minutes changes in playlist. How close to “on air-time” can modifications be done?	

7.3 Video

As described in 3 Scope, the infrastructure before and after in the signal chain is currently SDI, and therefore the initial installation will be predominantly SDI based. However the migration to more and more IP based transportation is expected to happen in the not too distant future, so the optional support for NDI, ST2110 both as sources and main/monitoring output will be important (see 7.5 AVoIP for specifications).

#	Requirement description	Priority
1	The system should be able to do playout of files which are still being copied to the system (“growing files”).	
2	The system should be able to perform time shifted playout of a file being recorded.	
3	The system should be able to do up/down conversion on playout to match a defined output format	
4	The visual quality must be approved by NRK based on a subjective judgement	
5	The system should be able to play out 1080Psf/25-files (25i codec in 25p wrapper) as 1080p/50	
6	The system should be able to playout multiple media elements in sync - for instance video content with additional audio description tracks in separate audio files	
7	The system should support rule-based aspect ratio conversion based on schedule metadata or media headers	
8	The system should support manual override of the aspect ratio conversion on a per-program basis, and this change should be possible to do after the program in question has started	
9	The system should accept an external TC/time source as master clock	
10	It should be possible to configure recordings to include time-of-day-TC	
11	Please explain how flexible the solution is in relation to format agnostic playout. What is possible -and not, in a mixed timeline. Clarify strengths and limitations	
12	Please describe possible video sync source signals supported (black burst, tri-level, PTP etc)	

13	The system should support inputs for external graphics (fill/key)	
14	The system should be able to insert VITC on the output signal. “Time-of-day TC” on live and “Media-TC” on file playout.	

7.3.1 Video processing

#	Requirement description	Priority
1	Normal AB-mixing with transitions (cut, X-fade, V-fade, asymmetric V-fade, wipe)	
2	Two (or more) channel, fully controllable 2D DVE. Should be controllable by secondary events and external API for mixed-source graphical compositions	
3	The DVEs should be able to process any source in the system (file, live) – including external key/fill pairs	
4	Simultaneous playback of graphic clips/templates over the background video during AB-mixing (all with audio), DVE, subtitles, prerecorded and live voiceovers	
5	Frame accurate transition between all combinations of live and file playout, even when routed through DVE	
6	The coexistence of multiple flavors of HDR and new color space brings complexity into the playout chain. Please describe the HDR color space/signaling support in your solution, including HDR-to-SDR and SDR-to-HDR conversion.	

7.4 Audio

7.4.1 Sources

The main sources of audio during normal operation are:

- Specific channel groups in incoming SDI (stereo + 5.1)
- Specific channel groups in file-based video media (stereo + 5.1)
- Stereo audio from WAV/BWF-based media
- Stereo audio from off-tube suites
- Stereo audio from on- and off-screen channel hosts
- Stereo audio from radio broadcasts

As described in the use cases the continuity producers should be able to manually adjust program (source) and added audio tracks (typically voiceovers) but based on automatic preparation of the source routing.

The schematics in Figure 16 Audio processing logical overview show the current requirements for discrete processing of the different sources and encoding of the different outputs. The current plan is to output all audio one SDI stream with the different audio outputs stacked in the audio channels.

If the system has explicit functionality for voiceover handling, please describe how this differs from plain audio mixdown/level adjustment and how it may be used to handle off-tube and channel hosts.

7.4.2 Outputs

Separate processing should be done for the audio channels destined for DVB and OTT. Due to limitations in the DVB receivers, it is important that Dolby 2.0 is used when the source is stereo, and not just stereo encoded as 5.1. The following matrix shows the expected output encoding based on the source type. Currently the only source for 5.1 is file-based, and information about the source type may come from the scheduling playlist and exist in the automation playlist. This may be used for the switching logic.

In (file or live)	Out DVB	Out OTT
Stereo	PCM Stereo PCM 5.1 (upmix) Dolby 2.0	PCM Stereo Dolby 2.0
Stereo 5.1	PCM Stereo PCM 5.1 Dolby 5.1	PCM Stereo Dolby 5.1

All outputs packages should be able to have separate processing/level settings and watermarking.

