Hogia
Public Transport Systems

Vehicle System Interface 3.0
Interface Specification

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Interface Version History

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1 Introduction

This document describes the Vehicle System Interface (VSI). VSI is an interface for real time message exchange between a vehicle system and PubTrans. The primary purpose is reporting vehicle progress in real-time to PubTrans.

VSI works in combination with other PubTrans interfaces such as Data Output Interface – DOI – and Real-time Output Interface – ROI. DOI and ROI are not described in this document.

1.1 Background

A vehicle system in VSI context consists of some equipment and software in the vehicles, a wireless communication system and a controlling server application that controls the data communication, data distribution, data collection and validation. This type of system is usually called an AVL-system.

It is essential to understand that VSI is transparent to the actual communication topology of an AVL-system. VSI does not put any constraints of where the intelligence is placed in the AVL-system; locally in the on-board computer or in the central server or a combination of both. The exchange of VSI-messages takes place as a point-to-point-communication between a central AVL-system (the vehicle system) and the PubTrans VSI-processing engine.

VSI has been designed to manage communication with one or several AVL-systems. Users of applications connected to PubTrans will experience one consistent data view across all the AVL-systems. For instance, an operations control application connected to PubTrans will be able to monitor and control the operations across AVL-system boundary.

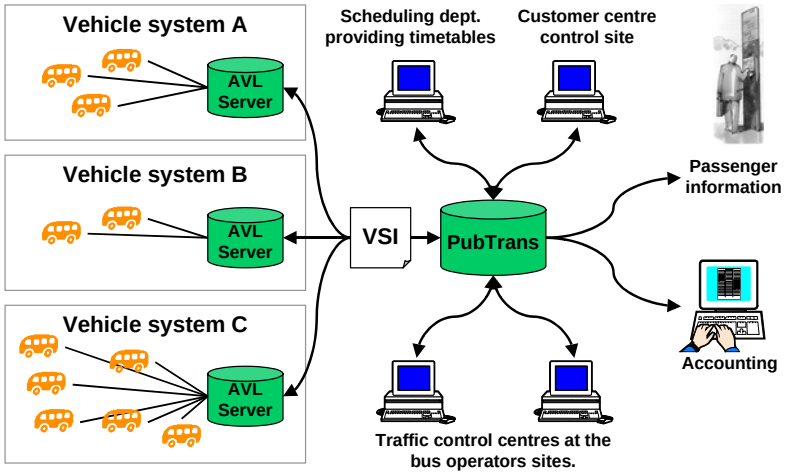

Fig. 1. *The role of VSI as an interface between the central system and one or several AVL-systems.*

1.2 Documentation

The VSI-documentation consists of this document and a set of XML schema definition files (XSD-files). The XSD-files are the formal definition of the interface. This document is written with the purpose to make the reader understand how to use the interface, which not necessarily cover all details expressed in the XSD.

1.2.1 VSI Versions

Versioning of the VSI-protocol is handled by replacing the XSD-reference to point on a new XSD-file.

1.3 Terminology

Term	Explanation
DOI	Data Output Interface. See IS-PUBTUG/I/DOI for details.
External system	The system that submits VSI reports to PubTrans.
GID	Global Identifier used in PubTrans. See Appendix for details.
PubTrans	The system that processes VSI reports and provides the result to other applications via other interfaces.
ROI	Real-time Output Interface. See IS-PT/I/ROI/3 for details.
VSI	Vehicle System Interface.
XML	eXstensible Mark-up Language.
XML-stream	A transport mechanism for transferring XML data. See Appendix for details.
XSD	XML Schema Definition

1.4 Data Model

The design of VSI is based on TRANSMODEL, the European reference data model for public transportation.

2 General

This chapter describes the general requirements to use VSI.

2.1 Time Data

VSI accepts data in any time zone and automatically converts it to the time zone used internally. The AVL system may operate in UTC or in local time. However, it is required that the AVL-system always know its current time offset from UTC, so that a correct and unambiguous timestamp can be set on each message also when taking daylight saving time in consideration.

Messages about events must include an accurate timestamp telling when the event occurred. The precision of this timestamp governs the quality of data.

2.2 Data Consistency

Network and timetable data in the AVL-System must be up to date and consistent with PubTrans. Network and timetable data are available through the Data Output Interface.

2.3 Message Exchange

VSI is a double directed message protocol. Real time data exchange is made in both directions, i.e. from the AVL-system to PubTrans and vice versa.

2.3.1 Message Id

Each VSI-message should have an Id. It is the responsibility of the sending system to decide the value of the Id. It is recommended that this is a running sequence number. The Id of a request will be reflected in the OnId attribute of a corresponding response. There will be two separate series of Ids, since messages can be sent in both directions.

2.3.2 Message Sequence

VSI reports and requests from an external system are applied by PubTrans to the production plan in the sequence they are delivered.

2.3.3 Priority Messages

Priority of message delivery is not included into the message content. Instead, priority of message delivery should be implemented in the transport protocol if necessary.

2.3.4 Transport Mechanisms

A VSI communication session is always a point-to-point communication between two servers. VSI message structure is designed to be independent of transport mechanism.

The transport mechanism used must support data exchange in both directions. For optimal performance, it is also recommended that the message exchange can be made asynchronously, i.e. that the external system

does not wait on responses on each messages, but sends requests without waiting on responses and processes responses asynchronously as they are received.

Each request message will automatically trigger a separate response message. A report message, on the other hand, will not trigger a separate response message. This is for performance reasons since report messages typically come in large quantities. Transport mechanisms built on top of TCP will already have the necessary means to ensure that data is delivered in sequence without losing data. Building another mechanism on top of that is unnecessary. Instead it is enough to verify that the transfer process is working by monitoring heartbeat indication or similar.

The transport mechanism has to be decided for each implementation. In addition, a number of technical parameters must be defined, such as message encoding, server addresses and error handling.

NOTE: PubTrans currently supports XML-streams. XML-streams are described in Appendix.

2.4 Message Types

An external application must be able to submit messages in the format specified in this document. An external application need not implement all message types to send to PubTrans, but must support all types of messages sent from PubTrans.

2.4.1 Messages to PubTrans

Category	Description
Vehicle Journey Progress Reports	Messages describing the state and progress for a vehicle journey, i.e. the progress along a route or deviations from the expected timetable.
Assignment Requests	Messages describing how resources are associated with tasks.
Vehicle Journey Info Reports	Messages containing vehicle journey related information that is not related to the progress of the vehicle journey, e.g. the current passenger load.
Vehicle Info Reports	Messages containing vehicle related information that is not related to a specific vehicle journey.
Vehicle State Responses	Messages containing responses to Vehicle State requests from PubTrans.

2.4.2 Messages from PubTrans

Category	Description
Assignment Responses	Messages containing responses to assignment requests from external system.
Inform Commands	Messages containing information to be delivered to the driver or the passengers in a vehicle.
Assignment Commands	Messages containing orders that assignment requests should be sent from the external system.
Vehicle State Requests	Messages requesting information concerning a vehicle.
Vehicle Tracking Commands	Messages containing orders to start or stop the sending of vehicle information reports.

3 Concepts

3.1 Process

The AVL-system is responsible for keeping track of its vehicles and informing PubTrans about their whereabouts.

It is possible to use different levels of detail when reporting from different AVL-systems. All AVL-systems will not need to be able to work with all different types of reports. It should be decided in the integration phase for each AVL- system which reports that are relevant.

3.1.1 Minimal Workflow

There is a minimum requirement for reports from an AVL-system concerning a vehicle working vehicle journeys:

1. Assign the vehicle to the vehicle journey it will work.
2. Report each departure from a stop, or passage of a stop, along the route as they take place.
3. Sign off the vehicle from the vehicle journey when the vehicle journey is completed.
4. Repeat 1 through 3.

It is actually even possible to omit step 1 and 3. In that case the vehicle will be assigned when the first departure report is received, and de-assigned when a departure report from the same vehicle concerning another vehicle journey is received.

