SBB CFF FFS

SBB interface specification 04/2018

VDV 453 – Version 2.8.2 (CUS 5.9)

ANS - Connection Monitoring Service
DFI - Stop Monitoring Service
VIS - Vehicle Monitoring Service
AND - General Message Service

Overall processing:
ε **SBB CFF FFS**
Swiss Federal Railways SBB
Informatics – Infrastructure Solution Centre – Customer Information
"VDV Customer Information and Further Development Projects" team

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Contents

Change history from V 2.5 to 2.6

Location	Change	Author	Date
General	The distinction between “CUS as a data hub” and “CUS as a railway data producer” is described in various chapters.	J. Wichtermann	22.03.2017
General	When XSD elements are described, only changes to VDV-RV 453 are now documented.	J. Wichtermann	22.03.2017
6.1.13, 6.2.4.2, 6.2.4.3.1 6.3.8.2, 6.3.8.3.1 6.3.8.3.5	Redundancies to VDV-RV 453 removed. In structures, only the deviations to the RV are now shown.	J. Wichtermann	22.03.2017
1.1 Version number removed	Version number removed; this information is already shown in chapter 8.1	J. Wichtermann	22.03.2017
1.2.1 Version number removed	Version number removed; this information is already shown in chapter 8.1	J. Wichtermann	22.03.2017
1.2.4 Distinction of client / server and data hub / railway data producer	New text added	J. Wichtermann	22.03.2017
1.2.5 Different data hub / data producer processing logic	New chapter added	J. Wichtermann	22.03.2017
1.4 Services supported by SBB	Text added	J. Wichtermann	22.03.2017
2.1.3.1	Various clarifications.	J. Wichtermann	22.03.2017
2.2.2	New Service Level Agreement 2017 – 2020 added.	J. Wichtermann	22.03.2017
5.1.2.1	Unnecessary text removed.	J. Wichtermann	22.03.2017

Location	Change	Author	Date
5.1.2.2 Subscription confirmation	More precise detail added.	J. Wichtermann	22.03.2017
6.1.5 Trip References (FahrtBezeichner)	The description for the trip reference was moved to RV-ÖV-CH and was therefore removed from this specification. Text about compatibility simplified.	J. Wichtermann	25.01.2017
6.1.7	More precise detail added for product types.	J. Wichtermann	22.03.2017

Change history from V 2.6 to 2.7

Location	Change	Author	Date
6.1.13	Element LinienfahrwegID added to FahrtInfo	J. Wichtermann	07.09.2017

Change history from V 2.7 to 2.8

Location	Change	Author	Date
6.1.6.1	New format for LinienID is like LinienText. It is possible that Abo-Filter need to be changed.	J. Wichtermann	14.11.2017
6.2.4.2	CUS supports now Zubringerinformation, but not Abbringerinformation.	J. Wichtermann	10.02.2018
6.2.4.2.2	Vorschauzeit can be set by a property if not transmitted	J. Wichtermann	10.02.2018
6.2.4.3.1	CUS supports now Zubringerinformation, but not Abbringerinformation.	J. Wichtermann	10.02.2018
10	This documents are not available anymore.	J. Wichtermann	10.02.2018

Change history from V 2.8 to 2.8.1

Location	Change	Author	Date
1.4, 3.1.1 6.2.4	CUS supports now Zubringerinformation, but not Abbringerinformation.	J. Wichtermann	05.04.2018
2.1.2	Chapter removed	J. Wichtermann	05.04.2018

1. Foreword

1.1. Supported versions

SBB here complies with the "VDV-RV 453" (=$_{eng.}$ VDV 453 Implementation specifications for public transport in Switzerland version 1.0) (see [1]).

In addition, SBB has produced its own XSD which is downwards-compatible with the official Version 2015a but will also take account of the stricter requirements (mandatory fields instead of optional fields) described in this document. On request, SBB will be happy to make this modified XSD version available to any interested partners.

Although the official XSD published by the VDV committee can be used for validation of the messages, it is not adequate for handling the additional mandatory fields specified by SBB. It is recommended that the XSD version adapted by SBB be applied.

1.2. Document structure and the limits to its scope

1.2.1. Demarcation

The current SBB-VDV 453 Interface specification describes the differences and concretisation of the VDV interface operated by SBB with reference to the "VDV 453-Realisierungsvorgaben öV Schweiz" (VDV-RV 453) officially applicable in Switzerland [1].

As VDV-RV 453 follows standard VDV-Schrift 453 "Ist-Daten-Schnittstelle" (=$_{eng.}$ Real Time Interface VDV 453 Actual data interface version 2.3.2) [2] strictly, as published by the "Verein Deutscher Verkehrsunternehmen" (VDV) (=$_{eng.}$ Association of German Transport Companies), knowledge of this document is also a prerequisite for understanding the present specification.

Partners wishing to use this interface to draw down data from SBB or to supply their own data to SBB must, in order to ensure correct operation of the interface, adapt their own VDV implementation to the specification details described here.

This document should not be considered a legal contract. The contractual situation between two partners and/or their suppliers is not part of this document.

1.2.2. Uniform section structure

SBB's VDV interface follows VDV-RV 453[1] and standard VDV 453 [2] as closely as possible. Consequently, from section 2 onwards, this document systematically adopts the same section structure as the two documents and strictly limits itself to a description of any variations from and changes to the SBB-VDV implementation of VDV-RV 453. This makes it easy to compare the official specifications and the present SBB specification.

Thus this document supersedes **neither** VDV-RV 453 **nor** standard VDV 453. Neither does this document contain all the information that would be necessary to implement or understand the VDV453 interface. It is assumed that the reader is familiar with the details of both documents referred to.

To be more precise:

- In general, "VDV 453-Realisierungsvorgaben öV Schweiz" (VDV-RV 453) shall apply. The statements and specifications there are not repeated in this document[1].
- Should there be no changes to the referenced "VDV453 implementation specifications for" Switzerland "in a complete (sub) chapter, this is marked with a reference in the form" (see VDV-RV 453) ".
- In cases where, due to the special situation of SBB, a deviation from VDV-RV 453 or VDV 453 is necessary, this will be specifically described in the relevant section.
- The structures and the scope of the master data for data exchange between VDV partners that are not already defined in VDV-RV 453, are described in detail in the relevant sections of this document[2].

The layout of the sections is identical except as follows:

Where there is a need for some additional clarification or explanation that would not fit into the original structure of the document, a separate section has been inserted at the end of the relevant subsection. The title of this new section is marked with the words "(***extended by SBB***)". There is, therefore, no equivalent section in "VDV 453-Realisierungsvorgaben öV Schweiz" to any such additionally inserted section (including any sub-section) and because these sections are placed at the end of each relevant section, it does not affect the order in which the subsequent sections appear.