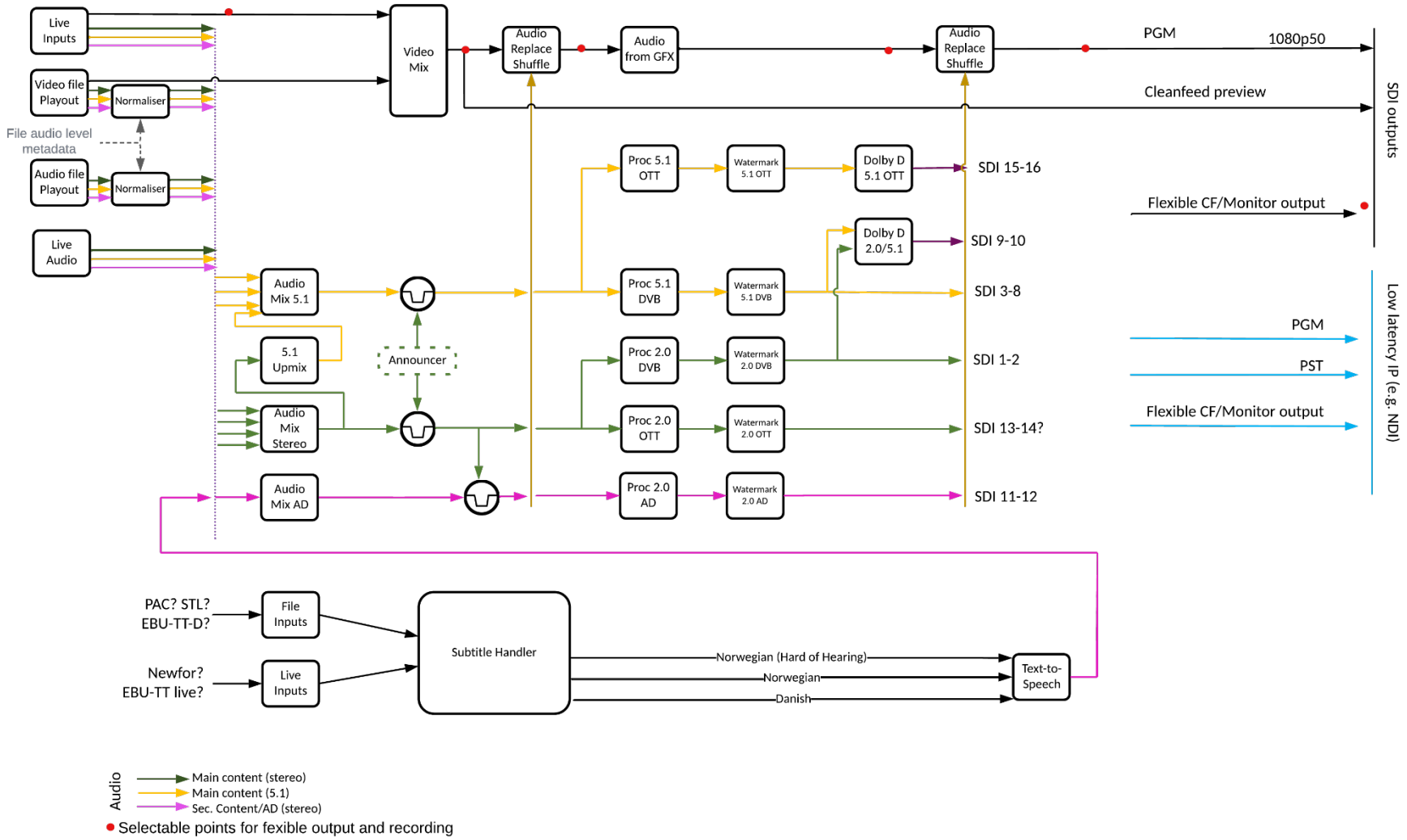


Figure 16 Audio processing logical overview

7.4.3 Loudness analysis

Today files sent to the automation system is pre-analysed by separate services, and peek level information is stored and transferred in the scheduler playlists. This is then used by external services to automatically control the audio processers.

Please describe what type of loudness analysis capabilities exists in the system, if it may be used for automatic normalising and how existing metadata may be used for adjusting the processors.

7.4.4 General audio requirements

#	Requirement description	Priority
1	De-embedding of all audio tracks in SDI-inputs.	
2	Re-embedding of all audio tracks in SDI-outputs.	
3	The system should maintain Audio Sync (“lip sync”) between audio and video in all modules/nodes in the chain where audio and video are processed together	
4	The system should maintain timing of audio channels within a channel group, keeping them in sync	
5	Playout of audio from video clips (see format specifications at 7.6)	
6	Internal playout of stereo and multi-channel WAV files (see format specifications at 7.6)	
7	Internal playout of stereo and multi-channel BWF files (see format specifications at 7.6)	
	Internal Audio Processor	
8	Describe the availability of individual, programmable Audio Delay	
9	Independent level adjustments for all channels at different points in the chain	
10	Independent mixes/routing for different physical outputs. For example, no voiceovers on a "clean feed" SDI output, but voiceovers included on a "program" SDI output.	
11	AB-mixing (cut/crossfade) of audio between successive program events with the transition type following the playlist. Audio for an event may come either from a live SDI source, or a video clip.	
12	Cut between two external sources must be without any glitch in the audio	
13	Automation controlled multi-channel shuffling should be possible	
14	Multi-channel shuffling via manual override should be possible	
15	Gain control of individual channels, planned in the automation play list should be possible	
16	Gain control of individual channels via manual override should be possible	
17	The Supplier should state whether manual gain control at different points in the chain can be achieved via software fader panel	
18	The Supplier should state whether manual gain control at different points in the chain can be achieved via a hardware fader panel	
19	Audio meter true peak level monitoring for all output tracks	
20	R128 audio meter level monitoring for output stereo and 5.1 groups	

21	The system should support upmixing of stereo to 5.1 for use when native 5.1 is not available in live or file source	
22	The 5.1 upmixing should have an up-mix algorithm with control- and routing parameters available to the user	
23	The system should be able to select native 5.1 or upmixed audio based on metadata from traffic system	
24	The system should be able to allow manual override of selection of native 5.1 or upmixed version	
25	Switching between native 5.1 and upmix should be seamless and without interruption, shift or artifacts in the audio	
26	It should be possible to manually override from 5.1 to stereo or from stereo to 5.1 in case of incorrect metadata from traffic system.	
27	The system should support audio processing for both stereo and 5.1 channel structures	
28	The audio processing should include Equalizer with several bands	
29	The audio processing should include Multiband Compressor/Expander (or similar) with parameters such as Adjustable Attack, Release, Ratio and threshold	
30	The audio processing should include Output limiter	
31	The audio processing should include Voice optimizing algorithms	
32	The audio processing should include normalizer compatible with EBU R128	
33	The audio processing should support user specified target level (e.g. -23LUFS and/or -16LUFS) in each chain	
34	The audio processing should support saving parameters to presets	
35	The audio processing should support dynamically loading presets without interruption or artifacts in the audio	
36	The system should be able to control the audio processing presets based on playlist metadata and external APIs	
37	The system should support manually loading presets and/or adjusting individual parameters	
38	The system should support minimum 3x stereo and 2x 5.1 concurrent and separate processing chains – with individual level adjustment, watermarking, compressors/expanders on all channel pairs/groups	
39	If externally sourced/OEM solution of audio processing is used, please describe which manufacturer and product/version is used	
40	Please include screenshot of the user interface used to adjust audio processing parameters	
	Watermarking	
41	The system should support Kantar audio watermarking	
42	The system should support multiple concurrent audio watermarking encoders	
43	The audio watermarking should support separate id codes for each encoder	
44	Please describe which other formats and manufacturers of audio watermarking are supported.	
	Dolby processing	
45	The system should support internal encoding of Dolby Digital (“AC3”)	

