

Technical document

B.14 – e-Ticket Exchange for Control

*In the Document History table, version are identified as x.n where
"x" is a correlative number assigned to an approved version when reaching a main milestones
"n" is a correlative number assigned to draft versions, starting by 1. "n"=0 means version approved
Information related to previous draft versions (i.e. 0.1, 0.2 etc.) shall be deleted from the table when a
subsequent approved version is issued.*

Document History

Version	Date	Comments
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Application:

With effect from **10 January 2020**.

All actors of the European Union falling under the provisions of the TAP TSI.

Table 1: Abbreviations

<i>ABBREVIATION</i>	<i>FULL TEXT</i>
CEN	European Committee for Standardisation
CENELEC	European Committee for Electrotechnical Standardisation
CER	The Community of European Railway and infrastructure companies
CR	Conventional Rail
DC	Direct Current
DeBo	Designated Body
DMI	Driver-Machine Interface
EC	European Commission
EEA	European Economic Area
EEC	European Economic Community
EIM	European Rail Infrastructure Managers
EN	European standard
ERA	European Union Agency for Railways also called “the Agency”
ERADIS	Interoperability and Safety database managed by the European Union Agency for railways
ERATV	European Register of Authorised Types of Vehicles
ERTMS	European Rail Traffic Management System
ESO	European Standardisation Organisation
EU	European Union
IC	Interoperability Constituent
IEC	International Electrotechnical Commission
IM	Infrastructure Manager
INF	Infrastructure
ISO	International Organisation for Standardisation
MS	EU or EEA Member State
NSA	National Safety Authority
NSR	National Safety Rule
NTR	National Technical Rule
PRM	Person with Disabilities or Person with Reduced Mobility

<i>ABBREVIATION</i>	<i>FULL TEXT</i>
RFU	Recommendation for Use
RINF	Register of Infrastructure
RISC	Railway Interoperability and Safety Committee
RR	Revision Request
RRA	Revision Request Author
RS	Rolling Stock
RU	Railway Undertaking
SC	Standard Committee
SS	Subsystem
TC	Technical Committee
TR	Technical Report
TS	Technical Specification
TSI	Technical Specification for Interoperability
UIC	International Union of Railways (Union Internationale des Chemins de Fer)
UIP	International Union of Private Wagons Owners (Union Internationale d'associations de Propriétaires de wagons de particuliers)
UIRR	International Union of Combined Road–Rail Transport Companies (Union Internationale des opérateurs de transport combiné Rail-Route)
UITP	International Association of Public Transport (Union Internationale des Transports Publics)
UNIFE	Union of the European Railway Industries (Union des Industries Ferroviaires Européennes)
UNISIG	Union Industry of Signalling (working party within UNIFE): steering committee involved in the development and implementation of ERTMS
WG	Working Group
WP	Working Party

1. Technical Document summary

The objective of this specification is to provide the capability of controlling dematerialized tickets (e-tickets) that are not necessarily linked to a reservation (non-integrated reservation tickets). In contrast to already existing solutions for tickets with an integrated reservation these tickets show some significant differences that require different solutions:

- › NRT tickets can be created by multiple systems without connection to the carriers involved, whereas IRT tickets are created and managed in a unique system per train that can provide the ticket data to the train controlling company (TCO).
- › NRT tickets can be modified in various ways by the carriers on the route according to the NRT fare conditions

The capabilities to be provided are:

- › Allow to travel with only a reference to the contract or his name
- › Avoid controlling the same ticket multiple times

- › Enable TCOs to securely change the tickets according to the fare conditions
- › Exclude the risk of fraud due to missing information on cancelled tickets on the train and on refunds due to missing information on ticket usage

To enable the same capabilities that are possible for IRT e-tickets the following topics are addressed in this specification:

- › Transfer of ticket data from the company creating the ticket to the TCO/carrier controlling the ticket
- › Transfer of ticket updates (like cancellations) from the company creating the ticket to the TCO/carrier controlling the ticket
- › Transfer of control information from the TCO/carrier to other TCOs and to the company creating the ticket
- › Transfer of ticket changes from the TCO/carrier to other TCOs and to the company creating the ticket

This specification does not affect sales or pricing procedures for tickets.

This technical document relates to sales and distribution of tickets for services in Europe and those linked with Europe.

2. Introduction

2.1. Current Situation of ticket control

The control of NRT tickets is today based either on secure paper tickets which need to be printed on special security paper (security in paper) or on the validation of signed bar codes for home print tickets (Security in Data).

Both approaches have severe limitations. The secure paper tickets are expensive and complex to handle. The security depends on the secure management of paper stock which is often not guaranteed and is vulnerable to fraud by insiders with access to the ticket stock.

The ticket data stay at the issuer system and are not provided to the TCOs/carriers of the ticket's travel contract.

The ticket validation by secured data on the bar code cannot validate intermediate changes / cancellations. (In a very few cases the validation of a ticket status to validate whether the ticket is already cancelled is provided via proprietary interfaces).

Changes made to the ticket on board cannot be transferred between TCOs and to the issuer. As a work around handwritten notes on tickets or on blank paper in case of home print tickets are used by the conductors, but without any security.

The accounting data for the tickets are provided by the issuer to the carriers on a monthly base and are thus worthless for ticket control.