3.1.2 Recommended Workflow

The recommended workflow concerning a vehicle working vehicle journeys:

1. Report that the vehicle is manned.
2. Assign the vehicle to the vehicle journey it will work, if it has not already been signed on.
3. Make an advance assignment of the following vehicle journey.
4. Report when arrival to a stop is due.
5. Report that the vehicle has arrived at the stop.
6. Report that the vehicle departs from or passes the stop.
7. Repeat 4, 5 and 6.
8. Sign off the vehicle from the vehicle journey when the vehicle journey is completed.
9. Repeat 2 through 8.
10. Report that the vehicle is unmanned.

There could also be additional reports between step 2 and 8.

Step 3, advance assignment of the next journey, might be omitted in some systems and when the next vehicle journey is not known. If omitted there will not be any forecasts for this vehicles following journey until that journey is in progress.

Step 4, reporting that a vehicle is due to arrive at a stop, should only be included if it is essential to give this type of information, such as in a subway station.

Step 5, reporting that a vehicle has arrived at a stop, might be omitted at the cost of losing arrival information.

Step 1 and 10, reporting that the vehicle is manned or is unmanned, might be omitted in some systems.

3.2 Assigning Resources to Tasks

3.2.1 Normal Sign On and Off

The AVL-system must inform PubTrans when a vehicle starts on a service journey. This is accomplished by sending a *Vehicle Journey Sign On Request.* Correspondingly, when the vehicle finishes a service journey, a *Sign Off Request* should be sent.

If the sign on or sign off succeeds PubTrans will respond with a *Sign On Response* or a *Sign Off Response.* If PubTrans does not accept the request for some reason, an *Error Response* will be returned instead.

Similarly the public transport objects block, driver and duty can be signed on or off, but this is not a requirement.

Vehicle Journeys can be signed on in advance. Other types of public transport objects cannot be signed on in advance.

Signing off have side effects:

- Signing off a block also signs off the current and following vehicle journeys assigned to the concerned vehicle.
- Signing off a duty also signs off the driver.
- Signing off a driver also signs off the duty.

3.2.2 Implicit Sign On and Off

If PubTrans receives a progress report that contains references to a different vehicle journey than previously reported for this vehicle, or if the vehicle has never reported before, the new vehicle journey will be signed on implicitly.

3.2.3 Remote Sign On and Off

In some instances an operations controller wants to force a vehicle to sign on to, or off from, a specific task. In this case a *Sign On Command* or *Sign Off Command* is sent via PubTrans to the AVL-system that handles that vehicle. The AVL-system should then start a process so that an appropriate *Sign On Request* or *Sign Off Request* is initiated for the concerned vehicle, if possible.

3.2.4 Block Sign On

If a Block is signed on, and there is information in PubTrans that this Block defines a sequence of Vehicle Journeys, then a number of *Sign On Commands* describing the relevant Vehicle Journeys will be sent to the appropriate AVL-system.

3.2.5 Swapping Vehicles

Swapping vehicles is a shortcut to make the replacement or exchange of a vehicle in one atomic operation. Swapping simply means that vehicle A takes over the signed on tasks of vehicle B and vehicle B takes over the signed on tasks of vehicle A at the same point in time. The signed on tasks include the signed on block, driver, duty the current vehicle journey and also vehicle journeys signed on in advance.

The AVL-system must inform PubTrans when a swap takes place. This is accomplished by sending a *Vehicle Swap Request.* If the swap succeeds PubTrans will respond with a *Swap Response.* If PubTrans does not accept the request for some reason, an *Error Response* will be returned instead. A successful swap will also result in a number of *Sign Off Commands* and *Sign On Commands* directed to the two concerned vehicles. It is important to note that repeated *Vehicle Swap Requests* switches the tasks back and forth between the two vehicles, and sufficient feedback should therefore be supplied to the drivers doing the swap, so that they can ensure that the sought after action was achieved.

3.3 Reporting Progress

The AVL-system must send information as certain events takes place during a vehicle journey. These events will take place at journey pattern points or positions relative to journey pattern points. One such event is when a vehicle working a vehicle journey departs from a stop.

The AVL system must report events using the common identities of the involved vehicle, vehicle journey and journey pattern point as provided in other PubTrans interfaces.

Normally a journey pattern point is visited only once during a vehicle journey. However, some vehicle journeys have such journey patterns that the same journey pattern point is visited again. In such instances more information must be provided to distinguish between the first and consecutive visits.

3.4 Reporting Delays

The main principle of VSI is that facts such as actual events should be reported. Additional reports are needed when vehicles get stuck or are severely delayed at stops or between stops.

An extra report should be sent when a vehicles level of delay has changed more than a certain number of seconds since the last progress report.

If it is between stops then an *Extra Progress Report* should be sent, and if it is at a stop then a *Waiting Report should be sent.*

The delay condition is evaluated as follows:

The intended time for departing from or passing a journey pattern point is the later of *earliest departure time* and *latest arrival time*. The intended time for passing a point on route link of type 'TIMING' is calculated by adding *Has Duration From Beginning Seconds* to the later of earliest departure time and latest arrival time of the journey pattern point at the start of the route link.

When a vehicle on a vehicle journey is delayed, it should send an *Extra Progress Report* or *Waiting Report* every time the delay has increased a configured number of seconds compared with what was previously reported. Typically this value will be defined to 60 seconds.

A vehicle is considered delayed:

- If it has not reached the next stop point at the planned *latest arrival time*
- If it has not left a stop point after the later of *earliest departure time* or *latest arrival time*, i.e. the time when it is planned to have left the stop point.
- If it has not reached a point on route link of type 'TIMING' at the intended time for passing.

In addition, extra progress reports could be sent to PubTrans if there are local indications in a vehicle that it's level of delay has changed more than a certain amount. The decision to use this additional kind of extra progress reports must be evaluated and agreed on for each implementation.

The *Extra Progress Report* must contain the vehicles relative position on the journey pattern. This is expressed as an offset from the preceding journey pattern point. Observe that the related attribute is named *Previous Point Ref* for brevity instead of the more correct but more cumbersome *Previous Point on Journey Pattern Ref.*

Absolute position information from a GPS-device could optionally also be included in this report. If this should be the case must be agreed on for each implementation.

3.5 Tracking Vehicles

The progress reports provide sufficient information so that an operation controller can follow the progress of his vehicles along the different service journeys. However in some situations an operation controller might want to follow the movement of one or more vehicles even more closely.

In this case a *Start Tracking Command* is sent via PubTrans to the AVL-system that handles that vehicle. The AVL-system should then start a process so that sending of *Absolute Position Reports* from the concerned vehicle is initiated. The tracking command contains information of for how long the reporting should persist, and the interval between each report.

The tracking can be prematurely aborted through the *Stop Tracking Command.*

3.6 Emergency Handling

PubTrans will forward an *Emergency Report* to the relevant operation control centre. It is up to the operation controller or operation control system to initiate that a corresponding *Emergency Acknowledge Inform Command* is sent via PubTrans to the AVL-system that handles the vehicle.

3.7 Position Data

The following types of position references are used in VSI:

- Journey pattern point, i.e. a common reference point, e.g. a bus stop.
- Relative position i.e. an offset from a common point reference, usually a number of meters from a previous bus stop along a known route. From this information an absolute position may be derived.

- Absolute position, i.e. co-ordinates in a common reference system, such as GPS-positions. What common reference system that should be used is implementation specific and must be agreed on since it depends on the available data and positioning technology used.

4 Message Reference

This chapter describes the payload messages in VSI. In addition there might be message types that are specific for the transport mechanism.

4.1 Root Elements

The root elements are the wrappers defining the message sequence to and from PubTrans.

4.1.1 Message Types

4.1.1.1 To PubTrans Messages

The message types that an external system can send to PubTrans and that is processed by PubTrans.

4.1.1.2 From PubTrans Messages

The message types that PubTrans send to an external system, and that PubTrans expects the external system to process.