46	The system should support minimum 2 concurrent Dolby Digital encoders with individual inputs and outputs	
47	The system should allow access to adjust all Dolby Metadata fields	
48	The Dolby Digital encoders should support dynamic switching between 2.0 and 5.1 mode (with switching of input signals) based on metadata from the traffic system	
49	The system should be able to manually override the parameters and operation mode of the Dolby Digital encoders.	
50	The switching between 2.0 and 5.1 should be seamless without interruption, delay or artifacts in the audio	

7.5 AVoIP

As described in 3 Scope, the infrastructure before and after in the signal chain is currently SDI, and therefore the initial installation will be predominantly SDI based. However, the migration to more and more IP based transportation is expected to happen in the not too distant future, so the optional support for AVoIP streams both as sources and main/monitoring output will be important.

Except for some less critical applications like in-application monitoring and graphics sources, where technologies like NDI may be put to use relatively early, it is expected that the initial AVoIP installation will be the test environment, followed by parallel IP-based chains for the other channels in production. Full adaptation in the production environments will follow later when the AVoIP infrastructure at NRK has stabilized and is mature enough for handling playout.

For the anticipated AVoIP-spec please see attachment “MPP AVoIP Live Media Standards”. Note that this spec is work-in progress, but indicates the direction NRK are heading with the underlaying infrastructure.

#	Requirement description	Priority
1	The system must be able to support full ST2110-based sources and playout according to the attached MPP AVoIP Live Media Standards-document.	
2	When AVoIP support is installed/deployed, the automation system must be able to playout on both SDI and IP-based chains simultaneously (not necessarily on the same hardware) in sync.	
3	Please describe how a gradual migration from SDI to AVoIP may be taken (in context of the automation and playout servers and services), including necessary hardware- and software-upgrades, and if it affects any functionality or capabilities of the initial SDI based system	
4	If the system is able to use NDI as source even in an SDI-configuration, for instance as source for key/fill for graphics, please describe requirements (network, hardware)	

7.6 File-formats

7.6.1 File-formats currently in use at NRK

#	Requirement description	Priority
1	The system must be able to play back MPEG IMX intra-frame 50 Mb/s, MPEG-2 4:2:2P@ML, 576i/25 video with 8x 16 or 24 bits (in 32 bits samples) audio channels in AES3, all in an MXF OP1a, eVTR wrapper	H
2	The system must be able to play back XDCAM HD422 MPEG2 long-GOP 50 Mb/s, MPEG-2 4:2:2P@HL, 1080i/25 video with 8x 16 or 24 bits audio channels, all in an MXF OP1a, RDD9 wrapper	H
3	The system must be able to play back and record XAVC Intra Class100 100/200 Mb/s, 1080i/25, 1080Psf/25 and 1080p/50 video with 8x 16 or 24bits audio channels, all in an MXF OP1a wrapper	H

7.6.2 File-formats that should be supported

#	Requirement description	Priority
1	The system should be able to play back and record XAVC Intra Class200, 1080i/25, 1080Psf/25 and 1080p/50 video with 8x 16 or 24bits audio channels, all in an MXF OP1a wrapper	M
2	The system should be able to play back and record XAVC Intra Class300, 2160p/25 and 2160p/50 video with 8x 16 or 24bits audio channels, all in an MXF OP1a wrapper	M
3	The system should be able to play back and record XAVC Intra Class480, 2160p/25 and 2160p/50 video with 8x 16 or 24bits audio channels, all in an MXF OP1a wrapper	M
4	The system should be able to play back and record XAVC Long GOP 35, 1080i/25, 1080Psf/25 and 1080p/50 video with 8x 16 or 24bits audio channels, all in an MXF OP1a wrapper	M
5	The system should be able to play back and record XAVC Long GOP 50, 1080i/25, 1080Psf/25 and 1080p/50 video with 8x 16 or 24bits audio channels, all in an MXF OP1a wrapper	M
6	Please state the support for XAVC Long GOP/UHD formats: XAVC Long GOP 188, 2160p/25 video with 8x 16 or 24bits audio channels, all in an MXF OP1a wrapper XAVC Long GOP 300, 2160p/50 video with 8x 16 or 24bits audio channels, all in an MXF OP1a wrapper	
7	Please state the support for HDR formats and flavours	
8	Audio; Stereo and multi-channel WAV files	
9	Audio; Stereo and multi-channel BWF files	
10	The playout should handle the above mentioned video formats natively, that is without transcoding during ingest	
11	Please attach a total overview which media file formats are supported for both recording and playout. (UHD/HDR included)	

7.6.3 Future file formats and codecs

#	Requirement description	Priority
1	Please state your strategics for implementation of future file formats and codecs in software	

7.7 Accessibility services

As a national broadcasting company, NRK has a clear social responsibility defined by law with clear requirements for the availability of accessibility services, including subtitles, text-to-speech and sign-language interpretation for hearing-impaired viewers.

7.7.1 Subtitles

Subtitles are an important tool to achieve the goals set in the statutes mentioned in 2.1.

NRK provides subtitles to *live* and *planned productions* – and both are rendered and muxed down-stream with the DVB-signals using a combination of in-house software and Polistream from Broadstream (former Screen). NRK uses a combination of open and closed subtitles, with multi language support.