1.2.3. Mandatory, optional and non-supported fields

The last column in the tables, which describe the XML structure of a data element, specifies whether an element must be stated, can be stated or is not supported. The value is shown in red if the use of an element differs from the VDV-RV 453.

mandatory	Element must be stated in the XML structure **and** it may not be empty. Exception: An empty specification is permitted if "empty" has a correct semantic meaning. This is then explicitly stated in the specification.
optional	Element can be stated or be absent. An element that is stated can also be empty.
n/a	Element is not supported. The content will be ignored if it is stated. (technically it is an optional field)

Table 1: Mandatory and optional fields

1.2.4. Distinction of server and client *(expanded SBB text)*

It is sometimes important to distinguish whether CUS functions as a data retriever (client) or a data supplier (server) in relation to the service in question. The relevant sections are marked as follows:

CUS as a data supplier:

- "CUS as a data hub – DH (server)" *(standard, not indicated)*
- "CUS as a railway data producer – RDP (server)" *(indicated)*

CUS as a data retriever:

[1] [6] The actual time of the first message may be delayed by up to 5 minutes because of the technology used.

[6] The actual time of the first message may be delayed by up to 5 minutes because of the technology used.

- "CUS as a data hub – DH (client)" *(standard, not indicated)*
- "CUS as a railway data producer – RDP (client)" *(indicated)*

1.2.5. Differences in data hub / data producer processing logic

CUS as a data hub – DH (Client/Server)

CUS as a data hub generally supports all elements of VDV-Schrift 453; exceptions are defined in the individual chapters under "CUS as a data hub – DH (Client/Server)".

In the case of CUS as a data hub / railway data producer, the contents of the elements are, with a few exceptions, not checked to ensure that they are correct and are forwarded without any changes. Responsibility for ensuring the quality of the data supplied lies with the supplier of the data and not with the data hub.

In the case of CUS as a railway data producer, the data for the individual services (DFI, ANS) is stored separately. If one element which is relevant to multiple services changes, the change must be individually transmitted for each service.

CUS as a railway data producer – RDP (Client / Server)

CUS as a data producer only supports the elements of VDV-Schrift 453 defined in this document.

1.2.6. References to VDV453-RV and VDV 453

Apart from a few exceptions, this specification will only refer to VDV453-RV [1] below. As VDV453-RV refers directly to VDV 453[2], a reference to VDV453-RV is thus simultaneously also an indirect reference to standard VDV 453. Knowledge of both documents is an prerequisite for understanding this specification.

1.3. Compulsoriness

This VDV interface specification describes how SBB will apply the VDV-RV 453 and the underlying standard VDV 453 respectively in practice. It forms the basis for agreements on the VDV links between the SBB and its public transport partners for exchanging data relating to Connection Protection and Dynamic Passenger Information.

1.4. VDV services supported by SBB

SBB does not implement all the services provided for in standard VDV 453. The services supported by SBB are listed in the table below. The services are largely independent of each other and allow each of the partners to make separate use of them.

Service	Supported by SBB	Comments
Reference data service for connection protection (REF-ANS)	No	• Exchange of the planning timetables and trip reference for guaranteeing connections

Process data service for connection protection (ANS)	**Yes, partially supported**	• Exchange of actual data for connection protection • This service is practically only of relevance where SBB provides the feeder service (on SBB side, no connection protection from partner-vehicles to SBB-vehicles is implemented). • Fetcher messages are neither received nor sent. • Time-referenced subscription is supported, only
Reference data service for passenger information (REF-DFI)	No	• Exchange of location-referenced planning timetables and trip reference for passenger information
Process data service for passenger information (DFI)	**Yes**	• Exchange of location-referenced actual data for passenger information • This service has been implemented in both directions
Process data service for visualisation (VIS)	No	• Exchange of actual data for visualising vehicles in external control centres
General message service (AND)	No	• Exchange of textual information about the operational status between control centres

Table 2: VDV 453 services supported by SBB

2. Background

2.1. The Project

This document, together with VDV-RV 453 [1] and standard VDV 453 [2], specifies the implementation of the interface between SBB and other public transport operators (PTOs) with computer-operated control systems for the mutual exchange of real-time information for modes of transport (MoT).

Taken together, these three documents describe the CUS VDV interface, as implemented by SBB. To be precise, they set out:

- what data is exchanged between SBB and a public transport partner
- how the data is exchanged (formats, communication protocols, etc.)
- which elements of standard VDV 453 are supported by SBB
- the format of individual data elements
- the data flows in terms of content and time
- what tasks arise during introduction of the interface and how they can be shared and/or coordinated between SBB and the public transport company partner
- what needs to be taken into account when operating the interface
- how data is to be interpreted, where this is not specified in VDV-RV 453

2.1.1. Modes of transport (MoT) & mode of transport trip (VM-Fahrt) (extended by VDV-RV 453)

(see VDV-RV 453)

2.1.2. Data retention and currency (extended by SBB)

2.1.2.1. Incoming data

CUS as a data hub – DH (client)

Incoming data is forwarded to the recipients without any changes immediately after receipt.

CUS as a railway data producer – RDP (client)

Information received by the VDV interface about trains being undertaken by a public transport partner (`<DatenAbrufenAntwort>`) is received in the VDV interface and then transmitted to the CUS core. As a result, the information received about one service is also available for other services. After storing the incoming data, the CUS core makes no further distinction as to the origin of the data.

Trips and bus stops or stations must be uniquely identifiable so that these incoming reports can be correctly attributed to the relevant modes of transport or to the bus stop or station which they have reached (see section 6.1.4 or 6.1.5).

Information received through the VDV interface about a partner's modes of transport is stored internally within the CUS core. This data is used by the connections calculator for calculating the connection situation at individual operating points (stations, bus stops, etc.) and also for displaying information on the departure screens at individual stations.

Calculating the connection situation begins approximately 20 minutes before the arrival of the feeder train and is continuously updated based on the incoming forecasts. Approximately 2 to 4 minutes before a train arrives at a station, the connection announcement is put together and made available to the recipient systems.

For example, connection announcements can be picked up by the customer information system (CIS) running on the vehicle platform, transmitted to the feeder train over an air interface and displayed on the interior displays in the carriages.

2.1.2.2. Outgoing data

(see VDV-RV 453)

2.1.3. DFI-ANS interaction (extended by SBB)

The interplay of the two VDV services, DFI and ANS, and the information flow between SBB and partner systems, is described in the following scenario by way of example.

This example is based on the following situation:

- A route 33 bus, scheduled to leave for Hünenberg at 17:30, connects with the S1 train, scheduled to arrive at 17:25.
- The interchange time specified is 5 minutes and is not shortened.
- The S1 is running 5 minutes late. This means that the bus must be held back by 5 minutes to ensure that the connection can be made.
- The partner has placed an ANS subscription with SBB, so that he is kept informed of the forecasts for arriving trains.
- SBB has placed a DFI subscription with the partner so as to obtain information about departing transport and to display this in the train as appropriate.