4.1.2 Content

Note that Default Location System Ref is only included in *To PubTrans Messages.*

Name	Type	Description
Document Layout Version	Attribute	The set of values in the enumeration indicates the range of schema versions that this schema version is backward compatible with. Used to ensure that the schema version that an incoming document was validated against is not in conflict with this schema version.
Default Location System Ref	Attribute	Optional attribute. Contains a reference to the default geographical reference systems used when supplying geographical positions in messages. Contains a combination of datum and zone if applicable. Must be provided if geographical positions will be provided in messages. Observe that details about what geographical reference systems that are allowed to be used and formats of the reported positions must be agreed on for each implementation.

In addition to the payload content, some of the attributes and elements of the root elements might be inherited from the transport mechanism used. The current implementation inherits from the general XML-stream transport mechanism.

4.2 Vehicle Journey Progress Reports

Vehicle journey progress reports are messages to PubTrans describing the state and progress of a task, i.e. the progress along a route or deviations from the expected timetable.

4.2.1 Message Types

4.2.1.1 Departure Report

This message informs PubTrans that a vehicle has departed from a stop. The report should be sent as soon as possible after a departure from a stop is detected. This will make it possible to get a swift clear down in presentation systems. The time stamp of this report should contain the observed departure time from the stop point.

4.2.1.2 Due Report

This message informs PubTrans that a vehicle is due to arrive at a stop. The time stamp of this report should contain the time of detection. This message should only be used in systems where it is essential to give this type of information, such as in a subway, otherwise it should be omitted to reduce the workload.

4.2.1.3 Arrival Report

This message informs PubTrans that a vehicle has arrived at a stop. The report should be sent as soon as an arrival to a stop is detected. The time stamp of this report should contain the observed arrival time to the stop point.

4.2.1.4 Passage Report

This message informs PubTrans that a vehicle has passed a journey pattern point included in the current journey pattern without stopping. The time stamp of this report should contain the observed non stop passing time.

4.2.1.5 Journey Aborted Report

This message informs PubTrans that the current vehicle journey is aborted.

4.2.1.6 Off Route Report

This message informs PubTrans that a vehicle has diverted from the expected route. The vehicle will be considered off route until another progress report is received.

4.2.1.7 Extra Progress Report

This message informs PubTrans how far a vehicle has advanced between two journey pattern points, and possibly additional information to enhance the forecast of future events.

Extra progress reports should be sent:

a) When the vehicle is delayed and the delay has changed more than a predefined time span compared with what have previously been reported.

b) When a vehicle reaches a point on route link of type Timing Point case 1 (as described in DOI).

c) When a vehicle does not reach a point on route link of type Timing Point case 2, 3 or 4 (as described in DOI) within the allotted time span.

d) When the AVL-system concludes that forecast is unreliable or that the level of journey progress has changed.

4.2.1.8 Waiting Report

This message informs PubTrans that a vehicle is still standing at a stop waiting to depart.

A waiting report should be sent when the vehicle is still standing at a stop a predefined time span after the estimated time of departure. This report should thereafter be sent repeatedly with an interval according to the predefined time span as long as it is still standing at the stop.

4.2.2 Content

4.2.2.1 Progress Reports in General

Note that not all content items below apply to all types of reports and that all items are not included below. See the XSD-files for additional details. The *Extra Progress Report* is described separately below.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the event was observed, i.e. when it occurred.
Vehicle Ref	Attribute	The concerned vehicle.
Journey Ref	Attribute	The vehicle journey that the event occurred on. Either expressed as the Vehicle Journey GID or the Vehicle Journey Id according to DOI.
Point Ref	Attribute	The journey pattern point where the event was planned to occur according to the long term plan. The journey pattern point is usually a stop point, but it could also be a virtual journey pattern point if dynamic stop point allocation is used.
Point Visit Count	Attribute	Optional attribute. Defaults to 1. Normally each stop is called only once during a vehicle journey. However, some vehicle journeys have such journey patterns that the same stop is called again. In such instances more information must be provided so that it is possible to distinguish between the first call and consecutive calls. A call referring to the first time a stop occurs in the journey pattern has Visit Count = 1. The next time the same stop is called the value 2 should be used. This attribute should only be provided if Visit Count has the value 2 or more.
Observed Point Ref	Attribute	Optional attribute. No default value. This is the journey pattern point where the event actually occurred. This attribute should only be provided if the vehicle is detected at another point than the long term planned point. If not provided; it is assumed that the event occurred at long term planned point.

Name	Type	Description
Forecasts	Element	This is an optional element that is only relevant in configurations where the AVL-System provides local forecasts. It contains updated forecasts for onward calls and indication if forecasts are unreliable.

4.2.2.2 Extra Progress Report

See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the report was generated.
Vehicle Ref	Attribute	The concerned vehicle.
Journey Ref	Attribute	The concerned vehicle journey. Either expressed as the Vehicle Journey GID or the Vehicle Journey Id according to DOI.
Previous Point Ref	Attribute	The most recently visited/passed journey pattern point according to the journey pattern of the long term plan. The journey pattern point is usually a stop point, but it could also be a virtual journey pattern point if dynamic stop point allocation is used.
Previous Point Visit Count	Attribute	Optional attribute. Defaults to 1. Normally each stop is called only once during a vehicle journey. However, some vehicle journeys have such journey patterns that the same stop is called again. In such instances more information must be provided so that it is possible to distinguish between the first call and consecutive calls. A call referring to the first time a stop occurs in the journey pattern has Visit Count = 1. The next time the same stop is called the value 2 should be used. This attribute should only be provided if Visit Count has the value 2 or more.
Distance Past Previous Point Meters	Attribute	The distance travelled after leaving/passing the previous journey pattern point.
Journey Progress Level	Attribute	This is an optional attribute. If provided, this should give an indication of how fast the vehicle is progressing compared with the "normal" situation. E.g., if the vehicle is in a jam it should indicate NO PROGRESS. If not provided, NORMAL PROGRESS is assumed.
Forecasts	Element	This is an optional element that is only relevant in configurations where the AVL-System provides local forecasts. It contains updated forecasts for onward calls and indication if forecasts are unreliable.

4.3 Assignment Requests

Assignment requests are messages to PubTrans describing requests to associate resources with tasks or dis-associate resources from tasks.

4.3.1 Message Types

4.3.1.1 Vehicle Journey Sign On Request

This message informs PubTrans that a vehicle is assigned to work a vehicle journey. It is assumed that there is a driver in the vehicle at this point in time.

4.3.1.2 Block Sign On Request

This message informs PubTrans that a vehicle is assigned to work a block. It is assumed that that there is a driver in the vehicle at this point in time.

4.3.1.3 Driver Sign On Request

This message informs PubTrans that a vehicle is manned. It could optionally refer to a certain employee, and/or a specific duty. It is assumed that that there is a driver in the vehicle at this point in time.

4.3.1.4 Sign Off Request

This message informs PubTrans about a de-assignment.

4.3.1.5 Swap Vehicle Request

This message to PubTrans is a request that all assignments are swapped between two vehicles.

4.3.2 Content

4.3.2.1 Content for Sign On/Sign Off Requests

Note that all items are not included below. See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the request was generated.
Vehicle Ref	Attribute	The concerned vehicle.
Journey Ref / Block Ref / Driver Ref	Attribute	The concerned vehicle journey, block or driver.

4.3.2.2 Content for Swap Vehicle Request

See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the request was generated.
From Vehicle Ref	Attribute	The vehicle where the request was initiated.
With Vehicle Ref	Attribute	The other vehicle.

4.4 Assignment Responses

These messages are sent from PubTrans as responses to previous assignment requests.

4.4.1 Message Types

4.4.1.1 Sign On Response

This is a message from PubTrans that informs the AVL-system that PubTrans has accepted a sign on.

4.4.1.2 Sign Off Response

This is a message from PubTrans that informs the AVL-system that PubTrans has accepted a sign off.