Due to this complexity and since the Polistream system is already handling the workflow with all the rendering and DVB insertion, there is currently no plans to use an internal subtitle functionality in the new playout chain except for a possible simple preview of the subtitle files to verify the basics. Since it is the Polistream system that is to do the final rendering, any internal preview will only be an indication of the end result, and full QA of subtitle files will at least in the first iterations be done through the use of Polistream.

However, we want the automation system to control the playout of the subtitles, so an integration with Polistream is needed – this is covered in 7.11.4 Subtitling .

#	Requirement description	Priority
1	The subtitle playout event type must be defined inside the the system's play list, which is based on information from WhatsOn (NRK's planning/scheduling system).	
2	File-based subtitle events inside the the system's play list must reference the appropriate subtitle filename.	
3	Preparation, start and stop of file-based subtitle playout events should be controlled automatically by the automation playlist	
4	The system should show a clear indication in case of missing subtitle files	
5	The system should deliver TC on video output as VITC	
6	For QC purposes the system should be able to preview video clips with burned in selectable subtitle-file(s). Optionally also to see the timecode as a burn-in.	
7	The system GUI should allow for subtitle events to be manually created and edited, both for file-based subtitle events	
8	The System GUI should allow for subtitle events (file-based or live) to be manually re-submitted without interfering with video, audio or graphics from the on-air event.	
9	On every change of a subtitle event, even after the program has started, it should be re-submitted to the subtitling system for playout. One example would be that the	

	program goes on air before the subtitle file is present - as soon as the file arrives, a load-command should be sent to the subtitling system	
10	The system GUI sould display the filenames of all the subtitle files contained in the active play list	
11	The system GUI must be able to display the current timecode of the on-air video clip.	

7.7.2 Text to speech

NRK has an automatic text-to-speech service that creates audio based on subtitle files. For the automation system this comes in the form of external audio sources that should be mixed, processed and inserted in the final output according to Figure 16 Audio processing logical overview.

7.8 Virtualization

An important stepping-stone in the process of separating compute and processing from the user surfaces and prepare for the move of headquarters is having as much server and client instances virtualised as possible – as long as it doesn't reduce uptime or general availability of the services.

NRK runs and maintains on- and off-prem Vmware instances, including a cluster in the current equipment rooms of TCR/MCR/Playout.

NRKs will prefer to virtualize as much as possible (both servers and clients) of the automation system on this system and will strive to automate the provisioning of both servers and virtualized infrastructure.

Servers that require specialized hardware (typically the playout servers using SDI/audio-cards and hardware offloading network) may be exempt from this, unless the system provider has experience with, and recommends, virtualizing even these using hardware forwarding.

#	Requirement description	Priority
1	When designing and describing the system, please state what parts may (and may not) be virtualized	
2	When designing and describing the system, please state any special requirements to the virtualization platform for each load, including vCPU/RAM/storage	
3	When designing and describing the system, please elaborate: Is the server load/service stateful or stateless – in other words; may the instance be provisioned from ground up or from images / snapshots, or does it need backup due to on-server stored state. If servers need local state, please describe why this may not live in a central data-/file-store.	

7.9 Network

NRK will provide the network for the system to run on. The networking platform is based on Ethernet with the following physical layers supported:

- 100 Base-T/TX
- 1000 Base-T
- 1G Base-T
- 10G Base-T/LR/SR
- 40G Base-T

The network will also provide segmentation with layer 4 firewalling. Examples of segmentation could be VLans for administration network, file transfer network, live video monitoring network (like for NDI) – these may be available for both virtual (in VMware) and physical loads and appliances.

Please describe how your solution can take use of network segmentation and layer 4 firewalling for security.

Please describe the network topology including protocols and port that are in use by the solution.

NRK might distribute hosting of the solution over multiple data centres. Please describe your requirements for bandwidth and latency between components. Please also describe how you ensure confidentiality and integrity in communication between components.

If your solution is not compliant with NRKs network infrastructure, please provide information on which parts you do not comply with, and why.

7.10 System Performance Monitoring

NRK currently uses several protocols, technologies, and systems, including SNMP, Prometheus, InfluxDB, Grafana, Loki, Icinga, CheckMK and Splunk On-Call for metric aggregation, alerting and notification-handling.

Please describe how, and to what extent the system exposes metrics and logs that are available for ingest/forwarding into NRKs monitoring platform, and if they are available through any common formats or protocols like Open Metrics and Open Telemetry. If for any reason some logs or metrics from your platform cannot be exported automatically – please describe these.

Please describe any integrated system monitoring, graphing, alerting and log aggregation, if available.

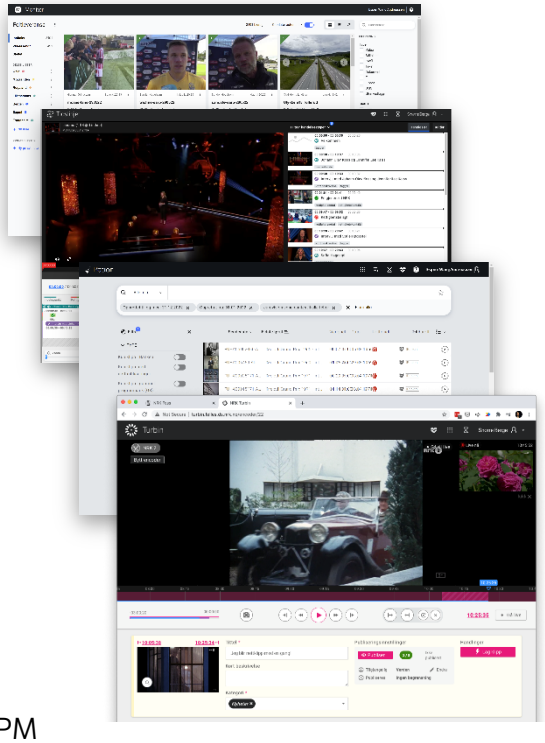
7.11 Integrations

Where there are well known and/or well-defined protocols and transports with little technical, business- or data-modelling ambiguity, NRK prefers and expects the automation system to include proper integrations to the systems mentioned in this chapter.