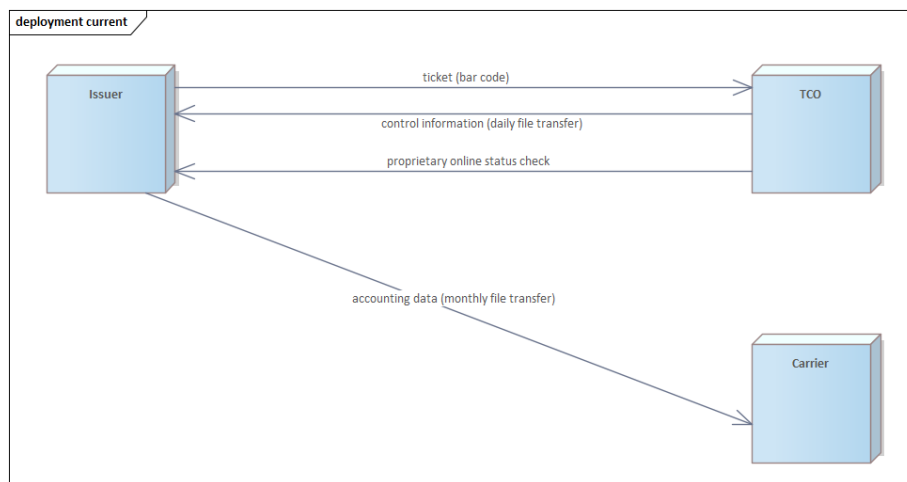


Figure 1 Current data exchange on NRT tickets

The current situation leads to limitations of ticketing control also affecting the passenger.

for NRT:

- › A TCO cannot control the real status of the ticket as this is in the sales system of the issuer
- › A customer needs to carry the ticket (either in paper or electronically)
- › Multiple TCOs on a route or train need to control independently
- › A customer is controlled multiple times for the same ticket
- › A check-In is not possible as the carrier and TCO does not have the ticket data beforehand

For IRT:

There is still one limitation that also applies to IRT tickets:

- › In case of multiple TCOs on the same train the access to the IRT inventory is not standardized

2.2. Objectives

The basic objective is to enable the following business capabilities:

- › The check of a ticket should use the real e-ticket stored on a central server
- › information on control on board should become available immediately for refund and further controls on the route
- › scenarios where an immediate online control is not possible due to infrastructure limitations should be covered

2.3. Requirements

Requirements covered by the specification:

- › There should be the option that the passenger does not need to carry a ticket but an identifier only (e.g. name, id, ...).
- › Control checks or partial control checks (e.g. of the route or area or zones, validity period, ticket status, class, ...) should be possible by systems (at gates, check-in services, ...) not only by humans.
- › Ticket cancellations and multiple use of a ticket should be taken into account at the control.
- › It should be possible to avoid personal controls and multiple personal controls to not disturb the passenger on his trip.
- › Sales and after sales conditions should not be restricted compared to classic tickets on secure paper.
- › The TCO/Carrier should be enabled to integrate the tickets into his own control system.
- › As carrier I would like to provide the same service to passengers in case of delays or missing service regardless of the issuer.
- › Interoperability between different solutions on one ticket (using bar codes, secure paper,...) should be possible. E.g. in case a TCO is not able to control the e-tickets online a mixed scenario with bar code control and security in system control should be possible.
- › Two TCOs using two sets of control devices should be enabled to control on one train.
- › Complete ticket information including annotations should be made available to the issuer for refund and to further controls along the route:
 - on non-used parts of a ticket
 - information on delays and missing service quality
 - on non-transported dogs or bicycles or group members (or luggage)
 - on extensions of the validity (in case of delays or missing service quality)
 - on extensions on allowed routes (in case of delays or disruptions)
- › e-Tickets for bicycle should be possible.
- › e-Tickets with check of group countermarks should be possible where countermarks are still in use.
- › Anonymous tickets should be possible.
- › A picture of the passenger should be an option to validate the use of an e-ticket.
- › It should be possible to deactivate a ticket (e.g. in case some problems need to be clarified with the customer).
- › It should be possible to provide data for the validation of a DOSIPAS dynamic bar code after the ticket creation (s. IRS 90918-9). It should be possible to link the ticket to a phone or other items to be validated via the dynamic bar code content.

Non-functional requirements:

- › A TCO/carrier must not have access to ticket data where he is not involved as TCO/carrier

- › It should be ensured that an annotation on a ticket refers to a specific status of the ticket data that cannot be manipulated later on.
- › The issuer needs to know which personal data are required by each TCO/carrier to collect the personal data compliant to GDPR. It must be possible to provide ticket data without personal data in case the TCOs do not need them.
- › It must be possible to only sent the personal data only to TCOs who need them.

Requirements **not** in the scope:

- › Providing extensive information about the contract of carriage for the passenger.
- › Prevention of paying with fraud or stolen bankcard.
- › Payment processes are out of the scope of the specification, but information on already detected fraud in payments can be provided using the data exchange described.
- › In case of system failure on board the TCO must be able to validate the ticket with its central system via a central office of the TCO.
- › The manual backup in case the services described in this specification are not working is not defined in this specification. These depend on the ticket content and the local circumstances and the TCOs infrastructure (e.g. a phone hotline might be an option for long distance travels but not feasible for mass transport).
- › Cross company blacklisting of customers

2.4. Legal Requirements

The following legal regulations provide requirements that affect the solution:

2.4.1. Regulations

- **Rail PRR:** Regulation (EU) 2021/782 on Rail Passengers' Rights and Obligations
- **GDPR:** Regulation (EU) 2016/679 on data protection
 - The passenger must be informed on the use of his data and on passing his data to the carrier and TCO
 - The passenger must be informed which data are stored including data passed to the carrier and TCO
 - The passenger has the right to ask to delete the data in case the data are not required to fulfil the contract of carriage
 - The passenger has the right to ask for data correction in case the data are wrong
 - Legal basis for processing of personal data with a view of black-listing

Although the exchange of blacklists is not in the scope of the specification the data exchanged can be used by the issuer for a local blacklist. He has therefore to obey the regulations when using the data.

Two processing actions (automated profiling) are concerned:

- (i) Collection and analysis of personal data on regular basis for trigger points: consent of passengers or legitimate interests of the rail carrier is needed
- (ii) Storage of information in the blacklists: legitimate interest of the rail carrier is needed
- General black list for use by multiple companies is allowed
 - (i) No access to the full list is provided
 - (ii) No automatic checking in all cases
- Pre-cautions to be pursued by the railway undertaking
 - (i) Ensure right of access and objection
 - (ii) Information preceding such processing and notification of inclusion into the blacklist
 - (iii) Safeguards to prevent confusion
 - (iv) Additional organizational and technical safeguards for processing

2.5. Methodology

This IRS follows the UML specification to define the solution:

- Actors
- Sequence diagrams
- Use Case diagrams
- Deployment diagrams

UML data models have been replaced by the graphical data description used for JSON data structures.