4.4.1.3 Swap Vehicle Response

This is a message from PubTrans that informs the AVL-system that PubTrans has accepted a swap vehicle request.

4.4.2 Content

Note that not all content items below apply to all types of responses and that all items are not included below. See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the response was generated.
On Message Id	Attribute	This attribute contains a reference to the Message Id of the original Request message.
Public Transport Object Ref	Element	The concerned vehicle journey, block, duty or driver.

4.5 Assignment Commands

These messages are sent from PubTrans and contain orders that assignment requests should be initiated from the AVL-system.

4.5.1 Message Types

4.5.1.1 Sign On Command

This is a message from PubTrans containing a remote sign on order. The AVL-system should start a process so that an appropriate *Sign On Request* is initiated for the concerned vehicle, if possible.

NOTE: This command might have been initiated by an operation control centre and forwarded to PubTrans for further distribution.

4.5.1.2 Sign Off Command

This is a message from PubTrans containing a remote sign off order. The AVL-system should start a process so that an appropriate *Sign off Request* is initiated for the concerned vehicle, if possible.

NOTE: This command might have been initiated by an operation control centre and forwarded to PubTrans for further distribution.

4.5.2 Content

See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the command was generated.
From Ref	Attribute	Optional attribute. No default value. The name, role-name or initials of the person or system that originally initiated this command.
For Vehicle Ref	Attribute	The vehicle that should be assigned or signed off.
Public Transport Object Ref	Element	The concerned vehicle journey, block, duty or driver.
Consequence of Request Message Id	Attribute	Optional attribute. No default value. Provided if this command was generated in PubTrans as a consequence of a previous request. E.g. a *Block Sign On Request* might initiate several *Vehicle Journey Sign On Commands.*

4.6 Vehicle Journey Info Reports

Vehicle journey info reports are messages to PubTrans containing vehicle journey related information that is not related to the progress of the vehicle journey.

4.6.1 Message Types

4.6.1.1 Passenger Load Report

This message informs PubTrans of the general occupancy level in a vehicle. It can also be used to report the number of boarding or alighting passengers.

4.6.2 Content

See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the report was generated.
Vehicle Ref	Attribute	The concerned vehicle.
Journey Ref	Attribute	Optional attribute. No default value. The concerned vehicle journey, if known. Either expressed as the Vehicle Journey GID or the Vehicle Journey Id according to DOI.
Boarding Count	Attribute	Optional attribute. No default value. The number of passengers boarding at the last stop.
Alighting Count	Attribute	Optional attribute. No default value. The number of passengers alighting at the last stop.
Occupancy Level	Attribute	Optional attribute. No default value. Situation when leaving last stop: Left passengers behind, standing passengers, seats available or empty.
Absolute Position	Element	Optional element. Where the vehicle was when the report was generated.

4.7 Vehicle Info Reports

Vehicle info reports are messages to PubTrans containing vehicle related information that is not related to a specific vehicle journey.

4.7.1 Message Types

4.7.1.1 Emergency Report

This message informs PubTrans that there is an emergency situation in a vehicle.

NOTE: This information will be forwarded from PubTrans to the relevant operation control centre.

4.7.1.2 Lost Contact Report

This message informs PubTrans that the AVL-system has been out of contact with a vehicle for such a long time that forecasts for that vehicle are unreliable.

NOTE: There is no corresponding report to state that the contact to the vehicle has been established again. When the next progress report or extra progress report is sent from the AVL system it is assumed that the validity of the Lost Contact Report is ended

4.7.1.3 Absolute Position Report

This is a message to PubTrans with supplemental information about the absolute position of a vehicle.

NOTE: This information will be forwarded from PubTrans to the operation control centre that initiated the sending of these reports.

4.7.1.4 Text Report

This is a message to PubTrans containing a text message sent from a driver in a vehicle.

NOTE: This information will be forwarded from PubTrans to the relevant operation control centre.

4.7.1.5 Number Report

This is a message to PubTrans containing a number message representing a predefined meaning sent from a driver in a vehicle.

NOTE: This information will be forwarded from PubTrans to the relevant operation control centre.

4.7.2 Content

Note that not all content items below apply to all types of reports and that all items are not included below. See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the report was generated.
Vehicle Ref	Attribute	The concerned vehicle.
Absolute Position	Element	Optional element. Where the vehicle was when the report was generated.

4.8 Vehicle State Requests

These messages are sent from PubTrans to request state and position information about one or several vehicles.

4.8.1 Message Types

4.8.1.1 Vehicle State Request

This message from PubTrans is a request for vehicle state information for a certain vehicle.

NOTE: This information request might have been initiated by an operation control centre and forwarded to PubTrans for further distribution.

4.8.1.2 List Vehicles within Area Request

This message from PubTrans is a request for information about vehicles that are within a certain area and in contact with the AVL-system.

NOTE: This information request might have been initiated by an operation control centre and forwarded to PubTrans for further distribution.

4.8.2 Content

See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the request was generated.
For Vehicle Ref/Rectangle	Attribute/Element	The vehicle selection criteria, either a reference to a specific vehicle or a geographical area.

4.9 Vehicle State Responses

These messages are sent to PubTrans as responses to previous Vehicle State requests.

4.9.1 Message Types

4.9.1.1 Vehicle State Response

This message to PubTrans is a response to the *Vehicle State Request*.

The message contains the current vehicle state for a specific vehicle. It includes the current vehicle journey, absolute position of the vehicle and optionally some additional text information.

NOTE: This information will be forwarded from PubTrans to the operation control centre that requested this information.

4.9.1.2 List Vehicles within Area Response

This message to PubTrans is a response to the *List Vehicles within Area Request*.

The message contains information about all vehicles handled by the reporting AVL-system that are positioned within an area. It includes the current vehicle journey, absolute position and optionally some additional text information for each vehicle.

NOTE: This information will be forwarded from PubTrans to the operation control centre that requested this information.

4.9.2 Content

See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the response was generated.
On Id	Attribute	This attribute contains a reference to the Message Id of the original Request message.
Vehicle State/Vehicle States	Element	Optional element containing vehicle state information. Omitted if information is not available.

4.10 Vehicle Tracking Commands

These messages are sent from PubTrans and contain orders to start or stop the sending of vehicle information reports from the AVL-system.

4.10.1 Message Types

4.10.1.1 Start Tracking Command

This is a message from PubTrans containing an order to start reporting absolute positions for a vehicle.

NOTE: This command might have been initiated by an operation control centre and forwarded to PubTrans for further distribution.

4.10.1.2 Stop Tracking Command

This is a message from PubTrans containing an order to stop reporting absolute positions for a vehicle.

NOTE: This command might have been initiated by an operation control centre and forwarded to PubTrans for further distribution.

4.10.2 Content

Note that not all content items below apply to the stop tracking command. See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the command was generated.
From Ref	Attribute	Optional attribute. No default value. The name, role-name or initials of the person or system that originally initiated this command.
For Vehicle Ref	Attribute	The concerned vehicle.
Reporting Duration	Attribute	Optional attribute. No default value. The maximum period of time, counted from the time in timestamp, for which the reporting should continue. If not provided, reporting should continue until further notice.

Name	Type	Description
Report Interval Duration	Attribute	The interval between each absolute position report.

4.11 Inform Commands

These messages are sent from PubTrans and contain information to be forwarded by the AVL-system for presentation to the driver or the passengers in a vehicle.

4.11.1 Message Types

4.11.1.1 General Inform Command

This is a message from PubTrans that contain general information that should be delivered to the driver and/or passengers in a vehicle.

NOTE: This information might originally have been created in an operation control centre and forwarded to PubTrans for further distribution.

4.11.1.2 Target Stop Point Inform Command

This is a message from PubTrans that contain dynamic stop point allocation information to be presented to the driver of a vehicle.

4.11.1.3 Emergency Acknowledge Inform Command

This is a message from PubTrans containing an acknowledgement that confirms to the driver that the operation control centre have acknowledged that there is an emergency situation in the vehicle.