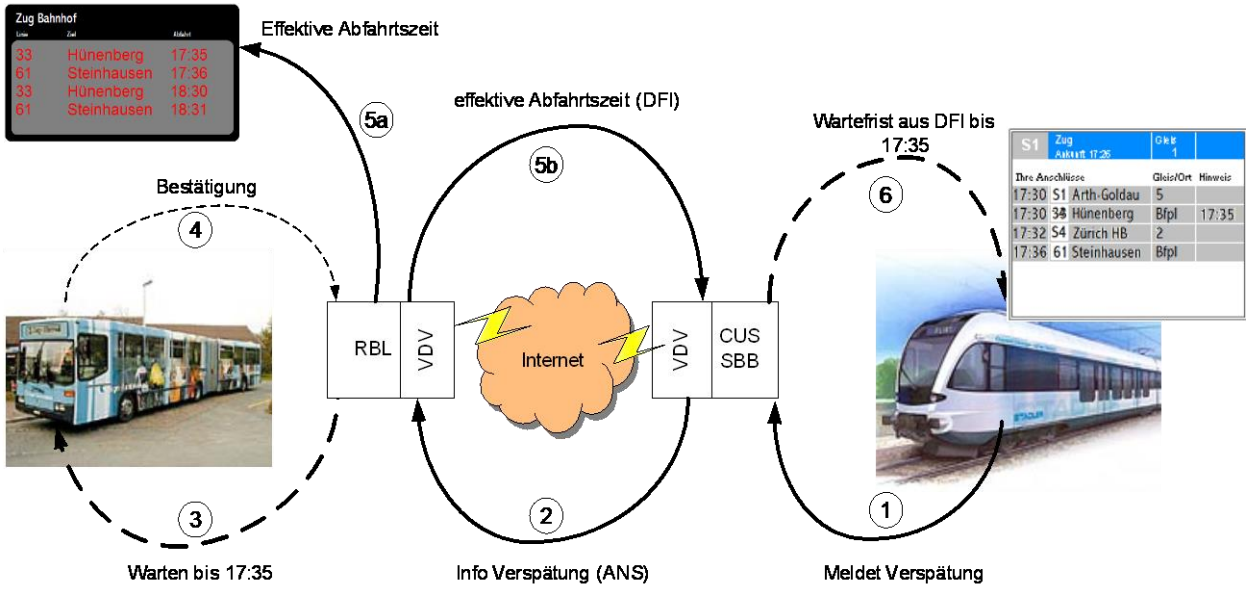

Figure 1: An example of VDV information flow

In this scenario, the following information is exchanged:

1. The delay to a train is identified in the CUS and reported to the VDV interface.
2. The VDV interface reports the delay through the VDV protocol (ANS) to the partner's computer-operated control system.

3. Because of the delay to the train, the partner's computer-operated control system holds the bus back (automatically, or through a scheduler) and informs the bus driver of the new departure time.
4. If necessary, the bus driver acknowledges receipt of the reported delay to the train.
5. The resulting new bus departure time is:
   a. updated accordingly at the bus stop
   b. transmitted to the CUS through the VDV interface
6. CUS includes the bus's new departure time in its calculation and display of the delayed train's outgoing connection situation.

2.2. Objectives

(see VDV-RV 453)

2.2.1. SBB functioning as a data hub (extended by SBB)

CUS as a data hub – DH (client/server)

SBB will provide the function of a national data hub for VDV-Messages. VDV partners will be able to obtain not just SBB's real time date data but also other VDV partners' data. In CUS as a data hub, delivered real-time data is forwarded to the recipients without any changes. This does not apply to railway data (see below).

CUS as a railway data producer – RDP (client/server)

Data supplied by VDV partners für den Bahnverkehr will be transmitted to the CUS backbone. In that process the data may be subjected to some modification or conversion[3]. Consequently, SBB cannot guarantee that data which a partner supplies to the system will be provided unchanged to another partner.

However, SBB will make every effort to ensure that all the information it receives from a partner through the VDV interface is supplied semantically complete to other interested partners to the extent that this is technically possible.

2.2.2. Swiss Federal Office of Transport (BAV) mandate (extended by SBB)

The scope of the interfaces to the SBB CUS real-time data hub is described in the Swiss Federal Office of Transport Service Level Agreement (SLA) 2017 - 2020. The data provided by the timetable forecast interfaces allows the exchange of real-time information about trips being undertaken by all participating transport companies.

Real-time information is exchanged through the VDV interface for transport companies whose scheduling is not included in the RCS scheduling system. Standard VDV 453 provides extensive services for exchanging real-time forecasts.. Services related to the planning timetable will be realised in the INFO+ product in accordance with the Service Level Agreement (SLA) 2017 – 2020.

2.3. Model

(see VDV-RV 453)

[6] The actual time of the first message may be delayed by up to 5 minutes because of the technology used.

3. Introduction and Basic Terms

3.1. Connection Protection (ANS / CP)

3.1.1. Tasks and objectives

CUS as a data hub – DH (server)

The feeder services transmitted to the partner through the VDV interface will be used by the partner's RBL for scheduling the outgoing connecting service. Feeder services are both those modes of transport within CUS's sphere of influence and partners' modes of transport whose data has been transmitted to CUS (see section 2.1.2. with respect to data origins and data currency).

SBB supports only the time-referenced subscription mechanism.
Trip-referenced subscriptions are not supported.

3.1.2. The Feeder-Fetcher Principle

(see VDV-RV 453)

3.1.3. Definition of Inter-Operational Connection Protection

(see VDV-RV 453)

3.1.4. Operational Models

(see VDV-RV 453)

3.1.4.1. Stations

(see VDV-RV 453)

3.1.4.2. Multi-connections

(see VDV-RV 453)

3.1.4.3. Multi-Serviced Stops

(see section 6.1.8 for `<HstSeqZaehler>`)

3.1.5. Schedule and Connection Planning (Planned Schedules)

(see VDV-RV 453)

3.1.6. Connection areas

(see VDV-RV 453)

3.1.7. Passenger Information on Interior Displays

(see VDV-RV 453)

3.1.8. Trip-Related Connection Protection

Not supported by CUS at present.

3.1.9. Time-Related Connection Protection

(see VDV-RV 453)

3.2. Dynamic Passenger Information (DFI / DPI)

(see VDV-RV 453)

3.2.1. Tasks and Objectives

(see [1] section 3.2.1 and [this document] section 2.2.1)

3.2.2. Data Supply and Control

The information flow is fully automated.

See section 2.1.2 with regard to data origin and data currency.

3.2.3. Display Areas

The SBB's DFI service does not support direct control of passenger information displays as envisaged by standard VDV 453. The data transmitted is that which partners need for display on their terminal devices. Each operator retains the full control over his display equipment.

3.3. Visualisation of Foreign Vehicles (VIS)

Not supported by SBB.

3.4. General Message Service (AND / GMS)

Not supported by SBB.

4. Architecture

4.1. Communication vs. Technical Services

(see VDV-RV 453)

4.2. Reference Data vs. Process Data

The SBB VDV 453 interface supports only process data (actual data).