3. Actors – setting the scene

Actors are defined according to the UML specification:

An Actor models a type of role played by an entity that interacts with the subject (e.g., by exchanging signals and data), but which is external to the subject.

Actors may represent roles played by human users, external hardware, or other subjects. **Note that an actor does not necessarily represent a specific physical entity but merely a particular facet (i.e., “role”) of some entity** that is relevant to the specification of its associated use cases. Thus, a single physical instance may play the role of several different actors and, conversely, a given actor may be played by multiple different instances.

Source: OMG Unifier Modelling Language Superstructure v 2.1.2

The following diagram shows the actors and principal use cases involved in rail distribution and control. The principal use case relevant for this specification is marked in yellow.

Commented [JS1]: Allocator to be reviewed

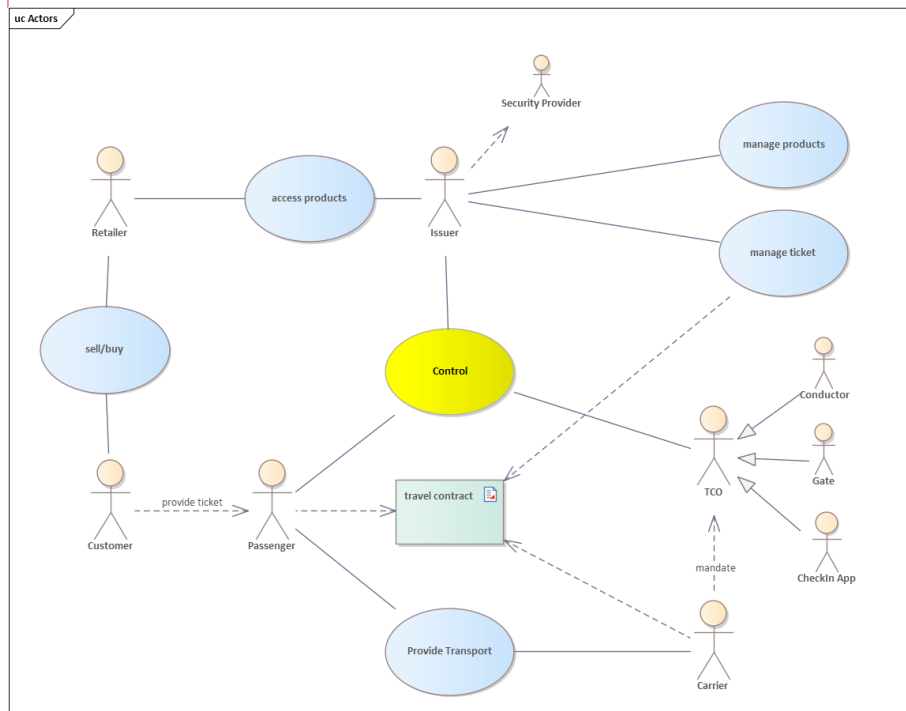


Figure 2 Actor model for distribution and control

3.1. Actors description

3.2. Customer	
Definition	Means a person who intends to buy, is buying, or has bought a railway product for him/herself or for other person(s). May therefore be different from passenger (see passenger) Note: The customer is entitled to receive refund payments.
Motivation / Distinction to other roles	The customer buys the ticket which represents the travel contract between one or more passengers and one or more carriers .

Commented [JS2]: TAP TSI: Means a person who intends to buy, is buying, or has bought a railway product for him/herself or for other person(s). May therefore be different from passenger (see passenger)

3.3. Passenger	
Definition	Person who travels using a travel contract.
Motivation / Distinction to other roles	s. Customer

Commented [JS4R3]: To be replaced by "Passenger"

Commented [JS3]: TAP TSI used the term "Passenger": Means a person who intends to make, or is making, or has made a journey using the transport services and other services of one or more railway undertakings May be different from customer (see customer)

3.4. Ticket Vendor	
Definition	Ticket vendor means any retailer of rail transport services selling tickets, including through-tickets, on the basis of a contract or other arrangement between the retailer and one or more railway undertakings;.
Motivation / Distinction to other roles	Note: The ticket vendor is divided in separate roles (retailer, distributor and Issuer).

Commented [JS5]: Definition in PRR: "ticket vendor" means any retailer of rail transport services selling tickets, including through-tickets, on the basis of a contract or other arrangement between the retailer and one or more railway undertakings;

3.5. Distributor	
Definition	The Distributor Means an undertaking provides legal and technical capacity to issuers to sell rail products or to provide on line-facilities to customers to buy rail products. Besides, the distributor can offer services to issuers by assembling O-Ds carried out by different carriers into complete journeys as required by the traveller. The distributor may be a carrier
Motivation / Distinction to other roles	

3.6. Issuer	
Definition	The Issuer means an undertaking selling the ticket and receiving payment. May be a carrier and/or a distributor. The issuer is the undertaking indicated on the ticket with its code and possibly its logo

Motivation / Distinction to other roles	
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3.7. Carrier	
Definition	The carrier means the contractual carrier with whom the passenger has concluded the contract of carriage.
Motivation / Distinction to other roles	

3.8. Ticket Controlling Organization	
Definition	Means Ticket Controlling Organisation. This is an organisation empowered to inspect passenger tickets. Mostly a carrier. If necessary, the TCO is to deliver security certificates for ticketing and to deliver ticket control data / ticket status modifications to the ticket issuer. The TCO provides the control equipment which might limit the ability to check tickets.
Motivation / Distinction to other roles	The company acting as TCO is in many cases also acting as carrier, but in some cases the TCO could be implemented by separate companies (e.g. in THALYS trains).

Commented [JS6]: Check with TAP

Commented [JS7]: Too restrictive

3.9. Security Provider	
Definition	The security provider seals the ticket data and thereby guarantees the correctness of the data.
Motivation / Distinction to other roles	The role to provide the signature of ticket data in a Security in Data environment cannot be attributed to one of the already defined actors. In many cases for NRT and IRT tickets it is made by the same company that issues the ticket.