However, NRK has a strong developer community, and in situations where frequent future feature adjustments, enhancements or replacements will be needed, there is a policy of developing and owning these integration-services or -modules in-house rather than asking the involved suppliers to co-develop a bespoke interface/integration.

Therefore, systems with well documented interfaces and extension-points, event-based integrations and API-first policies in general are valued.

7.11.1 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.

A simplified logical stack is shown in Figure 17 Program Bank production platform. Except for some operations-related tasks, users access the Program Bank (and underlaying MAM) through concise and streamlined user-interfaces – both in the browser and embedded in some productions systems (most notably Premiere Pro, ENPS, Quantel QEdit, Digas).

A simplified logical diagram of the current integrations between the automation system, What's On and the MAM/Program Bank is shown in Figure 18 Current MAM integration.

The underlying MAM powering parts of the production platform is Tedial (with products like Evolution, Fikus, MPM and AST). It supplies an online/offline storage system (AST) with archiving/offlining implemented through on-site and remote tape-robots handled by Telestream DIVA, transfer to/from regional offices and housekeeping of local production storage.

The Program Bank APIs may provide endpoints and events for:

- Querying technical metadata (formats, codecs, preview urls ++)
- Querying availability of media
- Requesting transfer of files to the playout system and filepaths to media online on the central storage
- Media conversion/transcoding

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 automation/playout system.

#	Requirement description	Priority
1	Please describe the possible media flow strategies in and out of the playout system, including internal media management and housekeeping capabilities/workflows (if any), and what type of integrations/interfaces (APIs, callbacks and events) are available for the NRK development teams to receive requests for media.	
2	Please describe what type of hooks, callbacks, events and APIs are available to handle automatic query, fetch and push of media files and technical metadata to and from the automation system	