4.3. Protocols

(see VDV-RV 453)

5. Interface Description of the “Basic Infrastructure”

5.1. Subscription Procedure

(see VDV-RV 453)

5.1.1. Summary

(see VDV-RV 453)

5.1.2. Setting Up Subscriptions

(see VDV-RV 453)

5.1.2.1. SubscriptionRequest (*AboAnfrage*)

Definition of *AboAnfrage*:	
Sender	(Attribute) as VDV 453
Timestamp	(Attribute) as VDV 453
AboASBRef	n/a
AboASB	as VDV 453.
AboAZBRef	n/a
AboAZB	as VDV 453
AboVIS	n/a
AboAND	n/a
AboLoeschen	as VDV 453
AboLoeschenAlle	as VDV 453

CUS as a data hub – DH (server)

(no changes over VDV453-RV)

5.1.2.2. SubscriptionReply (*AboAntwort*)

CUS as a data hub – DH (client)

The following deviations from VDV-RV in the `<AboAntwort>` type must be noted:

Element	Comments	Field
XSDVersionID	(Attribute, optional) Interface version used by the server (XSD filename).	n/a

Tabelle 3: Sub-Elemente von `<AboAntwort>` für SBB-Server

Folgende Abweichungen im Typ `<Bestaetigung>` müssen gegenüber der VDV-RV 453 beachtet werden:

Element	Comments	Field
DatenGueltigAb	(Siehe VDV-RV 453	n/a

DatenGueltigBis	See VDV-RV 453 CUS as a data hub – DH (server): If it is noted that a data client is making a subscription, the validity (VerfallZst) of which exceeds the CUS data horizon, the end of the data horizon is transmitted in the element “DatenGültigBis” (“DataValidTo”). When the end of the data horizon is reached, the subscriptions made are terminated by CUS.	optional
Fehlernummer	See VDV-RV 453	n/a
KuerzMoeglicherZyklus	See VDV-RV 453	n/a

Tabelle 4: Sub-Elemente von `<Bestaetigung>` für SBB-Server

CUS as a data hub – DH (server)

The data horizon for a subscribed subscription ends in CUS at 23:59 clock of the following day (The validity of a subscription made by the data subject to CUS is thus maximum 48h).

SBB therefore recommends only making subscriptions with a validity which falls within the scope of the specified data horizon.

5.1.3. SBB therefore recommends exclusively to issue subscriptions whose validity is within the scope of the data horizonSignalling Data Availability

(see VDV-RV 453)

5.1.3.1. DataReadyRequest (*DatenBereitAnfrage*)

(see VDV-RV 453)

5.1.3.2. DataReadyAnswer (*DatenBereitAntwort*)

(see VDV-RV 453)

5.1.4. Polling Data

(see VDV-RV 453)

5.1.4.1. DataSupplyRequest (*DatenAbrufenAnfrage*)

(see VDV-RV 453)

5.1.4.2. DataSupplyAnswer (*DatenAbrufenAntwort*)

(see VDV-RV 453)

The SBB master data holds a value fpr every partner of how many data structures (`<FahrtLoeschen>`, `<Fahrplanlage>`, etc.) at most should be contained in a `<DatenAbrufenAntwort>`. If the available data exceeds the specified limit, only part of the data will be transmitted and the element `<WeitereDaten>` will be set to **`true`**. The partner can then retrieve the remaining data by sending additional `<DatenAbrufenAnfragen>`.

As defined in the original standard VDV 453, data that refers to a particular subscription will **not be** separated. i.e. it is theoretically possible that messages are sent which are larger than the configured limit if all the included data belongs to one subscription.

Currently there is a global threshold value **which applies to all partners in common**.

5.1.5. Deleting Data Subscriptions (AboLoeschen/Alle)

(see VDV-RV 453)

5.1.6. Reset after Interruption

(see VDV-RV 453)

5.1.7. Reset after Crash

(see VDV-RV 453)

5.1.8. Alive handling

Alive handling uses the method described in standard VDV 453 [2].

Further checks, such as measurement of the anticipated message volume from partners (like performed in CUS4), are not done.

5.1.8.1. StatusRequest (StatusAnfrage)

(see VDV-RV 453)

5.1.8.2. StatusReply (StatusAntwort, Status)

(see VDV-RV 453)

5.1.8.3. Client Status Query

The `<ClientStatusAnfrage>` with which it is possible for a server to check whether a client is still "alive" is currently not supported by SBB.

5.2. Http Link

5.2.1. Procedure

The following applies in addition to the points described in VDV-RV 453:

CUS as a data hub – DH (client)

A partner's target address (IP and port) will be recorded in the VDV interface configuration. It must be defined by mutual agreement when setting up the VPN connection. The possible redundancy of clients within the SBB cluster environment is irrelevant as regards the partners' servers.

CUS as a data hub – DH (server)

The logical address (IP and port) of the load balancer that is responsible for routing the incoming HTTP requests must be shown as the target address. The IP and port number need to be defined by both partners' network specialists during the introductory phase when the VPN connection is being set up.

The server's redundancy is irrelevant as regards a client since the client does not directly address the SBB server but directs its requests to the upstream load balancer. It is not possible to address the SBB server directly (see also 5.3).

5.2.2. Character Set

(see VDV-RV 453)

5.2.3. Service codes

The following VDV 453 services are currently supported:

Service	Identifier	Description
Connection protection process data service (ANS)	ans	Makes available on the server the current actual data for feeder services. The data is processed client-side in the connection protection service.
Passenger information process data service (DFI))	dfi	Makes passenger information data available on the server. The data is displayed client-side on the relevant display monitors.

Table 5: HTTP service identifiers

5.2.4. Request URL

(see also VDV-RV 453)

The addressing method described in standard VDV 453 [2] has to be expanded because of the system landscape prevailing within SBB. As the interface is located within a shared platform, it is necessary to state the application responsible for the query within the address.

Complete addressing for a VDV service in SBB is thus structured as follows:

```
http://<host>[:<port>]/<application path>/<control centre
        identifier>/<service identifier>/<query identifier>
```

The current application path is: **`kihub/kivdv`**

Example: http://192.168.0.1/**kihub/kivdv**/xyz_prod/dfi/status.xml

Note: Since addressing of the application may also change in the event of changes to the system environment, the connected VDV partners should keep the addressing of VDV queries configurable.

See also section 6.1.3 for the definition of the control centre identifier.

In a deviation from VDV-RV 453, SBB does not support server-side alive handling either as a server or as a client. Consequently, the `<ClientStatusAnfrage>` or `<ClientStatusAntwort>` is neither sent nor answered.

5.2.5. Error handling

5.3. Security

(see also VDV-RV 453)

The following should be noted in configuring the VPN connection:

- The four platforms, **Development**, **Test**, **Integration** and **Production** are operated. Accordingly, when establishing the connection, account should always be taken of the platform on which the relevant target system is running.

- The SBB's VDV servers are not directly addressed by the partner system. There is one address associated with each of the platforms available, which is the one that should be addressed. This is converted in the NAT into the actual address of the platform concerned (NATting). This ensures that the address configuration concerned remains stable, even if there is a server change at SBB or the partner. In this case, it is only necessary to adjust the NAT.
- Many partners have in their system environment just one system, which is used in both the test phase and the integration phase. In such a case, the system administration must ensure that the correct IP addresses are used in the NAT for the various phases. SBB itself always uses separate environments for testing and integration. This behaviour is also illustrated in the graphic below.
- Every SBB platform has an upstream load balancer to which the httpRequest is forwarded. The load balancer is responsible for routing to the VDV server responsible. This permits efficient control of the server load and helps to avoid performance problems.