4. Functional design

4.1. Business Capabilities / Use Cases

The business capabilities to be supported cover the following three areas:

Online Control:

The e-ticket needs to be validated by the TCO. In order to achieve this all data describing the ticket and all previous annotations made to it must be provided to the TCO. The data needed to identify the ticket ("ticket identification") must be transferred to the TCO.

The functional use cases defined to provide this capability are:

- Retrieve a ticket
- Retrieve tickets of a train
- Provide tickets
- Provide control annotation

Travel Contract modification:

The TCO can make changes to the ticket to change the validity concerning the time, the route, the allowed products and the number of passengers.

The functional use cases defined to provide this capability are:

- Provide validity change annotation
- Provide quality violation annotation (delays, service degradation)

Check-In:

To support Check-In services the TCO can indicate check-In information at the ticket.

The functional use cases defined to support this capability are:

- Provide check-In annotation
- Provide check-out annotation

Note: The check-in service itself is not part of this specification. It provides only the option to inform on existing check-ins for a ticket.

Commented [JS8]: Allocator to be replaced by Issuer to be in line with TAP TSI

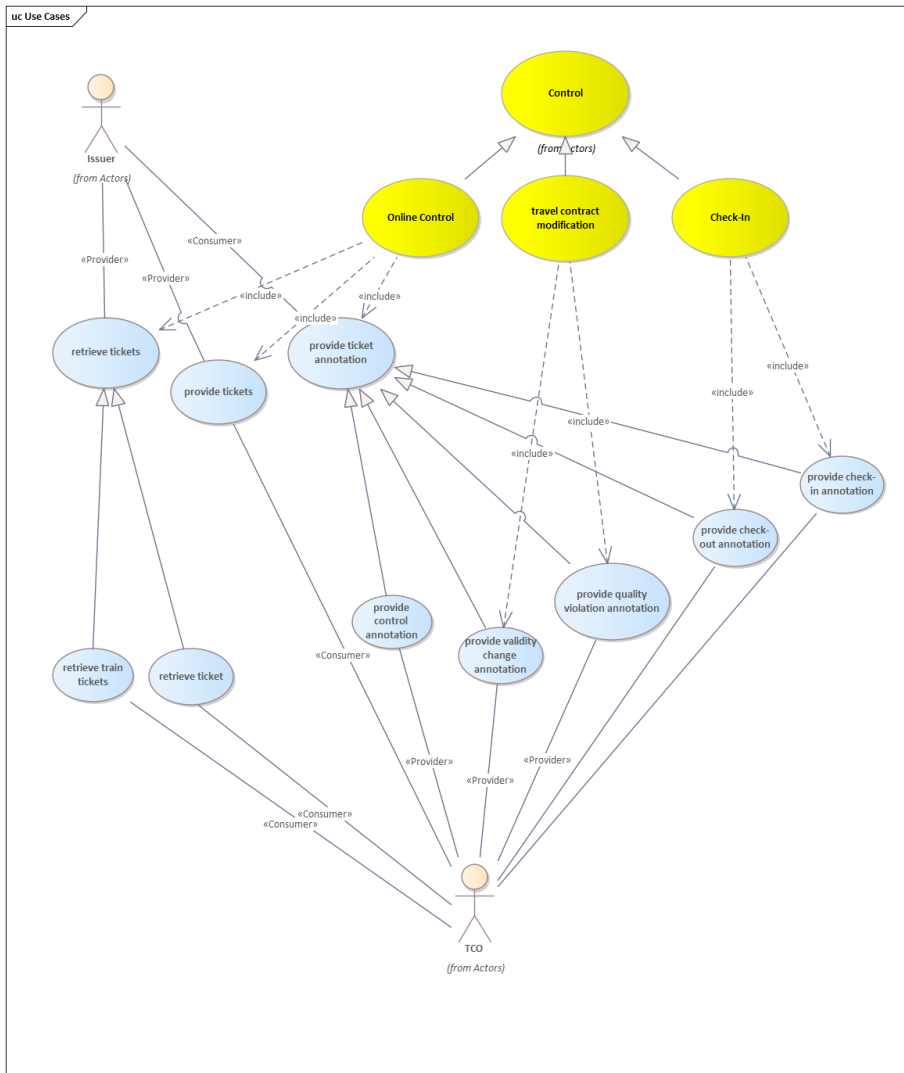


Figure 3 Use Cases Overview

4.2. Business Objects

The control deals with two data objects only:

- the ticket
- the ticket annotations

The ticket data describe the initially sold ticket whereas the ticket annotation describes all possible changes to the ticket.

4.2.1. Tickets

The ticket data set contains all data that can be part of the FCB data content for home print tickets used to control home print tickets defined in TAP TSI TD B.12. These data have been extended by the personal data defined for e-Ticketing of IRTs in TAP TSI TD B.5.

4.2.2. Annotations to tickets

Annotations are used to add information to the ticket and to document changes to the ticket and contract of carriage. They can be created by the TCO (on behalf of the carrier) or the issuer.

All annotations contain a basic set of data describing:

- To which ticket does the annotation apply?
 - Ticket Identification
 - Ticket signature to ensure that the ticket will not be modified (optional)
- Who created the annotation?
 - Carrier / TCO
 - Staff Id / device id / device type
- Where was the annotation created?
 - Location on a train / location at a station / geocoordinates
- When was the annotation created?
 - UTC time
- When was the annotation added to the ticket data?
 - UTC time

4.2.3. Control vs. Check-In vs. Activation

Annotations can be made for (among others) control of a ticket, activation/Deactivation of a ticket and Check-In. All three have a different semantics that does not overlap:

Annotation	Semantics
Control	The ticket has been controlled. The control might concern the entire ticket validity of only some aspects of it. Automated controls might not validate all aspects of a ticket (e.g. validity on the train but not the age of passengers). A controlled ticket can be assumed as at least partially used.
Activation	An activation makes the ticket valid. A ticket might be activated from scratch in the ticket data itself or might become activated or deactivated later-on by annotations. A deactivated ticket is not valid for travelling. An activated ticket is a valid ticket but might not have been controlled.
Check-In	The check-In links a ticket to a specific train and place(s) where the customer is located. There might be multiple check-ins for a ticket due to different trains or a change of place during the travel. A Check-In does not indicate a control of a ticket, so an invalid ticket might be checked-In. Check-In is used to facilitate automated control without or with limited control by train staff. It provides also the possibility to pass information from one train staff to another along the route of a ticket previously not linked to a train.