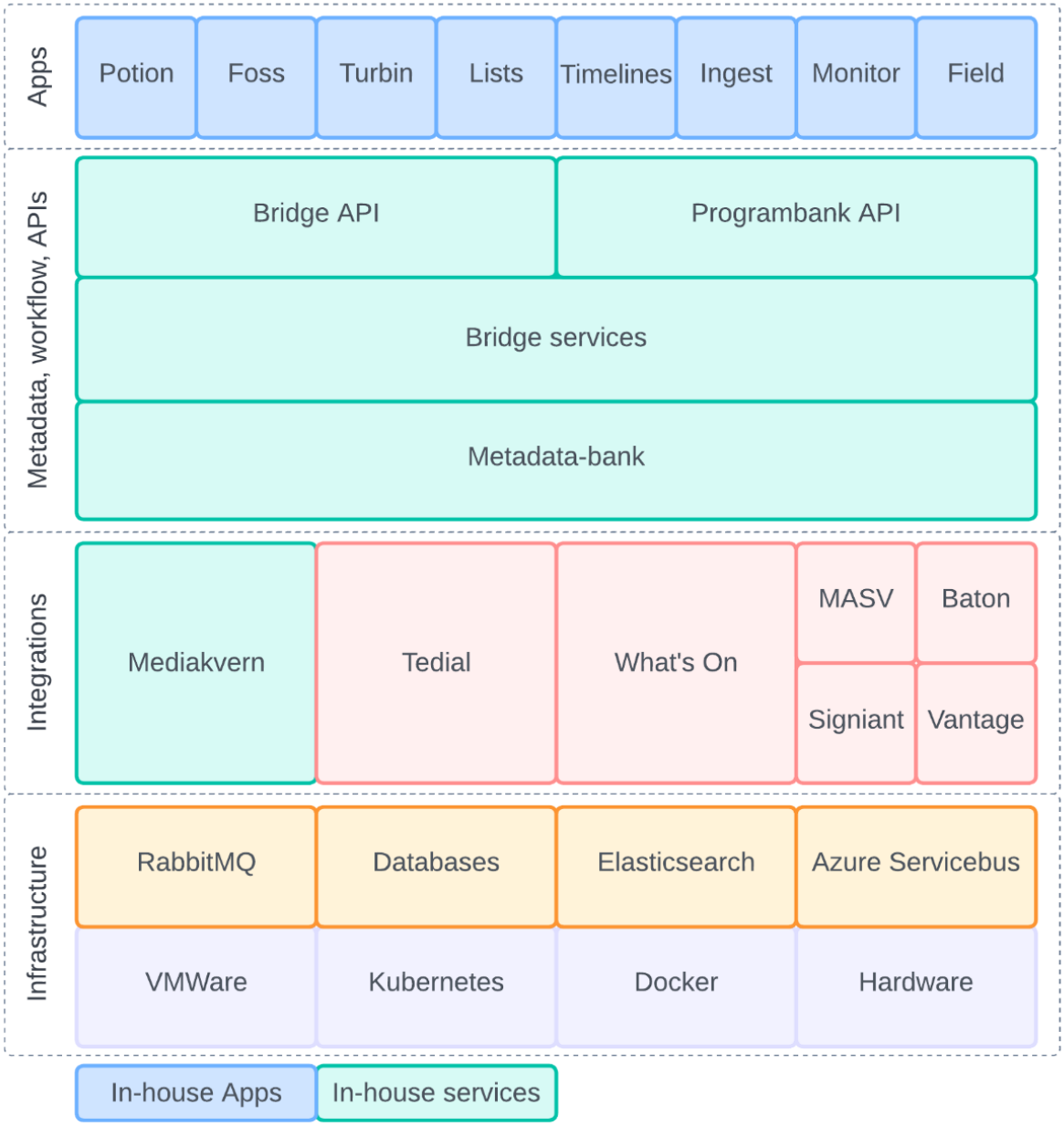


Figure 17 Program Bank production platform

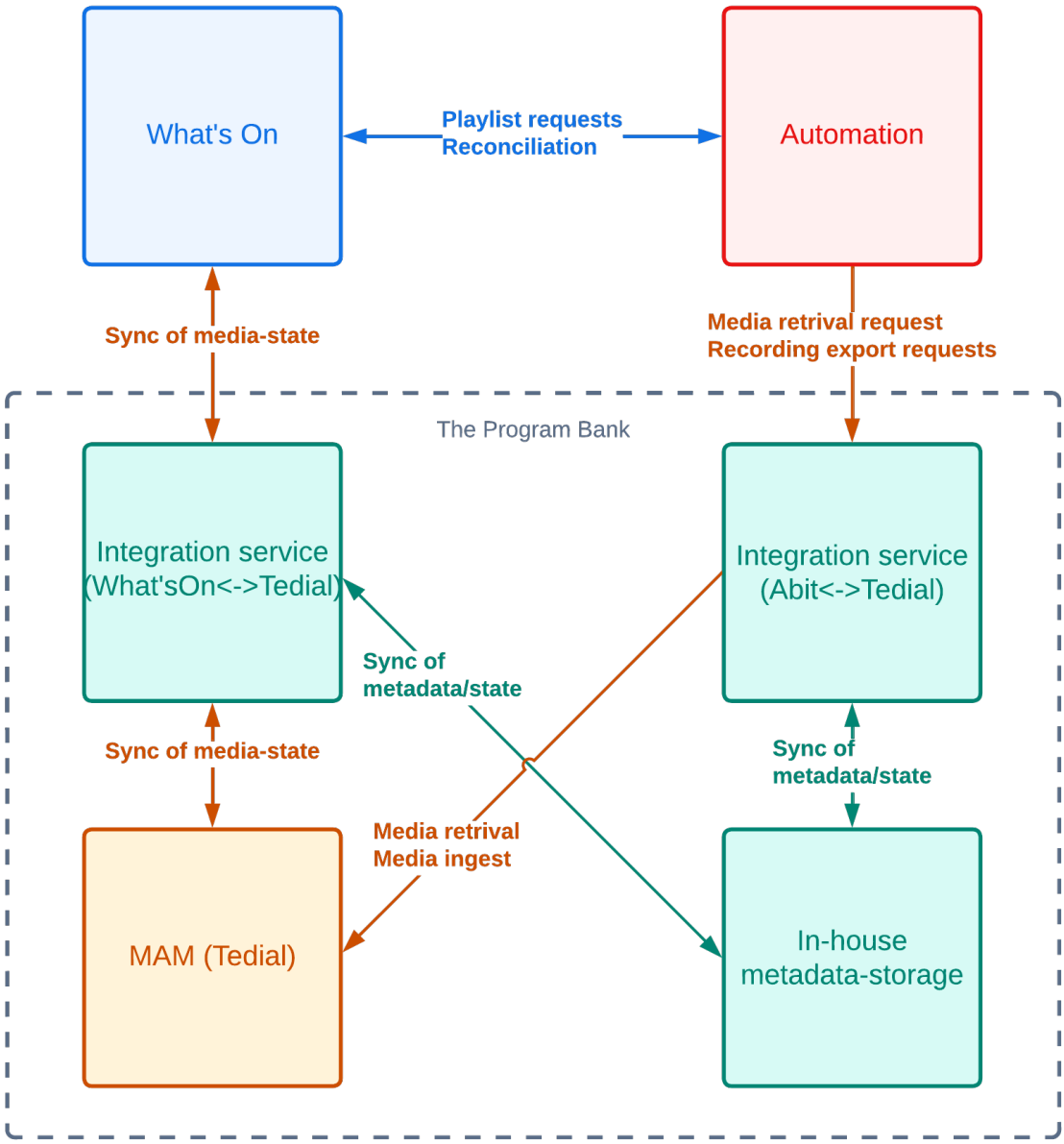


Figure 18 Current MAM integration

7.11.2 Routing

The automation system will be installed in a somewhat aging SDI-infrastructure, and at least for the first iterations the only routing expected is source-routing, with optional automatic failover routing to follow.

The current SDI routers installed in the Playout centre will be replaced – either partly or completely, but the choice of brand and type is to be decided. It may be a set of smaller pure SDI-routers handling source-routing for the automation (reducing complexity), or some somewhat larger modular routers with possible IP-video capabilities for a slightly more future-proof system. Whatever we chose, it will be from some of the known broadcast router manufacturers, as one of the goals of the intermediate SDI-step is to reduce risk. It may

therefore be expected that the routers available for controlling by the automation will be modern and up to date.

#	Requirement description	Priority
1	Please list the existing router / router-control-system protocols and integrations available in your system together with licensing strategy.	

7.11.3 Scheduling

NRKs scheduling system is What's On from Mediagenix, currently at version 2019r3 – expected to be upgraded to 2022r4/5 during the fall.

All linear channels (and rights for all long-format on-demand content) are planned using What's On, so this will be an important integration point for the system and the master source for both playlist and some metadata.

The current automation (Abit Present-It) does a lot of bespoke SQL-queries towards the What's On database. This is powerful, but fragile. We want the new system to integrate using the new Business API and/or through the BXF Automation Integration Module in What's On.

#	Requirement description	Priority
1	If your system has an existing and flexible integration with What's On, and you as a vendor has former integration experience with the products of Mediagenix, please describe the capabilities of this integration and how it will solve the user cases described in 5.6.1.	
2	Regardless of whether this integration already exists, please describe and provide documentation of your APIs, events, hooks, callbacks for playlist manipulation/integration.	