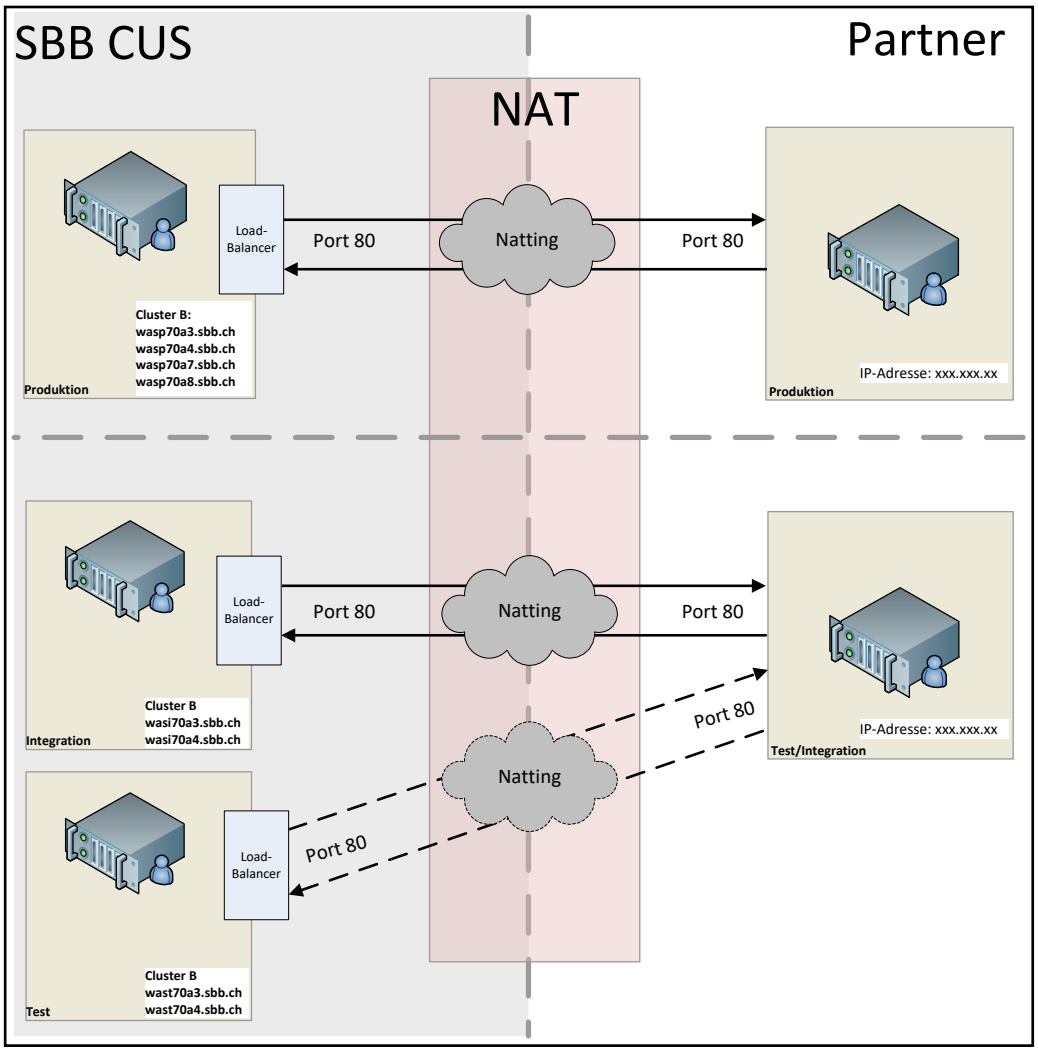

Figure 2: Technical connection of the VDV interfaces (SBB<=>Partner)

6. Interface description for "Technical Services"

6.1. General Terms

An SBB master data tool is used to configure the master data. Changes to the configuration will be made by mutual agreement.

The following sections describe the master data needed for the exchange of data and explain VDV-RV 453[1] and standard VDV 453[2] in greater detail.

6.1.1. Operating Days

(see also VDV-RV 453)

Note on the date format: SBB transmits operating day information as a pure date without time stamp, but with a deviation from UTC (e.g. 2014-05-19+02:00). This complies with ISO8601. The sender is free to choose the format for incoming data, as long as it complies with the ISO standard.

6.1.2. Date and Time Format

(see VDV-RV 453)

SBB sends and expects all time data to be accurate to the second and not rounded. Times are required stated to the second for subsequent calculations and control systems.

6.1.3. Control Centre Code

(see also VDV-RV 453)

SBB supports the four platforms defined in VDV-RV 453.

CUS as a data hub – DH (client)

This results in the source identifiers shown below for the SBB platforms:

Platform	Source identifier
Development	sbb_entw
Testing	sbb_test
Integration	sbb_int
Production	sbb_prod

Table 6: The SBB source identifiers

CUS as a data hub – DH (server)

The example below shows the partner source identifiers for the four possible platforms of the Zurich Transport Network (ZVV) partner. The source identifiers for other partners are formed in the same way.

The source identifiers for the (possible) ZVV platforms are shown below:

Platform	Source identifier
Development	zvv_entw
Testing	zvv_test
Integration	zvv_int
Production	zvv_prod

Table 7: Source identifiers of partner platforms (Zurich Transport Network)

6.1.4. Location References

(see VDV-RV 453)

The option described in VDV-RV 453 of specifying an additional region code is not supported by SBB. Accordingly the following patterns are required for location references:

Composition of the AZBID:

Z + UIC country code + UIC code

Example for Zurich central station: Z8503000

Composition of the ASBID:

S + UIC country code + UIC code

Example for Zurich central station: S8503000

The location references (including those for bus stops, tram stops etc.) are provided by SBB in the master data on the basis of the operating point list for the whole of Switzerland (DIDOK master data).

6.1.5. Trip References (FahrtBezeichner)

(see VDV-RV 453)

CUS as a data hub – DH (client/server)

CUS as a DH forwards the trip reference (FahrtBezeichner) 1:1. Both the new format in accordance with RV and alternative formats of the trip reference (FahrtBezeichner) are supported.

CUS as a railway data producer – RDP (client/server)

CUS as a railway data producer expects the trip reference (FahrtBezeichner) as defined in VDV-RV 453 and always supplies it for trains in this format too. Old formats for existing connections are still accepted.

6.1.6. Line and Direction References

(see VDV-RV 453)

6.1.6.1. Route Reference (extended by VDV-RV 453)

(see VDV-RV 453)

CUS as a railway data producer – RDP (server)

The route IDs available for each operating point are recorded in the master data. This determines which routes can be subscribed to at each operating point.

LinienID is like LinienText and can be used in Abo-Filter.

6.1.6.2. Direction Reference (extended by VDV-RV 453)

(see VDV-RV 453)

CUS as a railway data producer – RDP (server)

Details of the ANS & DFI services

SBB defines the <RichtungsID> for each operating point for **trains**. It is always composed of two official operating point abbreviations (according to DIDOK). Different RichtungsIDs are generated for the ANS and DFI services:

Service	Formula for <RichtungsID>
ANS	[Previous stop made by the MoT]-[current stop]
DFI	[Current stop]-[next stop]

Table 8: Formula for <RichtungsID>

Example: at the operating point "Emmenbrücke", a train whose previous stop was "Lucerne" and whose next stop is "Emmenbrücke Gersag", will be given the <RichtungsID> "LZ-EBR" in the ANS service and "EBR-GSAG" in the DFI service.