Commented [CG10]: Proposal for the requested clarification on control vs. check-in vs. activation

Commented [JS9]: Still to be defined to distinct between the check-in in case of some long distance operators, such as Eurostar.

4.3. Online Control

A passenger on board of a train is controlled by a TCO. The ticket data are available online only. The TCO needs to retrieve the ticket data to validate the ticket. It is assumed that there is an online connection available to retrieve data. If there is no online connection a whitelist solution needs to be applied to load the relevant tickets beforehand.

4.3.1. Retrieving the ticket

The TCO needs to retrieve the ticket data. He therefore needs to know where to find the ticket data and how to identify the ticket.

Retrieving the ticket via the ticket id:

The TCO takes the ticket id and the responsible issuer from a bar code provided by the passenger or manually typed in.

- Issuer Id
- Ticket Id / control id
 - ticket id as used today can be used to retrieve a ticket
 - to simplify manual input preferably capital letters are used for a ticket id
- Date of issue (date as indicated on the ticket or in the bar code)

Note: The date of issue is used as the ticket id will be reused after some time. As the date on a ticket printout might be given in local time zones the provider of the service needs to ensure that the ticket is found regardless of the time zone used.

This is implemented by the service "[Retrieve a ticket](#)".

In case a ticket cannot be retrieved the following cases should be indicated:

- Ticket does not exist → the requested ticket has never been issued
- Ticket not found → no information on the ticket, might be ok but we don't know

This can be used in case of technical problems or during a ramp up phase when not all tickets have been included in the system.

Retrieving the ticket via the train number:

The TCO requests all tickets linked to a train. The TCO requests the tickets for a carrier, a train number and a travel date.

The following tickets will be retrieved:

- Reservations on the requested train
- Tickets with a train link to that train
- Tickets with a check-in on that train
- Tickets controlled on that train

Note 1: This will not deliver tickets valid on the train but not (yet) linked to the train and is thus limited to special scenarios as in: "[Train staff check-in](#)~~Night train check-in~~".

Note 2: The request will deliver tickets with a departure date as indicated in the request. In case a train runs over midnight two requests will be needed.

This is implemented by the service "[Retrieve tickets linked to a train](#)~~Retrieve tickets linked to a train~~".

Retrieving the ticket via passenger data:

The ticket should be retrieved via the passenger name or a passenger id.

An implementation of this scenario shall be made by the TCO using the tickets provided by the issuers. This avoids implementing a complex logic to identify the relevant issuer systems and to implement name search in all issuer systems.

This scenario is only supported by the ticket data delivery via the ticket queue specified in chapter "Ticket Queue". The personal data needed for the search can be provided in these ticket data.

Retrieving the ticket without permanent online connection:

The tickets provided to the TCO in the ticket queue specified in chapter "Ticket Queue" can be loaded to the local control devices by the TCO beforehand.

Retrieving all tickets

Tickets can be delivered only to those TCOs/Carriers that are indicated as allowed companies in the ticket data.

Tickets are delivered via a message queue. Issued tickets need to be delivered. A new delivery is required when annotations have been added. The ticket queue is specified in chapter "Ticket Queue".

A request message is provided to restart the delivery of all tickets in this queue. The TCO/carrier can request a restart of the ticket delivery in case of:

- A severe disaster that destroyed the ticket data at the TCO/Carrier
- As initial load when a TCO/carrier starts to use e-ticket control
- As initial load to start a new test system

Ticket for a specific train run can be requested by a service.

4.3.2. Validating the ticket

The validation of the ticket is the task of the TCO. There is no standardization need for this part.

Optionally the trip for which the ticket was sold and where the ticket is guaranteed to be valid can be added in the ticket data.

4.3.3. Documenting the validation of the ticket

The control annotation documents a control of the ticket. It provides information on the scope of the control and the result of the control and optionally the actions taken in case the ticket was not ok.

Scope of Control

- Full control
- This ticket was seen as Check-In
- This ticket was seen as Check-Out
- Route is checked
- Carriers are checked
- Class of travel is checked
- Validity (time) is checked
- Tariffs are checked
- Train number is checked
- Service brand is checked

Result of the control

- Control is ok
- Route is not ok

- Carrier is not ok
- Class of travel is not ok
- Validity (time) is not ok
- Tariffs are not ok
- Train number is not ok
- Service brand is not ok

Action taken

- Fine issued
- New ticket was issued (incl. Ticket Id)
- passenger left the train
- Ticket collected for further checks (only in case of secure paper ticket combined with e-ticket)
- None

Further Usability

- Detailed check needed ticket probably not usable any more
- Ticket not usable any more
 - Indicating that the ticket has been used and cannot be used any more after the given date and time.

This is implemented by the service "Create an annotation".