NOTE: This information might originally have been created in an operation control centre and forwarded to PubTrans for further distribution.

4.11.2 Content

Note that not all content items below apply to all types of reports and that all items are not included below. See the XSD-files for additional details.

Name	Type	Description
Message Id	Attribute	Identification of the message.
Timestamp	Attribute	The time when the message was generated.
From Ref	Attribute	Optional attribute. No default value. The name, role-name or initials of the person or system that originally initiated this message.
For Vehicle Ref	Attribute	The vehicle where the message should be presented.
Message to Driver	Attribute	Optional attribute. No default value. Contains a text message that should be presented to the driver in the vehicle.

Name	Type	Description
Message to Passengers	Attribute	Optional attribute. No default value. Contains a text message that should be presented to the passengers in the vehicle

5 Embedded Elements Reference

This chapter provides additional description of embedded elements.

5.1 Forecasts

5.1.1 Content

See the XSD-files for additional details.

Name	Type	Description
Are Unreliable	Attribute	Optional attribute. Defaults to FALSE. This attribute is used when the AVL-system suspects that forecasts concerning this vehicle journey are unreliable.
Forecast	Element	Optional element. There can be multiple elements. If no Forecast elements are provided, then it is assumed that current data is still valid. Only those elements where the forecast has changed more than a configured duration since last reported needs to be provided.

5.2 Forecast

5.2.1 Content

See the XSD-files for additional details.

Name	Type	Description
Planned Point Ref	Attribute	The concerned journey pattern point (usually a stop point) according to the long term plan. Could also be a virtual journey pattern point if dynamic stop point allocation is used.
Planned Point Visit Count	Attribute	Optional attribute. Defaults to 1. Normally each stop is called only once during a vehicle journey. However, some vehicle journeys have such journey patterns that the same stop is called again. In such instances more information must be provided so that it is possible to distinguish between the first call and consecutive calls. A call referring to the first time a stop occurs in the journey pattern has Visit Count = 1. The next time the same stop is called the value 2 should be used. This attribute should only be provided if Visit Count has the value 2 or more.
Estimated Arrival Date Time	Attribute	Optional attribute. No default value. Omit this attribute if the forecast has not changed more than a configured duration since last reported.
Estimated Departure Date Time	Attribute	Optional attribute. No default value. Omit this attribute if the forecast has not changed more than a configured duration since last reported.

5.3 Absolute Position

5.3.1 Content

See the XSD-files for additional details.

Name	Type	Description
Location System Ref	Attribute	Optional attribute. No default value. Contains a combination of datum and zone if applicable. Should only be supplied if the position is given in another geographical reference system than the default location system. If not provided the default location system as specified in the root element is assumed.
Northing	Attribute	Northing coordinate.
Easting	Attribute	Easting coordinate.
Altitude	Attribute	Optional attribute. No default value.
Age	Attribute	Optional attribute. Defaults to PT0S. This value shows how much older the position information is compared with the timestamp of the message. This could be of relevance in situations where the positioning device is blacked out for a period of time.
Heading	Attribute	Optional attribute. No default value. Indicates the geographical direction that the vehicle is heading. 0 degrees indicates the front of the vehicle is pointing due North. 90 degrees indicates the front of the vehicle is pointing due East.
Speed	Element	Optional element. No default value. How fast the vehicle is travelling.

5.4 Vehicle State

5.4.1 Content

See the XSD-files for additional details.

Name	Type	Description
Vehicle Ref	Attribute	The concerned vehicle.
Journey Ref	Attribute	Optional attribute. No default value. The current vehicle journey, if known. Either expressed as the Vehicle Journey GID or the Vehicle Journey Id according to DOI.
Additional Info	Attribute	Optional attribute. No default value. Implementation specific state information.
Absolute Position	Element	Optional element. The last known geographical position of the vehicle. Omitted if the position is unknown.

5.5 Arrival

This embedded element is used in the target stop point inform command.

5.5.1 Content

See the XSD-files for additional details.

Name	Type	Description
Journey Ref	Attribute	The concerned vehicle journey.
Planned Point Ref	Attribute	The concerned journey pattern point (usually a stop point) according to the long term plan. Could also be a virtual journey pattern point.
Planned Point Visit Count	Attribute	Optional attribute. Defaults to 1. Normally each stop is called only once during a vehicle journey. However, some vehicle journeys have such journey patterns that the same stop is called again. In such instances more information must be provided so that it is possible to distinguish between the first call and consecutive calls. A call referring to the first time a stop occurs in the journey pattern has Visit Count = 1. The next time the same stop is called the value 2 should be used. This attribute should only be provided if Visit Count has the value 2 or more.
Target Point Ref	Attribute	Optional attribute. No default value. The allocated stop point for disembarking passengers. If omitted it is assumed that the long term planned point is targeted.
Latest Date Time	Attribute	Optional attribute. No default value. Aimed latest arrival time. If omitted it is assumed that the long term planned latest arrival time is still valid.
Earliest Date Time	Attribute	Optional attribute. No default value. Stop point available from this time. If omitted it is assumed that there is no restriction on how early the vehicle is allowed to arrive.

5.6 Departure

This embedded element is used in the target stop point inform command.

5.6.1 Content

See the XSD-files for additional details.

Name	Type	Description
Journey Ref	Attribute	The concerned vehicle journey.
Planned Point Ref	Attribute	The concerned journey pattern point (usually a stop point) according to the long term plan. Could also be a virtual journey pattern point.

Name	Type	Description
Planned Point Visit Count	Attribute	Optional attribute. Defaults to 1.Normally each stop is called only once during a vehicle journey. However, some vehicle journeys have such journey patterns that the same stop is called again. In such instances more information must be provided so that it is possible to distinguish between the first call and consecutive calls. A call referring to the first time a stop occurs in the journey pattern has Visit Count = 1. The next time the same stop is called the value 2 should be used. This attribute should only be provided if Visit Count has the value 2 or more.
Target Point Ref	Attribute	Optional attribute. No default value. The allocated stop point for boarding passengers. If omitted it is assumed that the long term planned point is targeted.
Earliest Date Time	Attribute	Optional attribute. No default value. The earliest permitted departure time. If omitted it is assumed that the long term planned earliest departure time is still valid.
Latest Date Time	Attribute	Optional attribute. No default value. Stop point is not available after this time. If omitted it is assumed that there is no specific restriction on how long the vehicle may occupy the stop point.

5.7 Rectangle

A rectangle element describes a rectangular geographical area. The coordinates of two opposite corners define the rectangular area, one position for the northwest corner and one for the southeast corner.

5.7.1 Content

See the XSD-files for additional details.

Name	Type	Description
North West Position	Element	The upper left corner position of the encompassing area.
South East Position	Element	The lower right corner position of the encompassing area.

5.8 Position

5.8.1 Content

See the XSD-files for additional details.

Name	Type	Description
Location System Ref	Attribute	Optional attribute. No default value. Contains a combination of datum and zone if applicable. Should only be supplied if the position is given in another geographical reference system than the default location system. If not provided the default location system as specified in the root element is assumed.
Northing	Attribute	Northing coordinate.
Easting	Attribute	Easting coordinate.

Appendixes

1 Using XML-Streams

XML-streams are a simple and efficient way to exchange XML-data over a TCP-connection. All messages are sent as XML elements inside an indefinitely long XML document. The end tag of the XML document is transmitted just prior to the shutdown of the TCP/IP connection.

1.1 Terminology

The following terminology is used in this appendix.

Term	Meaning
Client	The peer that is configured to initiate (and at failure re-initiate) the communication. This could be either PubTrans or the External system.
External system	The external application that is communicating with PubTrans over the XML-stream.
Message batch	The sequence of messages sent from one peer to another.
Peer	The application at each end of the communication link, i.e. PubTrans and the External system.
PubTrans	The PubTrans server application that an External system is communicating with over the XML-stream.
Request	A message sent by one peer to the other as a request to process data provided in the message.
Response	A message from the peer that processed a request sent to the requesting peer with information about the result of the request. If an error occurred, it will be an Error Response.
Server	The peer that responds to incoming requests to initiate the communication.