This formula and, in particular, the distinction between ANS and DFI also has the advantage that the same <RichtungsID> is always used even in the event of a disruption to service, e.g. for a replacement train running on a route which is different from the original train.

All <RichtungsID>s available for each operating point and route ID are recorded in the master data.

6.1.6.3. Specification of Intermediate Stations (extended by SBB)

The <ViaHst1Lang> element is used to specify intermediate stations for a mode of transport. SBB sends and expects to receive intermediate stations together with a priority, separated by a semi-colon.

The format of the via information therefore appears as follows:

Prio1;ViaHst1;Prio2;ViaHst2;…;Prio<n>;ViaHst<n>

In addition, the following applies:

- The priority level makes it easier to choose what via text information to display if there is insufficient space on the display screen for the complete information. The smaller the number, the higher is that stop's priority. SBB limits the priority value range to [1, 998] in the range of natural whole numbers.
- Via points still to be reached are only indicated if they are operating points where passengers can leave the train. On regional services in general the regional service designator will be used (e.g. "Zürich Stadelhofen" => "Stadelhofen").

- SBB will transmit a maximum of 6 operating points still to be called at by the mode of transport. These will be calculated on the basis of their priority and will be listed in the order in which they will be called at. The next operating point of relevance to customers will always be included as the first via point.
- The standard VDV 453 also defines in addition to the `<ViaHst1Lang>` *element the elements <Via>,* `<ViaHst2Lang>` and `<ViaHst3Lang>`. However, these will neither be sent nor analysed by SBB. All the via data is thus included in the `<ViaHst1Lang>` element.

6.1.7. Product Types

(see chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** and VDV-RV 453)

CUS as a data hub – DH (client/server)

All elements supplied are forwarded.

CUS as a railway data producer – RDP (client)

Not supported by SBB as a railway data producer.

CUS as a railway data producer – RDP (server)

SBB as a railway data producer supplies the ProduktID with the values: “bus”, “ship”, “funicular” or “train”.

6.1.8. Circular Trips

See [1] for the definition of the stop sequence counter (`<HstSeqZaehler>`[4]).

6.1.9. Service Types

CUS as a data hub – DH (client/server)

All elements supplied are forwarded.

CUS as a railway data producer – RDP (server)

Not supported by SBB as a railway data producer.

6.1.10. Errors at the Technical Service Level

(see VDV-RV 453)

6.1.11. Optional fields

(see VDV-RV 453)

6.1.12. Stop Information (extended by VDV-RV 453)

6.1.12.1. HaltepositionsText

(see VDV-RV 453)

The length of the text in the field is limited to 5 characters[5].

[6] The actual time of the first message may be delayed by up to 5 minutes because of the technology used.

The value is interpreted as follows if the element is filled:

- Value without spaces:
  ➔ The value is adopted as the actual platform or actual boarding area.
- Value with spaces:
  ➔ Values with spaces are permitted only for trains.
  ➔ The space is interpreted as a separator between the actual platform and the actual sector. The text before the space is taken for the platform; that after the space as the sector (e.g. "12 A" means platform 12 and sector A).

If characters separated by a space are received in `<HaltepositionsText>`, this is always interpreted as platform and sector.

CUS as a railway data producer – RDP (client)

SBB uses this field to pass the platform and (if known) the sector of the platform (e.g. "12", "7 D", "13 AB", "41/42").

- Platform and sector are always separated by a space.
- Planning data (where available) is sent in its place if the actual data is missing.
- The `<HaltepositionsText>` element is not transmitted if the planning data is also missing.

6.1.12.2. HaltID (Stop Position)

(see VDV-RV 453)

In contrast to VDV-RV 453, SBB defines the `<HaltID>` as a **mandatory field**.

The supported formats are described below; all existing formats for supplying the HaltID are still supported.

CUS as a data hub – DH (client/server):

The recommended format from VDV-RV 453 is supported for local services.

To allow simple and efficient trouble-shooting, SBB recommends that its partners likewise transmit the UIC code of the operating point concerned if the `<HaltID>` is unknown. Should this not be possible for technical reasons, by agreement a different value can also be sent to indicate the fact that the `<HaltID>` mandatory field is not known.

CUS as a railway data producer – RDP (client/server)

For new connections:

The recommended format from VDV-RV 453 is supported for railway traffic.

For existing connections:

All existing formats for supplying the HaltID are still supported (in railway traffic, the track was transmitted in this element up to now).

[6] The actual time of the first message may be delayed by up to 5 minutes because of the technology used.

CUS as a railway data producer – RDP (client/server) und NAV mit Anschlussrechnung

The <HaltID> element contains the technical designation of the boarding area. It is used in order to determine the associated bus / station stop area and thus the precise connection time at the platform or boarding area for calculating the connection. Only those designations as specified in the master data may be transmitted in this element, otherwise the connection time cannot be calculated precisely.

The UIC code of the operating point concerned is transmitted if the information is not (yet) known at the time the message is created.

6.1.13. Trip Information (FahrtInfo) (extended by SBB)

The optional <FahrtInfo> element is conceived of in VDV 453 for transporting information relating to individual trips.

CUS as a data hub – DH (Client/Server)

All elements are supported.

CUS as a railway data producer – RDP (server)

The following elements are supported.

Element	Comments	Field
Betreiber	Contains the operator (abbreviation) determined from the unique TU code.	optional
KursNr	Contains the mode of transport number. SBB transmits the <KursNr>, which contains the mode of transport number of the relevant mode of transport (in the case of railways, this is always the train number (ZN))	optional
ProduktID	Clearly identifies the product (ship, bus, train etc.).	mandatory
BetreiberID	This value is a piece of metadata. The BetreiberID is a code which identifies the transport company operating the service. With the help of this code, transport (routes) operated by certain companies can be filtered out. The BetreiberID can also be used to determine responsibility for additional functions, such as bookings and seat reservations.	mandatory
LinienfahrwegID	See VDV-RV 453, section 6.2.3.3.1	optional
(remaining elements)	All other FahrtInfo elements are not supported.	n/a

Table 9: Sub-elements of <FahrtInfo> for SBB server

CUS as a railway data producer – RDP (client)

None of the sub-elements of the <FahrtInfo> element are supported, and any transmitted values will be ignored. Such values will not be forwarded to third parties, even with respect to the data hub function.

6.2. Connection Protection (REF-ANS, ANS / REF-CP, CP)

6.2.1. Introduction

(see VDV-RV 453)

6.2.2. Operational Data Supply and Management

(see VDV-RV 453)

6.2.3. Reference Data Service (REF-ANS / REF-CP)

Is not supported by SBB.

6.2.4. Process Data Service (ANS / CP)

CUS as a data hub – DH (client)

For technical reasons, the automatic connection protection service for partners' modes of transport is not currently operated on SBB trains.

6.2.4.1. Data Exchange

(see VDV-RV 453)

6.2.4.1.1. Updating / Hysteresis

See VDV-RV453.