In the same manner as with the MAM-integration, it may be that NRK wants to own the integration-layer between the automation and the scheduling system, removing any need for cross-vendor integration and coordination and providing future flexibility and control.

7.11.4 Subtitling

NRK is using Broadstream (former Screen) Polistream for subtitling. As described in the user stories and the technical requirements the workflow is quite complicated due to dual language requirements, a combination of open/closed subtitles and frequent use of live-subtitling done with in-house developed live-subtitling tools.

A complete subtitle-solution is therefore not a part of this request, and we plan to let the output of the playout chain to be muxed with the DVB-subtitles from the Polistream system in our current muxer down stream.

However, we want the automation system to control the playout of the subtitles, so an integration with Polistream is needed.

The subtitle files will be available on network storage, and information about assigned subtitle files are available from metadata in the schedules from What's On.

#	Requirement description	Priority
1	Please describe what existing integration is available for controlling subtitle systems like Polistream, and please describe and provide documentation of your APIs, events, hooks for subtitle information manipulation/integration.	

As a minimum the ability to ask Polistream to load subtitle files (including reporting the return state of this command) and clear/unload subtitle files is required.

7.11.5 List of out-of-the-box supported integrations

Our Presentation suites will change over time, with new user and business requirements, and we expect the transition to AVoIP to happen in the lifetime of the new system.

#	Requirement description	Priority
1	To better understand how changing needs may be accommodated by the system, please provide a list of existing and out-of-the-box supported integrations and protocols, indicating licensing model, if it is configurable by the operational staff or if it requires extra hardware/software installations.	

7.12 API

As mentioned under 7.11 Integrations, 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 have therefore seen a shift in the last years from commissioning bespoke integrations between third-party systems to making the glue-services in-house, and this has enabled us to deliver new and powerful integrations and workflows to our users and viewers.

We therefore 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.

7.12.1 General API requirements

#	Requirement description	Priority
1	The system must provide access to all vital functionality in the business layer like playlist manipulation and media handling through a public API.	
2	The API must be thoroughly documented.	
3	The data model in use by the API should be documented and include formal schema definitions.	
5	Usage of the API must be covered by the support level agreements.	

6	The API and documentation must be kept up to date when new features are added to the system so that requirements #1 and #2 are always fulfilled.	
7	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).	
8	The API should be consistent on media format and return types – using correct Content-Type headers including character sets.	
9	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.	
10	The API authentication should offer single sign on through Azure AD.	
11	The concurrency control mechanism (locking, etags, row version or similar) in use by the system should also be available and in use by the API, enabling prevention or detection of the Lost Update Problem.	
12	The API should allow external systems to subscribe to events affecting assets in the system (like creation, modification, etc) through callbacks, message queues or other event systems.	
13	The system-provided user interfaces should rely on publicly exposed and documented APIs	
14	Responsiveness of the API should not be linked to the responsiveness or availability of the automation/playout-capabilities; it should not be possible to affect the stability of the playout due to excessive use of the API by an ill-behaving client.	

7.12.2 Program flow events

NRK wants to emphasise the importance of this type of API/interface in the new system. Several existing integrations are based on the presence of instant, reliable program flow events; Events notifying integrations about:

- Scheduling of program (the insertion of a program in the playlist)
- Modification of program (any type of change on a program in the playlist – including secondary events or metadata)
- Cuing of program (including predicted/estimated start-time)
- Start of playout of program (including exact start-time of playout)
- Stop of playout of program (including exact stop-time of playout)
- Start of recordings
- Stop of recordings

#	Requirement description	Priority
1	All events should include at least the following information: • An ID of the event – this should be unique for this instance and not be reused by any other messages/events • Timestamp of the event • Channel ID	

	• Type of event (live, file, other ++) • Automation ID of the program (unique ID of the program as known by the automation system) • MAM ID of the program • At least minimal metadata – like title • Estimated or exact start/stop/duration – any combination that makes sense for the given event type • Auxiliary information relevant for the event type (like source type, source id (router/file), secondary event information, subtitle file)	
2	If the events do not include all program information in the event-body itself, a fast, responsive API for querying this information should be available, so that integrating services are able to quickly fetch any relevant information. Please describe your solution.	
3	There may be several viable transports for these type of messages – please state what type of technology/service makes these events available (message queues, callbacks, tcp-sockets etc) and the media format and data model of the events.	
4	Please state how client may keep a reliable connection or message flow during failover-situations. At-least-once delivery of messages is expected – ideally pr client (proper queues) but at least for established connections is expected.	

7.13 Security

Content not yet available – work in progress

7.14 Other technical requirements

7.14.1 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 shall be described.

7.14.2 Scalability and flexibility

The Solution has a logical and technical architecture that supports scalability and flexibility regarding new requirements and efficient maintenance.

The contractor is asked to describe how the Solution is scaled up or down and important limitations or dependencies.

7.14.3 Environments

The Solution is delivered with a minimum of pre-production- (Sandbox), test- and production-environments so that it is possible to test changes before they are put into the production environment. Describe the different environments that will be made available, and the “built-in” functionality for moving application logic between environments (for example from a test environment to a production environment).

7.14.4 Update environments

The Contractor shall ensure that all environments are kept up to date with the production environment so far as is appropriate for maintaining their primary function. The test environment shall be identical to the production environment in all aspects other than for those aspects that are supposed to be different for the purpose of testing prior to being put into production (e.g. new functionality).

8 DOCUMENTATION REQUIREMENTS (CF. CLAUSE 2.3.6)

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

8.1 Design documentation

The solution is provided with a design document that is developed during the design phase. The 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.

8.2 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 as minimum in English

8.3 User documentation

The Solution is provided with NRK-specific user documentation that is:

- provided in a common editable electronic format (e.g. Word).
- adapted to different user groups, including advanced users, such as project managers, superuser, system managers, and end-users who will use the Solution in a limited way

8.4 Documentation of integrations

The Solution is provided with technical documentation in English describing integrations specific to NRK (interfaces, methods, etc.).