1.2 Concepts

XML-stream concept uses a generic concept of request and response messages sent as XML-formatted messages over a TCP-connection. The definition of the generic mechanism for message exchange is separated from the definition of actual payload.

The payload is hooked into the XML-stream message model by deriving the payload messages from the Message element type.

1.3 Requirements

In order to use XML-streaming, a peer must fulfil the requirements described in this section.

1.3.1 Communication

The peer must be able to communicate with the other peer over a TCP-connection. The TCP-connection must have sufficient bandwidth.

1.3.2 Security

For increased security, the XML-streams TCP-connection can be established using Secure Sockets Layer (SSL) or the newer Transport Layer Security (TLS). It is the system administrator that defines the requirements for using SSL/TLS.

If it is the connection itself that shall be protected, it is sufficient that only the server shall have a certificate. If it is required to authenticate the clients, each client must also have a certificate. If it is not required to identify them uniquely, only that a client is authorised, then the clients can all share the same certificate.

NOTE: PubTrans only supports SSL/TSL for protection of the connection. Client identification is currently not supported.

1.3.3 XML Parser Type

A peer application must use an XML-parser that can deliver each element for further processing as they arrive. This means that it should be a SAX-parser or similar. A DOM-parser will not work, because it requires that a complete document is loaded before further processing can occur.

1.4 Configuration

Before configuring the communication, it has to be decided which peer that shall act as a client. Normally an External system acts as client and PubTrans as a server, but in some scenarios it is necessary to configure PubTrans to be the client.

NOTE: PubTrans does not currently support acting as a client.

1.4.1 Server Configuration

The system administrator decides the *IP address* and *port number* where the server will be available. When running, the server process shall listen on this port for incoming TCP/IP-connection requests. The server should also be configured with a unique *peer id*.

1.4.2 Client Configuration

The client needs to be configured with the servers *IP address* and *port number*. The client should also be configured with a unique *peer id*.

1.4.3 Data encoding

Definition and detection of the text encoding of the XML-stream should follow relevant standards for XML-documents. The used encoding must be agreed for each implementation. Missing definition of encoding will be interpreted as UNICODE.

1.5 Initialisation

1.5.1 Example of Initialisation

This example shows how a session is initialised for one of the PubTrans public interfaces, RII.

1.5.1.1 Client Request

The client always initialises the communication by opening a TCP/IP socket to the server on the port defined for the specific installation.

When the TCP/IP connection is established, the client starts the streaming by sending the initial part of the XML-stream.

```
<?xml version="1.0" encoding="UTF-8"?>
```

This is then followed by the initial root element:

```
<RII:ToPubTransMessages
  xmlns:RII="http://www.usergroup.pubtrans.com/RII/2.0"
  xmlns:PT="http://www.usergroup.pubtrans.com/PT/1.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.usergroup.pubtrans.com/RII/2.0 RII-
ToPubTrans.xsd"
  PeerId="OCS_H1"
  LastProcessedMessageId="3976"
  DocumentLayoutVersion="2.0.0"
  MaxMessageInterval="PT60S"
>
```

1.5.1.2 Server Response

If the client is authorised, the server accepts the TCP-connection and replies in a similar way:

```
<?xml version="1.0" encoding="UTF-8"?>
```

This then is followed by:

```
<RII:FromPubTransMessages
  xmlns:RII="http://www.usergroup.pubtrans.com/RII/2.0"
  xmlns:PT="http://www.usergroup.pubtrans.com/PT/1.0"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.usergroup.pubtrans.com/RII/2.0 RII-
FromPubTrans.xsd"
  PeerId="PubTrans01"
  LastProcessedMessageId="6612518"
  DocumentLayoutVersion="2.0.0"
  MaxMessageInterval="PT60S"
>
```

1.5.2 Attributes

Some of the attributes in the samples above are specific for the XML-stream transport mechanism, and other are specific to the PubTrans interface. Declaration of namespaces and document layout version is specific for each interface; peer id, last processed message id and max message interval is specific for the XML-stream. The XML-stream attributes are explained below.

1.5.2.1 Peer Id

The *peer id* is the session identity of a peer. The peer id must be a unique identifier in the context of the other peer, and must be agreed upon for each implementation.

1.5.2.2 Last Processed Message Id

The *last processed message id* contains a reference to the last successfully received message from the opposite peer, i.e. on the parallel stream working in the opposite direction. This attribute is optional and can be omitted if no messages have been processed yet or if the peer does not support this function.

If a *last processed message id* is provided, the application at the other peer shall re-transmit only the messages that are newer than the message with the specified id. If the *last processed message id* is not provided it is up to the implementation to decide what messages that should be transmitted. Specifically, a decision must be taken for how long time back in time the applications shall recover the communication.

1.5.2.3 Max Message Interval

If no message has been sent after half this time interval, an Idle message must be sent. If at the receiving end, no message has been received within the time interval, the receiver shall try to send an error message followed by the closing root element and then terminate the connection. It is the client that is responsible for re-establishing the connection regardless which peer that detects a time-out.

1.6 Termination

1.6.1 Normal

The message stream can be terminated by either peer. A peer request to terminate the connection by sending the closing element that corresponds to the opening element:

```
</ToPubTransMessages>
```

Then the peer waits for the other peer to respond with its closing element:

```
</FromPubTransMessages>
```

After this confirmation, the client can close the socket.

1.6.2 Abnormal

If an error occurs, the TCP/IP-connection should be closed and the client should try to re-establish it. Possible errors are defined in section 1.8.

It is recommended that all causes for abnormal termination are logged and that it is possible for a system administrator to be alerted in real time.

1.7 Message Exchange

1.7.1 Timestamp Sequence Order

Time stamped messages can be sent in any order to PubTrans. However, if two messages with timestamps concerning the same object arrive in the wrong time sequence, PubTrans may process the ‘late’ message different, because of the wrong time sequence.

1.7.2 Id Sequence Order

The Id of a message shall at least be unique per session. The Id can have any value and PubTrans does not assume any implicit order of Id. However, it is important that the External system internally keep track of its sequence of messages so it can understand how long processing has been acknowledged when PubTrans provides the *last processed message id* at re-connection.

1.7.3 Message Response

Some types of messages require responses. To optimise performance, a client can send messages without waiting for response on each message. Instead responses are processes asynchronously. Using asynchronous message responses put some requirements on the client application:

- The client application must keep a state for all sent but not yet acknowledged messages.
- If a response is not received within a configurable *response time out* time, the message shall be regarded as not received by PubTrans. Client behaviour in this case is implementation specific.

1.7.4 Keep-alive

If no other messages are sent, each peer must ensure that a connection is alive and send an idle message at the interval specified by the other peer in the attribute *max message interval*. This is explained in section 1.5.2.3 above.

1.7.5 Last processed message

It is possible for a peer to ask the other peer what message the other peer has last received and processed.

The other peer answers this message with a corresponding LastProcessedMessageResponse message containing the *last processed message id*.

1.8 Error Handling

Generally, both peers should be able to handle all error situations mentioned in this section.

1.8.1 TCP-connection Cannot Be Established

When a client is not connected to the server (regardless of the cause: closed, crashed, not connected yet), the client shall continuously try to connect to the server until the connection is established.

However, in order to reduce the load in the reconnection process the client should implement a retry-scheme for re-establishing the TCP-connection. Such a scheme can include retries for a specified number of times with a short delay between each attempt.

1.8.2 Error Writing On the TCP-Socket

In this case the peer closes the socket without sending any information. The other peer will detect the situation due to the timeout mechanism (if not reported by the socket API). The client then tries to re-establish the TCP-connection again.