6.2.4.2. Requesting Connection Data (*AboASB*)

CUS as a data hub – DH (server)

SBB accepts elements of the `<AboASB>` type with the following elements:

The following table only contains changes to VDV-RV 453:

Element	Comments	Field
ASBID	AnschlussbereichsID (e.g. S8506016 for Oberwinterthur operating point) See section 6.1.4	mandatory
Fahrtfilter	Not supported.	n/a
Zeitfilter	Used with the following elements: See section 6.2.4.2.2	optional
Hysterese	A fixed 30 seconds	mandatory
AbbringerInfo	Not supported.	n/a

Table 10: Structure of the subscription query with `<AboASB>`

6.2.4.2.1. Trip Filter

Not supported by SBB.

6.2.4.2.2. Requesting Time-Related Connection Data (TimeFilter)

(see VDV-RV 453)

The following table only contains changes to VDV-RV 453:

Element	Comments	Field
Vorschauzeit	Time in minutes prior to the scheduled arrival time of the feeder service from which the sending of feeder service forecasts should start. Default: 30 Min. (via Property) if not transmitted in the Abo. See also chapter 6.2.4.2.4.	optional

Table 11: Structure of `<ZeitFilter>`

Although the element <Zeitfilter> is marked as optional in the XSD, it must always be specified (since the element <Fahrtfilter> is not supported). If the <Zeitfilter> is missing, the corresponding subscription is discarded and an error will be returned.

CUS as a data hub – DH (server)

If a subscription in which the <SpaetesteAnkunftszeit> lies more than 24 hours in the future is received, the subscription will be rejected, an error message to the partner will be generated and a corresponding log entry will be written.

The value in the <Frueheste-Ankunftszeit> element may lie at any time in the past, but SBB shortens the time in the past internally to a configurable value. At present, this value is set at 1 hour.

6.2.4.2.3. Additional Information for the fetcher (*AbbringerInfo*)

Is not supported by SBB.

6.2.4.2.4. Implicit preview time for ANS (extended by SBB)

SBB does not support the preview time element in the time filter. Instead, an implicit preview time, which is configurable in the master data, is defined (currently 30 minutes)[6]. The first message will not be sent to a mode of transport (meeting the filter criteria) until the mode of transport reaches this preview time.

Example:

Subscription set-up: **04:10:00**

Earliest arrival time: **15:50:00**

Latest arrival time: **16:10:00**

AnkunftszeitAZBPlan: train1: **15:55 ->** 1st message regarding train1 is sent at **15:25**.

AnkunftszeitAZBPlan: train2: **16:10 ->** 1st message regarding train2 is sent at **15:40**.

[6] The actual time of the first message may be delayed by up to 5 minutes because of the technology used.

6.2.4.3. Feeder Messages (*Zubringernachricht*)

Element	Comments	Field
AboID	(Attribut) see VDV453	mandatory
ASBFahrplan	see VDV453	n/a
ASBFahrplanlage	see VDV453	optional
ASBFahrtLoeschen	see VDV453	optional

Table 12: Structure of `<Zubringernachricht>`

6.2.4.3.1. Transferring Connection Data (*ASBFahrplanlage*)

CUS as a railway data producer – RDP (server)

The specifications of VDV-RV 453 and standard VDV 453 apply on principle for the dispatch of elements of the type `<ASBFahrplanlage>`. The following points should also be taken into account:

Element	Comments	Field
ASBID	AnschlussbereichsID (e.g. S8506016 for Oberwinterthur operating point) See section 6.1.4	mandatory
HstSeqZaehler	Strictly monotonically increasing – see section 6.1.8.	mandatory
LinienID	ID used within the system exclusively for subscriptions. See section 6.1.6.	mandatory
LinienText	Route name or type of train of relevance for customers – shown as a mode of transport's route name. See section 6.1.6.	mandatory
RichtungsID	ID used within the system exclusively for subscriptions. See section 6.1.6.	mandatory
RichtungsText	Trip destination of relevance to customers. See section Fehler! Verweisquelle konnte nicht gefunden werden.	mandatory
VonRichtungsText	Where the mode of transport began its trip (only stops of relevance to customers). See section 6.1.6.	optional
Umsteigewillige	Not supported.	n/a
ZubringerHstLang	Not supported.	n/a
SpaetesteAbbringer-Info	Not supported.	n/a
HaltID	Technical ID for a boarding area (platform). See section 6.1.12.2	mandatory
HaltepositionsText	The boarding area (platform) for a mode of transport – of relevance to passengers. See section 6.1.12.1	optional
Stauindikator	Not supported.	n/a

Table 13: Structure of the `<ASBFahrplanlagen>`

6.2.4.3.2. Feeder Loss (ASBFahrtLoeschen)

(see VDV-RV 453)

CUS as a railway data producer – RDP (server)

The following table only contains changes to VDV-RV 453:

Element	Comments	Field
VonRichtungsText	(See VDV-RV 453)	n/a
Ursache	(See VDV-RV 453) CUS as a railway data producer – RDP (server) always supplies the value “cancellation”.	mandatory

Table 14: Structure of the `<ASBFahrtLoeschen>`

6.2.4.4. Messages from the Fetcher Vehicles (*Abbringernachricht)*

The feedback channel as specified in standard VDV 453 **is not** supported.

A partner's scheduling decisions can, however, be transmitted through the `<AbfahrtszeitAZBDisposition>` field in the DFI service[7].

6.3. Dynamic passenger information (REF-DFI, DFI)

6.3.1. Introduction

(see VDV-RV 453)

6.3.2. Operational Data Supply and Management

(See section 2.1.2)

6.3.3. DFI Systems with Code Control

Is not supported by SBB.

6.3.4. DFI Systems with Autonomous Predictions

Is not supported by SBB.

6.3.5. Quick Cleardown

Is not supported by SBB.

6.3.6. Trainsets / Run Vehicles / Splitting or Combining Trips

Is not supported by SBB.

6.3.7. Reference data service (REF-DFI)

Is not supported by SBB.

6.3.8. Process data service (DFI)

6.3.8.1. Data exchange

6.3.8.1.1. Preview time (extended by SBB)

CUS as a data hub – DH (server)

The first SBB report will be issued once the `<Vorschauzeit>` has been reached. SBB accepts a minimum of 10 minutes and a maximum of 180 minutes as the `<Vorschauzeit>` for the subscription set. Periods of less than 10 minutes or greater than 180 minutes will be rounded up to the appropriate threshold values [10, 180].

CUS as a data hub – DH (client)

SBB sets up subscriptions with a `<Vorschauzeit>` of 10 to 180 minutes (default = 30 minutes).

6.3.8.2. Requesting DFI Data (*AboAZB*)

(see VDV-RV 453)

CUS as a data hub – DH (Client/Server)

The following table only contains changes to VDV-RV 453:

Element	Comments	Field
MaxAnzahlFahrten	Not supported.	n/a
Hysterese	A fixed 30 seconds. (Any deviating value sent will be replaced internally)	mandatory
MaxTextLaenge	Not supported.	n/a

Table 15: Structure of the subscription query with `<AboAZB>`

6.3.8.3. Messages from the Display User System (*AZBNachricht*)

Element	Comments	Field
MaxAnzahlFahrten	Not supported.	n/a
Hysterese	A fixed 30 seconds. (Any deviating value sent will be replaced internally)	mandatory
MaxTextLaenge	Not supported.	n/a

Table 16: Structure of the `<AZBNachricht>`

6.3.8.3.1. Transferring Predictions (*AZBFahrplanlage*)

(see VDV-RV 453)

CUS as a data hub – DH (Client/Server)

CUS as a data hub supports all elements.