4.3.4. Basic validation scenario

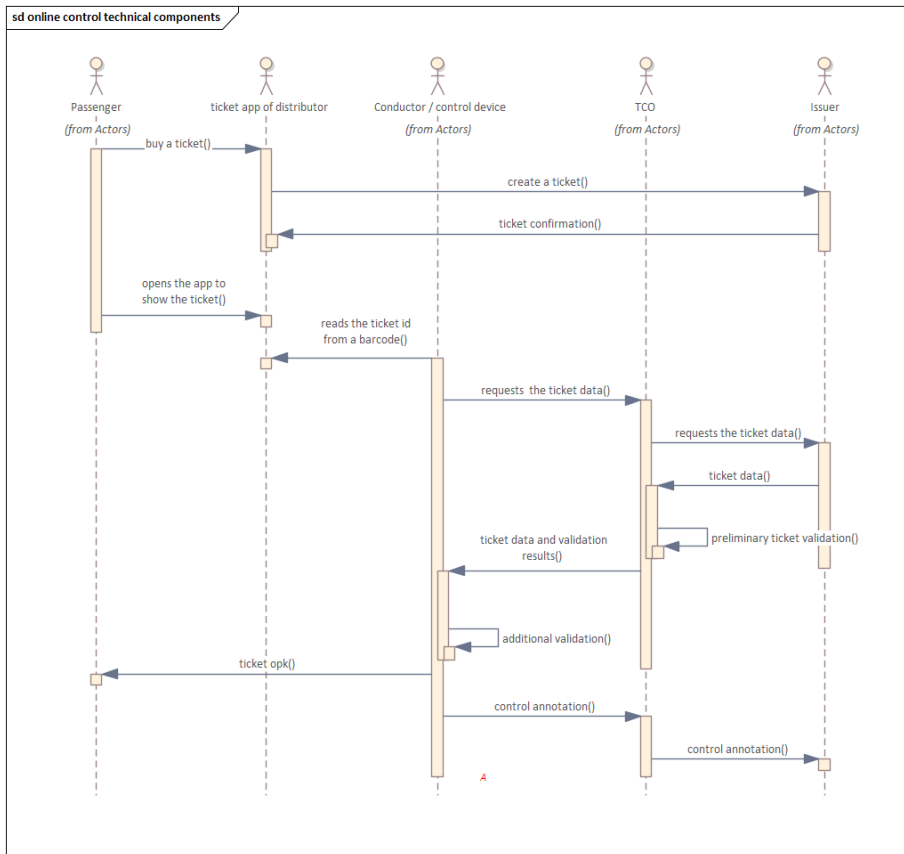


Figure 4 workflow and data flow for online control including TCO devices

4.3.5. Control scenarios with multiple TCOs

Two TCOs controlling along a route:

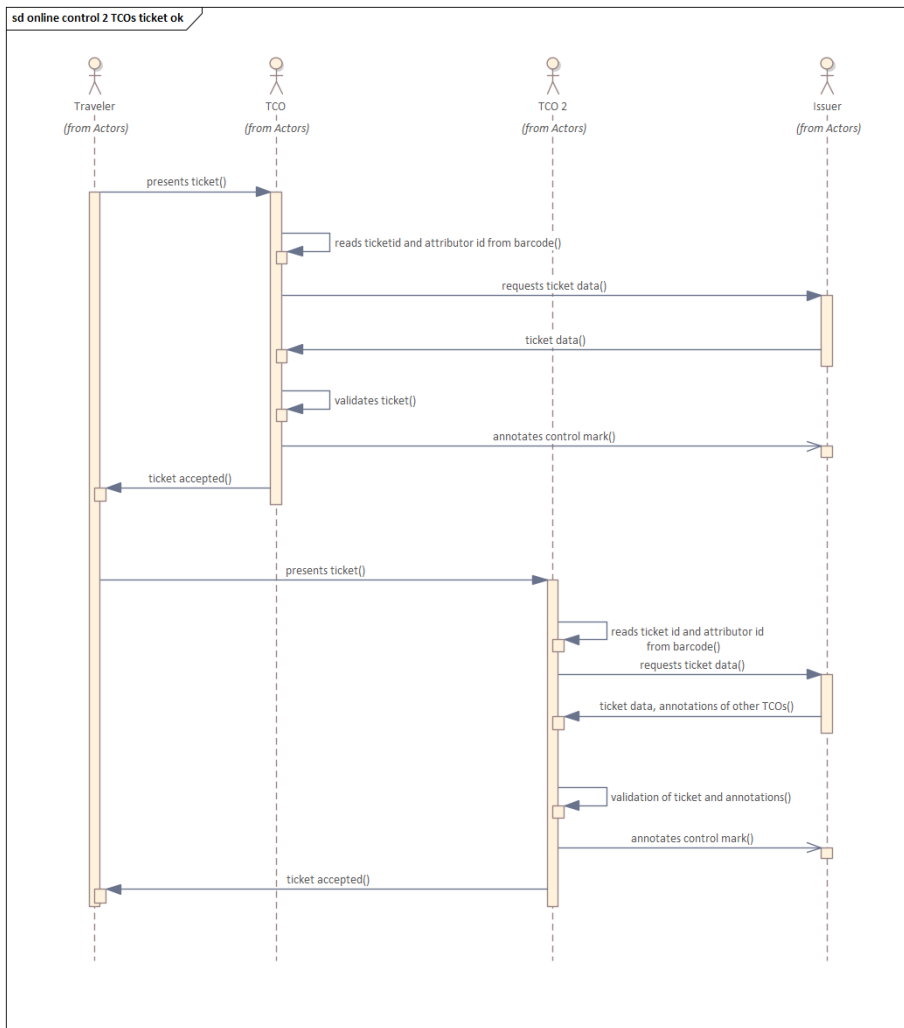


Figure 5 online control with two TCOs and ticket valid for both controls

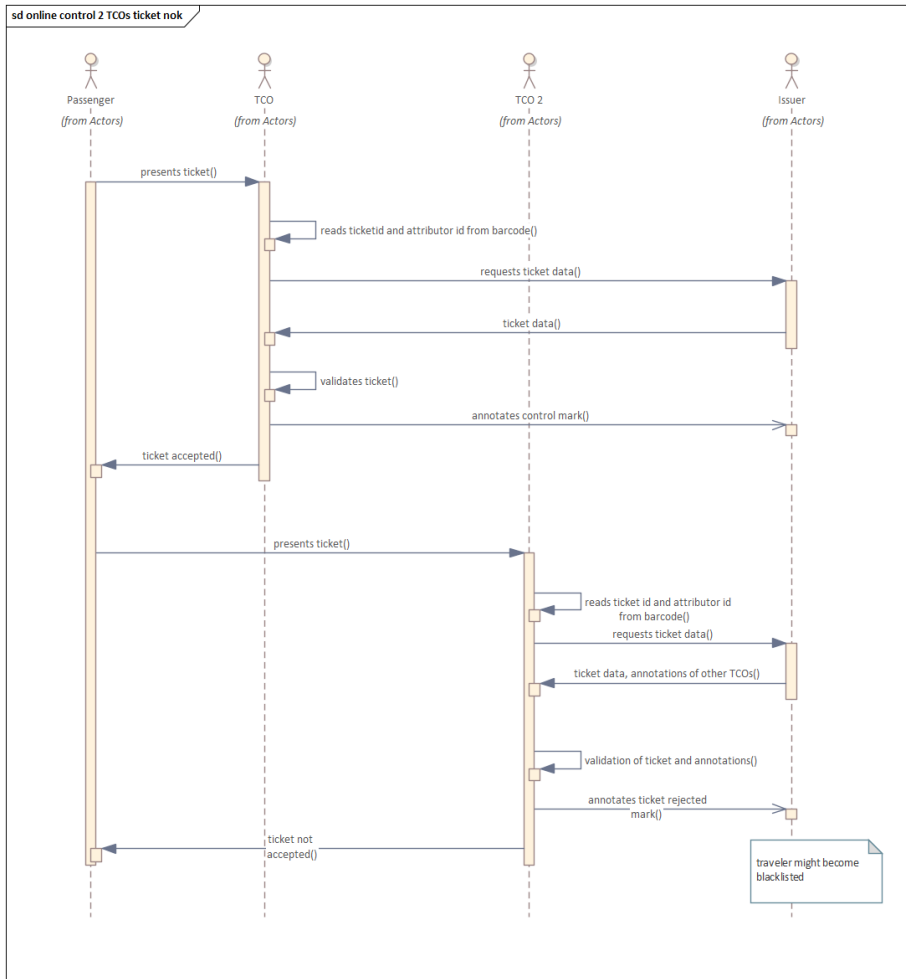


Figure 6 online control with two TCOs and ticket not valid after first control

Two TCOs controlling on the same train and route:

This occurs where staff two TCOs control tickets on one train. The control devices of the staff depend on the TCO and are thus different.

This scenario is a special case of the scenario of two TCOs controlling on different section of the train. No additional functions are needed to cover the scenario.

Two TCOs controlling one using whitelist and one using online validation:

Commented [JS11]: Traveller to be replaced by passenger,
Allocator to be replaced by issuer

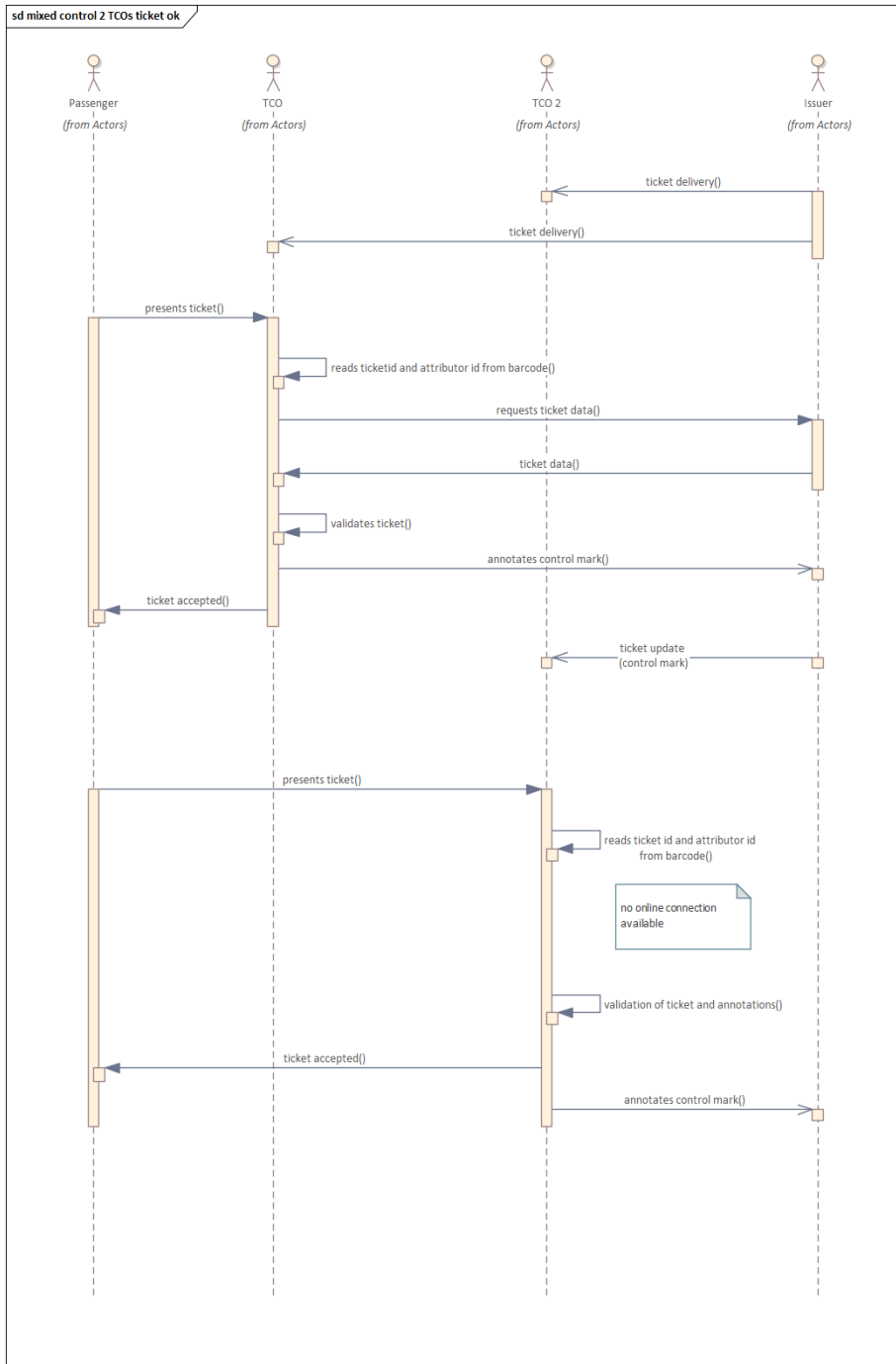


Figure 7 Mixed Online/Whitelist control

4.3.6. Delayed data transfer

In case the control device is offline for a significant percentage of time the control information will be received not in time by the issuer. Thus, there is the risk that a refund is paid although the ticket has been used. To exclude this risk the refund payment must be delayed (“freeze period”) until the annotations have been received.