1.8.3 SSL or TLS Protocol Error

This error indicates that the client cannot connect using SSL or TLS. In this case the client closes the socket without sending any information.

The client should log this error, and then try to re-establish the connection again.

1.8.4 Time Out

A peer shall monitor the time out of a connection. The connection should be considered broken if no message is received after a configurable *maximum idle- time* value.

When a peer detects a time out, it shall try to send an error message followed by the closing root element and then terminate the connection.

It is the client that is responsible for re-establishing the connection regardless which peer that detects a time-out.

1.8.5 Schema Version Not Supported

If a peer cannot support a schema version, the peer shall send a sequence consisting of the opening root element, an error report, the closing root element, and then close the TCP-connection. It is also recommended that the system administrator is alerted. This can be a configuration error or require a software update.

PubTrans support parallel versions, i.e. an External system can request that a specific schema version is used.

1.8.6 Error in Parsing and Validating XML Data

If a peer detects errors in XML parsing or XSD validation, the peer shall send an error message followed by the closing root element and then close the TCP-connection. If the schema definition supports it, an error response can be sent just before the closing root element.

1.8.7 Error in Data Format

Even if data is valid from a schema definition point of view, a peer can detect that the data provided for some other reason is not consistent with data format required. This error can for instance occur if reference data in a peer is erroneous or that data conflicts with integrity rules. In this case the peer shall send an error message.

This type of error can be an indication of that reference data is out of synch between the two peers. It is therefore recommended that these types of errors are logged and optionally alerted to the system administrator.

1.9 Error Types

Each interface has its own set of error codes. General types of errors using an XML-stream are listed below.

Error type	Error codes	Meaning
INTERNALERROR	100	An internal error has occurred.
TIMEOUT	101	

Error type	Error codes	Meaning
SERVICECLOSED	102	The service is closed, or will be closed.
NOTUNDERSTOOD	110	The XML is not understood because t is not well formed.
NOTUNDERSTOOD	111	The XML is not understood because it is not valid according to the schema definition.
NOTUNDERSTOOD	112	Requested schema version is not supported.
NOTSUPPORTED	Custom	An element or attribute is not supported.
NOTSUCCEDED	Custom	The operation could not be carried out for some reason.
NOTPERMITTED	Custom	The operation is not permitted.

Each interface defines a common set of custom error codes. In addition, each implementation may require additional error codes. The principle is that an error code should represent one type of error specific enough to locate the error.

1.10 Logging

In order to monitor the communication between the peers, it is recommended that both peers as minimum implement the following logging:

- Application software version, build version.
- Version of the schema definition file used to parse the XML-stream.
- Errors that occur with time and reason. Faults which do not cause errors should be logged with a less severity.

2 VSI Specific Error Codes

The table below shows the details of VSI specific error responses. It is sorted by **error codes**, where:

- 200 series contains Journey Progress Report errors
- 300 series contains errors on Assignment requests.

Code	Type	Text	Comment
200	NOTSUCCEDED	JourneyRef not found.	Occurs when a Journey Ref does not match the identity of any journeys in the system implementing the VSI server.
201	NOTSUCCEDED	No calls found for the journey.	Occurs when there are no calls on the journey specified by JourneyRef.
202	NOTSUCCEDED	PointRef not found on the journey.	Occurs when there is no match for the given Point Ref on the given Journey Ref.
203	NOTSUCCEDED	RepeatedCallSequence for the call on the journey not found.	Occurs when Point Ref exists on the journey but Repeated Call Sequence is incorrect.
230	NOTSUCCEDED	Last journey pattern point on this journey has already been reached.	Occurs when a DelayReport refers to the last point on the journey. Then there no calls left to change the prognosis for and therefore the report is of no value.
300	NOTGRANTED	PlannedStartDateTime exceeds PlannedEndDateTime.	Occurs when the PlannedStartDateTime for a SignOnRequest exceeds the PlannedEndDateTime.
310	NOTSUCCEDED	Vehicle not found in PubTrans.	Occurs when a SignOnRequest have PublicTransportObjectRef set to a vehicle that does not exist in the VSI server system.
321	NOTGRANTED	Block is already signed to another vehicle.	Occurs when the block is already signed on to a vehicle and the vehicle is different from the requested one.

Global Identifiers

PubTrans uses a numbering convention called *Global Identifiers* or *GID* for short. A GID is a numeric identifier that has the same value for the same object across all installations of PubTrans databases. GID is used extensively in the interfaces as keys for referring to PubTrans objects. It is assumed that a client application can map its internal data model to the proper GID when exchanging data with PubTrans.

GID Construction

A GID is a 16-digit number. Currently, there are two main types of GID:

- Key-based: A 16-digit number constructed by concatenating numeric attributes associated with the object. Key based GIDs starts with the number '9'.
- Abstract: A 16-digit number that does not contain any special meaning. An abstract GID does not start with the number '9'.

Key based GID

Key based GIDs consist of a four-digit class identifier, a three-digit Transport Authority number and a 9-digit value divided into one or several fields.

Each field contains a numeric attribute data from the object. The fields have different representation for each class; either constructed by concatenating numeric attributes of the object in question or as an abstract number that does not contain any special meaning. This is explained for each type of GID below.

A key based GID is defined in the context of a Transport Authority, i.e. it is unique within a Transport Authority. If an object is referenced by more that one Transport Authority, it will have a GID for each Transport Authority. Thus, it is possible that several different GIDs refer the same object in PubTrans.

A GID is uniquely referring zero or one object version at a specific point in time, but the same GID may refer different object versions at different times.

Each field has two reserved values; zero that means 'unknown' and an all-9-value which is reserved for testing purposes. A GID with a zero-field does not refer any object. The zero-value field is used in some cases to let PubTrans assign the field automatically. A GID with an all-9-value shall only be used for test purposes.

Abstract GID

An abstract GID is a non-descriptive 16-digit number. An abstract GID is always less than 9000000000000000. Abstract GIDs are assigned automatically by PubTrans. Because abstract GIDs are not based on key data provided from external systems, there is no way to see if two abstract GIDs from different PubTrans database instances represents the same object or not. In fact, abstract GIDs in different PubTrans databases never overlap, because an abstract GID is globally unique within a PubTrans group.

Object Types with GID

The following object types (classes) have global identifiers in PubTrans.

Class Id	Class id
Block	9041
Bridging Device	9095
Contractor	9013
Dead Run	9016
Deviation Case	9076
Deviation Message	9071
Direction (Direction of Line)	9014
Direction of Line (obsolete)	*9012*
Duty	9061
Employee	9051
Journey Pattern Point	9025
Line	9011
Place	9091
Service Journey	9015
Station Entrance Point	9023
Stop Area	9021
Stop Point	9022
Transport Authority	9010
Vehicle	9031
Virtual Vehicle	9038
Zone	9081

GID Format

Bold numbers indicates fixed values, and *italic* numbers indicate variable fields.

Transport Authority

9	**0**	**1**	**0**	*1*	*2*	*3*	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Class Id				Transport Authority Number			Not Used								

A *transport authority numb*er must be between 1 and 998.

Transport authority numbers should be coordinated between co-operating transport authorities, preferably on a national level.

Line

9	**0**	**1**	**1**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	**0**	**0**	**0**	**0**	**0**
Class Id				Transport Authority Number			Line Number				Not used				

A *line number* must be between 1 and 9998. The line number must be unique within a transport authority.

A line number is not necessarily the number presented to the public. In PubTrans, the public identification of the line is called *line designation*, which is a separate attribute from the line number.

If alphanumeric characters are used in the public identification of the line, it is necessary to define a numeric counterpart for use in GID, which can be considered as an internal alternative identification of the line.

If a line is operated by more that one transport authority (split responsibility), the line will have one GID per transport authority, with different transport authority number for, but preferably with same line number.

Direction of Line (old format)

This GID is obsolete in PubTrans 5. It will be supported in DOI 3 for backwards compatibility. It is replaced by the GID described in section 0 below.