CUS as a railway data producer – RDP (client/server)

The following table only contains changes to VDV-RV 453:

Element	Comments	Field
AZBID	AnschlussbereichsID (e.g. Z8506016 for Oberwinterthur operating point) See section 6.1.4	mandatory

Element	Comments	Field
FahrtID	See section 6.1.5.	mandatory
HstSeqZaehler	Strictly monotonically increasing – see section 6.1.8 CUS as a railway data producer – RDP (client) The element is not analysed.	mandatory
Traktion	Not supported.	n/a
BetrieblicheFahrzeugnummer	Not supported.	n/a
LinienID	ID used within the system exclusively for subscriptions. See section 6.1.6 CUS as a railway data producer – RDP (client) The element is not analysed.	mandatory
LinienText	Route name or type of train of relevance for customers – shown as a mode of transport's route name. See section 6.1.6 CUS as a railway data producer – RDP (client) The element is not analysed.	mandatory
RichtungsID	ID used within the system – not displayed to customers. See section 6.1.6 CUS as a railway data producer – RDP (client) The element is not analysed.	mandatory
RichtungsText	Trip destination of relevance to customers. See section 6.1.6 CUS as a railway data producer – RDP (client) The element is not analysed.	mandatory
VonRichtungsText	Where the mode of transport began its trip (only stops of relevance to customers). See section 6.1.6 CUS as a railway data producer – RDP (client): The element is not analysed.	optional
AbmeldeID	Not supported.	n/a
ViaHst1Lang	Via information, incl. the order of priority of the operating points See section 6.1.6.3 CUS as a railway data producer – RDP (client): The element is not analysed.	optional
ViaHst2Lang	Not supported.	n/a
ViaHst3Lang	Not supported.	n/a
Via	Not supported.	n/a
AnkunftszeitAZBPlan, AbfahrtszeitAZBPlan	(See VDV-RV 453)	partly optional
AnkunftszeitAZBPlan,	(See VDV-RV 453) This element must always be transmitted, apart from at the first stop.	optional / Pflicht

Element	Comments	Field
	CUS as a railway data producer – RDP (client): The element is not analysed.	
AbfahrtszeitAZBPlan	(See VDV-RV 453) This element must always be transmitted, apart from at the last stop. CUS as a railway data producer – RDP (client): The element is not analysed.	optional / Pflicht
AbfahrtszeitAZB-Disposition	(See VDV-RV 453) For transmitting a scheduling decision. CUS as a railway data producer – RDP (client): CUS forwards this element to the partners in the AbfahrtszeitAZBDisposition element.	optional
FahrtStatus	(See VDV-RV 453) CUS as a railway data producer – RDP (client): The element is not analysed.	mandatory
Fahrtspezialtext	Not supported.	n/a
Sprachausgabe	Not supported.	n/a
HaltID	Technical ID for a boarding area (platform). See section 6.1.12.2	mandatory
HaltepositionsText	The boarding area (platform) for a mode of transport – of relevance to passengers. See section 6.1.12.1	optional
Stauindikator	Not supported.	n/a
FahrtInfo	See 6.1.13. CUS as a railway data producer – RDP (client): Es wird nur das Element BetreiberID augewertet.	optional

Table 17: Structure of the `<AZBFahrplanlage>`

6.3.8.3.2. Definition of Trainset (*Traktion*)
Is not supported by SBB.

6.3.8.3.3. Transmitting Special Line Texts (*AZBLinienSpezialtext*)
Is not supported by SBB.

6.3.8.3.4. Deleting Special Line Texts (*AZBLinienSpezialtextLoeschen*)
Is not supported by SBB.

6.3.8.3.5. Trip Failure / Departure (AZBFahrtLoeschen)
(see VDV-RV 453)

Deviations to VDV-RV 453 are defined in the following table:

Element	Comments	Field
VonRichtungsText:	(See VDV-RV 453)	n/a

Table 18: Structure of the `<AZBFahrtLoeschen>`

CUS as a railway data producer – RDP (Client/Server)

Deviations to VDV-RV 453 are defined in the following table:

AbmeldeID	Not supported.	n/a
Ursache	Cause of a cancellation. Not applicable for standard departures.	partly optional

Table 19: Structure of `<AZBFahrtLoeschen>`

CUS as a railway data producer – RDP (Client)

Two cases must be distinguished in detecting a cancellation as opposed to a standard departure:

- If the <cause> field **is shown**, it will always be because of a **cancellation**.
- If the <cause> field **is not shown**, it will be a **standard departure**.

In the event of a failure of a VM (transport trip), the cause should always be specified. This is the only way to recognize by the message that it is a failure and not a regular departure. What is actually contained as text in the `<Ursache>` field is secondary (from today's point of view), but it is useful to specify the actual cause if it is known at the time of message transmission.

It should be noted that the DFI service always considers **the departures** of a VM. This also applies if a failure is reported. This has an effect especially when a partial failure is reported to successive BPs.

A reported failure therefore does not refer to the arrival, but only to the departure at a certain operating point. A statement about whether the arrival of the reported failure is affected can not be met with absolute certainty[8].

Processing within CUS:

- The mode of transport will be marked as having departed as soon as an `<AZBFahrtLoeschen>` is received.
- If another available timetable status is received for the same trip again after an `<AZBFahrtLoeschen>` the transport mode is published again and the departure flag is reset.
- SBB will deactivate cancellation detection through the VDV message in the event that partners update train assignments and cancellations through SBB's NeTS or RCS.

6.4. Visualisation of non-SBB vehicles (VIS)

Not supported by SBB.

6.5. General news service (AND)

Not supported by SBB.

7. Glossary

(see also VDV-RV 453 glossary)

CUS	Customer System. SBB's customer information system in the form of a backbone which consolidates the information about modes of transport which is of relevance to customers and makes it available in real time on output systems.
INFO+	Compendium of the timetables of Swiss public transport companies; supplies scheduled data for CUS Central 5.
NeTS	"Network-wide routing system": national planning system for timetable status and train routes.
TU-Code	Transport Company Code
RCS	Rail Control System: rail scheduling system operated by SBB and some private railways and railway undertakings. It is used for the provision of rail services.
ZN	Train number: a train's characteristic identification number.

8. References

8.1. Documents referenced

[1] VDV 453-Realisierungsvorgaben öV Schweiz (VDV-RV 453), Version 1.4.1.

[2] VDV Schriften 453, 07/15 : Ist-Daten-Schnittstelle, Version 2.4

[3] XML Schema, VDV 453_incl_454_V2015a_ohne_SIRI

[4] Swiss Federal Office of Transport's train-operating company list

8.2. Table of figures

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9. English Alias

(see VDV-RV 453)