8.5 Functional system documentation

The Solution is provided with functional documentation in English describing configurations and setup, including functional design for any customisations.

8.6 Technical system documentation (SaaS)

The Solution comes with a technical system documentation in English, describing at least security and access architecture (ADFS, etc.) and logical information architecture. The documentation should also describe the data table structure for transaction data and master data. This requirement applies only to SaaS-solutions.

8.7 Technical system documentation (On Premise)

The Solution comes with a technical solution documentation in English, describing at least application architecture, technical architecture, security and access architecture (ADFS etc.) and logical information architecture. The documentation should also describe the data table structure for transaction data and master data. This requirement applies only to On-premise-solutions.

8.8 Installation and maintenance documentation

The Solution comes with installation and maintenance documentation in English. This requirement applies only to On-premise-solutions.

9 TRAINING REQUIREMENTS (CF. CLAUSE 2.3.7)

9.1 Training method

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

For NRK to be able to test the Solution properly the training of NRK's testers must happen before acceptance testing begins and in an environment with converted data or otherwise NRK's "real" data. The training shall be designed appropriately for each specific user group.

All user groups shall receive training. The Contractor shall describe the training method.

The Contractor shall also describe typical user groups for the Solution.

9.2 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:

- Objective of the training
- Training content
- Expected benefits from completing the training
- Training style
- Duration

10 GDPR REQUIREMENTS (CF. CLAUSE 9.2)

Any personal data shall be processed according to the current legislation in the Norwegian Personal Data Act, as outlined in the attached “Data processing agreement”. The Contractor must accept the Data processing agreement. The Norwegian Personal Data Act is aligned with the EU’s “General Data Protection Regulation” (GDPR).

10.1 Personal data in the Solution

The Solution will be used to process personal data, for example related to the planning of work schedules and time tracking. The Solution will retrieve and use relevant information about employees from the HR application and enrich these with some additional information. The following is a non-exhaustive list of examples of personal data that will likely be processed in the Solution:

- Names, specifically first and second names
- Addresses, home, work and e-mail addresses
- Phone numbers
- Date of birth
- Employee ID
- Employed status (fixed, temporary, etc)
- Employee skills
- Absence information
- Travel information
- Various balances for time and money
- Various personal data contained in free text fields, help requests, etc.

10.1.1 Personal data – Contractor’s description

The Contractor is asked to describe how the Solution supports the Customer in complying with the “Obligations of the Controller” pursuant to section two of the Data processing agreement.

10.2 Data storage

The level of protection in the Personal Data Act must not be undermined if personal data is transferred to another state. All the countries within the EU / EEA area have implemented the Privacy Policy and thus ensured that personal data are handled properly. Therefore, one can freely transfer personal data to these states provided the other conditions of the Personal Data Act are fulfilled.

Under certain conditions, personal data may be transferred to states outside the EU / EEA area - so-called "third countries":

1) The European Commission has recognised that some third countries have a sufficient level of personal data protection. Transfers to such a country are recognized as adequate and are comparable to transfers to countries within the EU / EEA. It is currently 12 countries that have a decision on a sufficient level of protection. These are Switzerland, Andorra, the Faroe Islands, Guernsey, Jersey, the Isle of Man, Argentina, Canada, Israel, New Zealand and Uruguay.

2) USA – Privacy Shield: For the transfer of personal data to the United States, the Commission Decision on Privacy Shield applies. This decision includes companies established in the United States which have been certified under the Privacy Shield Agreement. If personal information is to be transferred to the United States under the Privacy Shield, the recipient of the personal data must be listed on the Privacy Shield Certified Entities. In addition, NRK will have to make the following assessments:
    a. Assess whether the transfer is in accordance with the basic requirements of GDPR Article 5.
    b. Carry out a risk assessment, in accordance with the requirements of the GDPR Article 32.
    c. Assess the risk and the financial consequences of a situation where the recipient of personal data loses its privacy Shield certification.

10.2.1 Data storage – Contractor's description

The Contractor is asked to describe in which country data will be stored.

10.2.2 USA – Privacy Shield (if relevant to the Contractor)

The Contractor is listed on the Privacy Shield Certified Entities (if not relevant for the Contractor's situation, this requirement can be answered with a "Not Applicable").

11 OTHER REQUIREMENTS/INSTRUCTIONS

ID	Requirement description
1	The Contractor shall in appendix 2 give a high-level description of the total Solution that is offered, including how this solves the purposes of the procurement.
2.	Any required changes to the Customer technical platform must be explicitly described in Appendix 2 in order to apply.
3	In appendix 2 the Contractor is required to provide an overview of which license terms that apply for standard software and/or any open source software that is included in the provided solution. The terms shall be presented in appendix 10.
4	The Contractor shall in appendix 4 describe a plan for the project and commissioning of the Solution, based on the Contractor's applied project methodology.
5	The Contractor shall in appendix 5 describe how testing and approval shall be conducted.
6	In appendix 6, the Contractor shall describe its organisation, staff and interaction with the customer as instructed. The Contractor’s fulfilment of the requirements regarding training shall also be set forth in appendix 6.
7	The Contractor shall specify prices and the principles for pricing in appendix 7.
8	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 contractual text refers to other documents.
9	If Standard terms and conditions for third-party deliveries are made applicable, these must be described under the relevant section in Appendix 2, with clear reference to which parts of the delivery they are made applicable. The terms themselves must be included in Appendix 10. It is emphasized that these may only be supplementary, and not contrary to the SSA-T. To the extent that they affect the offered performance, this must be clearly stated in the Contractors’ reply to Appendix 2 under the relevant section.