9	**0**	**1**	**2**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*1*	**0**	**0**	**0**	**0**
Class Id				Transport Authority Number			Line Number				Direction	Not used			

A *direction-of-line number* must be 0 or 1.

Direction of line is used to separate journey patterns and routes into two main groups running in opposite directions.

Contractor

9	0	1	3	*1*	*2*	*3*	*1*	*2*	*3*	*4*	0	0	0	0	0
Class Id				Transport Authority Number			Contractor Number				Not Used				

A *contractor number* must be between 1 and 9998. A contractor number must be unique within a transport authority.

The contractor number denotes a vehicle operator organisation that is engaged to operate public transportation within a region governed by a transport authority. If the same vehicle operators are engaged by several transport authorities, they will have a GID within each transport authority.

It is assumed that it is the transport authority that coordinates and assigns the contractor number for each engaged vehicle operator.

Direction (Direction of Line)

This GID replaces the direction of line GID in section 0 above and will be used in PubTrans 5 and in DOI 4. The terms *direction* and *direction of line* are used interchangeably.

9	0	1	4	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*1*	0	0	0	0
Class Id				Transport Authority Number			Line Number				Direction	Not used			

A *direction number* must be 1 (corresponding to 1 in the obsolete direction of line GID format) or 2 (corresponding to 0 in the obsolete direction of line GID format).

Direction (of line) is used to separate journey patterns and routes into two main groups running in opposite directions.

Service Journey

9	0	1	5	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*5*
Class Id				Transport Authority Number			Line Number				Journey Number				

A *service journey number* must be between 1 and 99998. A service journey number must be unique within a line and for a specific operating day.

The service journey GID uniquely defines a service journey within PubTrans. If it is important to retain the service journey GID over time, it is strongly recommended to avoid renumbering of the service journeys in the source system each time data is provided to PubTrans.

Dead Run

9	**0**	**1**	**6**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*5*
Class Id				Transport Authority Number			Contractor Number				Dead Run Number				

A *dead run number* must be between 1 and 99998. In the context of one transport authority, a dead run number must be unique within the contractor for a specific operating day.

Dead run numbers can be assigned sequentially over time to avoid duplicate numbers.

Stop Area

9	**0**	**2**	**1**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*5*	*6*	**0**	**0**	**0**
Class Id				Transport Authority Number			Stop Area Number						Not used		

A *stop area number* must be between 1 and 999998. A stop area number must be unique within a transport authority.

In PubTrans it is possible to define a stop area that can be utilised by several transport authorities. If several transport authorities share the operation at a stop area, they can assign a GID each.

Stop Point

9	**0**	**2**	**2**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*5*	*6*	*1*	*2*	*3*
Class Id				Transport Authority Number			Stop Area Number						Local Stop Point Number		

A *local stop point number* must be between 1 and 998. A local stop point number must be unique within a stop area.

This is the local number within the stop area assigned to each stop point, e.g. track or gate number. There is also a GID for globally numbering of stop points within a transport authority, see Journey Pattern Point in section 0 below.

Station Entrance Point

9	**0**	**2**	**3**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*5*	*6*	*1*	*2*	*3*
Class Id				Transport Authority Number			Stop Area Number						Local Station Entrance Number		

A *local station entrance point number* must be between 1 and 998. A local station entrance point number must be unique within a stop area.

Journey Pattern Point

9	**0**	**2**	**5**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Class Id				Transport Authority Number			Journey Pattern Point Number								

A *journey pattern point number* must be between 1 and 999 999 998. A journey pattern point number must be unique within a transport authority.

A journey pattern point is any type of point that can occur in a journey pattern, i.e. a point that can be used as a reference point in a scheduling system. Journey pattern points are: stop points, via-points and parking points. The journey pattern point number usually corresponds to a stop number.

Vehicle

9	**0**	**3**	**1**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*5*
Class Id				Transport Authority Number			Contractor Number				Vehicle Number				

A *vehicle number* must be between 1 and 99 998. In the context of one transport authority, a vehicle number must be unique within a contractor.

If a vehicle is identified in context of more than one transport authority, a vehicle will have a GID for each transport authority.

If a vehicle becomes operated by another vehicle operator (usually as a change of ownership) and still is in the context of a transport authority using PubTrans, the vehicle will get a new GID, because the contractor number will change. Probably the vehicle number as well, because each vehicle operator assigns internal vehicle numbers. Thus, a vehicle GID is not an identifier for the physical vehicle. However, PubTrans can handle several vehicle-GIDs referencing to one physical vehicle if some other identifier for the physical vehicle is provided at import of vehicle data.

Virtual Vehicle

9	**0**	**3**	**8**	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Class Id				Virtual Vehicle Number											

A *virtual vehicle number* must be between 1 and 999 999 999 998. A virtual vehicle number corresponds to one vehicle within one PubTrans system at a certain point in time.

Virtual vehicle numbers are used as temporary vehicle-identifier tags when information about the actual vehicle numbers is not available. Virtual vehicle numbers should only be used when it is not possible to use actual vehicle numbers. If virtual vehicle numbers are used, then it is preferable that a virtual vehicle number is attached for as long as possible to a certain vehicle.

Block

9	**0**	**4**	**1**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*5*
Class Id				Transport Authority Number			Contractor Number				Block Number				

A *block number* must be between 1 and 99998. In the context of one transport authority, a block number must be unique within a contractor.

Employee

9	**0**	**5**	**1**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*5*
Class Id				Transport Authority Number			Contractor Number				Employee Number				

An *employee number* must be between 1 and 99998. In the context of one transport authority, an employee number must be unique within a contractor.

The employee GID is mostly used to identify drivers within different vehicle operators.

Duty

9	**0**	**6**	**1**	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*5*
Class Id				Transport Authority Number			Contractor Number				Duty Number				

A *duty number* must be between 1 and 99998. In the context of one transport authority, a duty number must be unique within a contractor.

Deviation Message

9	**0**	**7**	**1**	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*5*	*6*
Class Id				Transport Authority Number			Message System Number			Message Number					

A deviation message GID consists of two parts: a *message system number* that must be between 1 and 998, and a *deviation message number* that must be between 1 and 999998.

The message system number identifies the source system of the message and the message number is a unique identifier of the deviation message within that system. Both numbers are assigned sequentially by PubTrans

NOTE: In PubTrans 4 a valid message system number can be zero.

Deviation Case

9	**0**	**7**	**6**	*1*	*2*	*3*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Class Id				Transport Authority Number			Not used	Deviation Case Number							

A deviation case number must be between 1 and 99999998.

The deviation case number is assigned sequentially by PubTrans

Zone

9	**0**	**8**	**1**	**1**	**2**	**3**	**1**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Class Id				Transport Authority Number			Type of Zone Number	Zone Number							

A zone GID consists of two parts: a *type-of zone-number* that must be between 1 and 98, and a *zone number* that must be between 1 and 9 999 998.

The following zone type numbers is reserved:

Zone type	Usage
10	Administrative zone of transport authority.
11	Local administrative zone (corresponding to Swedish 'kommun').
12	Regional administrative zone (corresponding to Swedish 'län').
13-19	Custom defined administrative zone types.
20	Tariff zones.
21-29	Custom defined additional tariff zone types. Can be used if different types of tariff zones are used in parallel.
30-39	Custom analysis zone types.
40-49	Custom technical systems zone type, e.g. radio coverage zones.
50-89	Reserved for future use
90-98	Reserved for system supplier specific use.

Place

9	**0**	**9**	**1**	*1*	*2*	*3*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Class Id				Transport Authority Number			Not used	Place Number							

A *place number* must be between 1 and 99 999 998 and must be unique within a transport authority.

Bridging Device

9	0	9	5	*1*	*2*	*3*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Class Id				Transport Authority Number			Bridging Device Number								

A *bridging device number* must be between 1 and 999 999 998, both values inclusive. The values 0 and 999 999 999 are reserved for special purposes. A bridging device number must be unique within a transport authority.