The agreement between the TCO and the issuer must define the time required to receive control marks. In case of multiple carriers on one ticket the longest time applies. There is no legal restriction on the length of the freeze period except for the periods to refund in case of train delays after one month.

Commented [JS12]: Traveller to be replaced by passenger, Allocator to be replaced by issuer

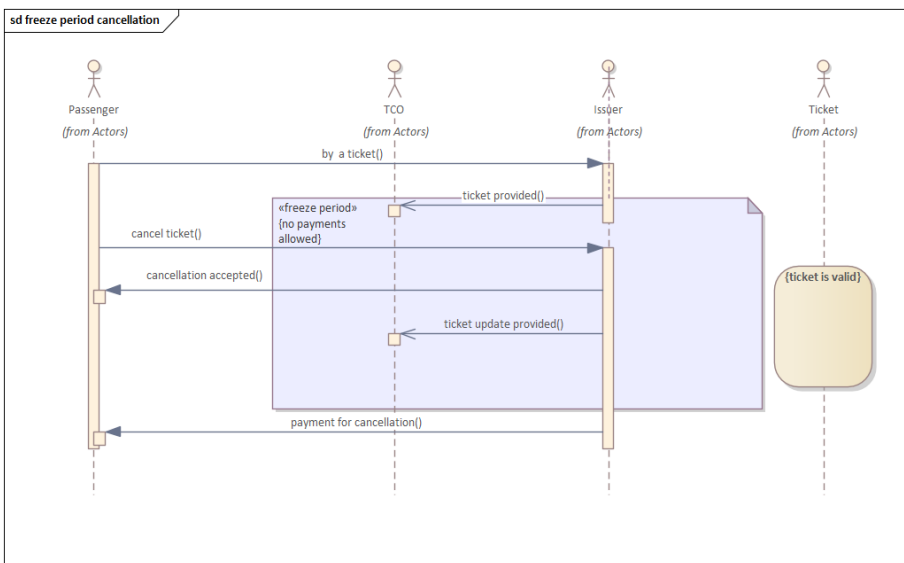


Figure 8 freeze period for cancellation (ticket not used)

Conform the European Regulation, a customer has the possibility/right to a full immediate refund when there is, before departure, a delay of 60 minutes or more. Ticket is refunded in that case, but customer can simply take the next train that leaves the next hour, with a copy of his digital ticket.

An immediate payment is not mandatory, so payment can be delayed.

Commented [JS13]: Traveller to be replaced by passenger, Allocator to be replaced by issuer

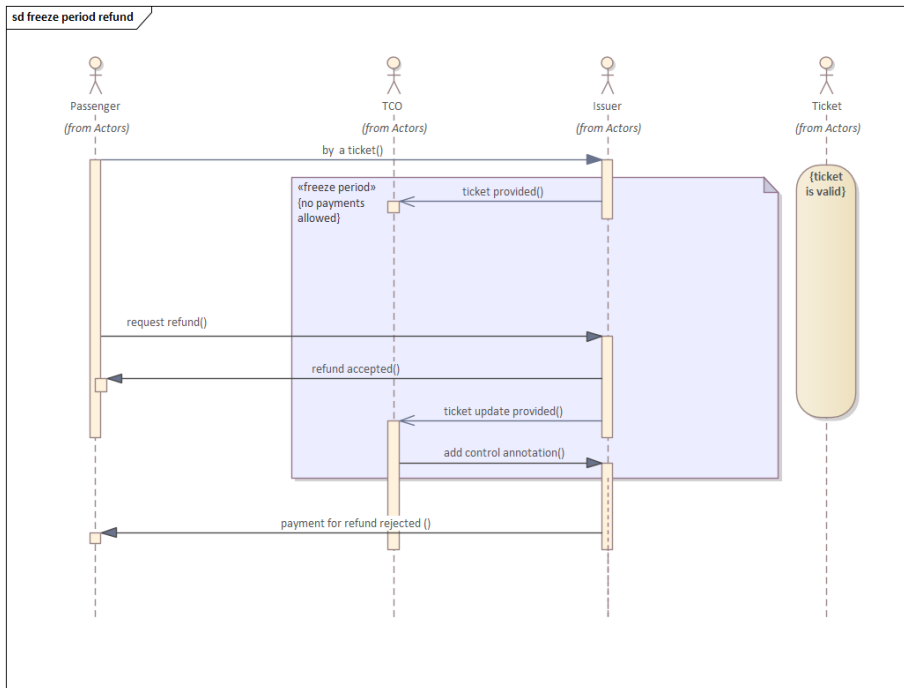


Figure 9 freeze period on refunds (refund claimed but ticket used)

4.3.7. Validating dynamic bar code content

The dynamic bar code (DOSIPAS) is defined in IRS 90918-9. It provides two levels of data, the level one data representing the ticket and the level two data representing data that are collected and signed during the control process in the app of the traveller.

ISR 90918-4 provides the option to exchange information that is included in the dynamic data part by the app with the TCO so the TCO can validate the dynamic bar code content.

Via an annotation it is possible to link the ticket to an app and providing information on:

- The phone id
- An electronic passport read at control time
- The option to ask the traveller to enter a challenge code in the app which will become part of the bar code

The provider of the app and the annotation data will most likely be the distributor of the ticket, however this is not required by the specification.

The data for the dynamic part of the bar code are provided by the LinkAppAnnotation. It is possible to make a new link annotation that indicates that the old link is replaced (e.g. to change the phone).

Commented [JS14]: Traveller to be replaced by passenger, Allocator to be replaced by issuer

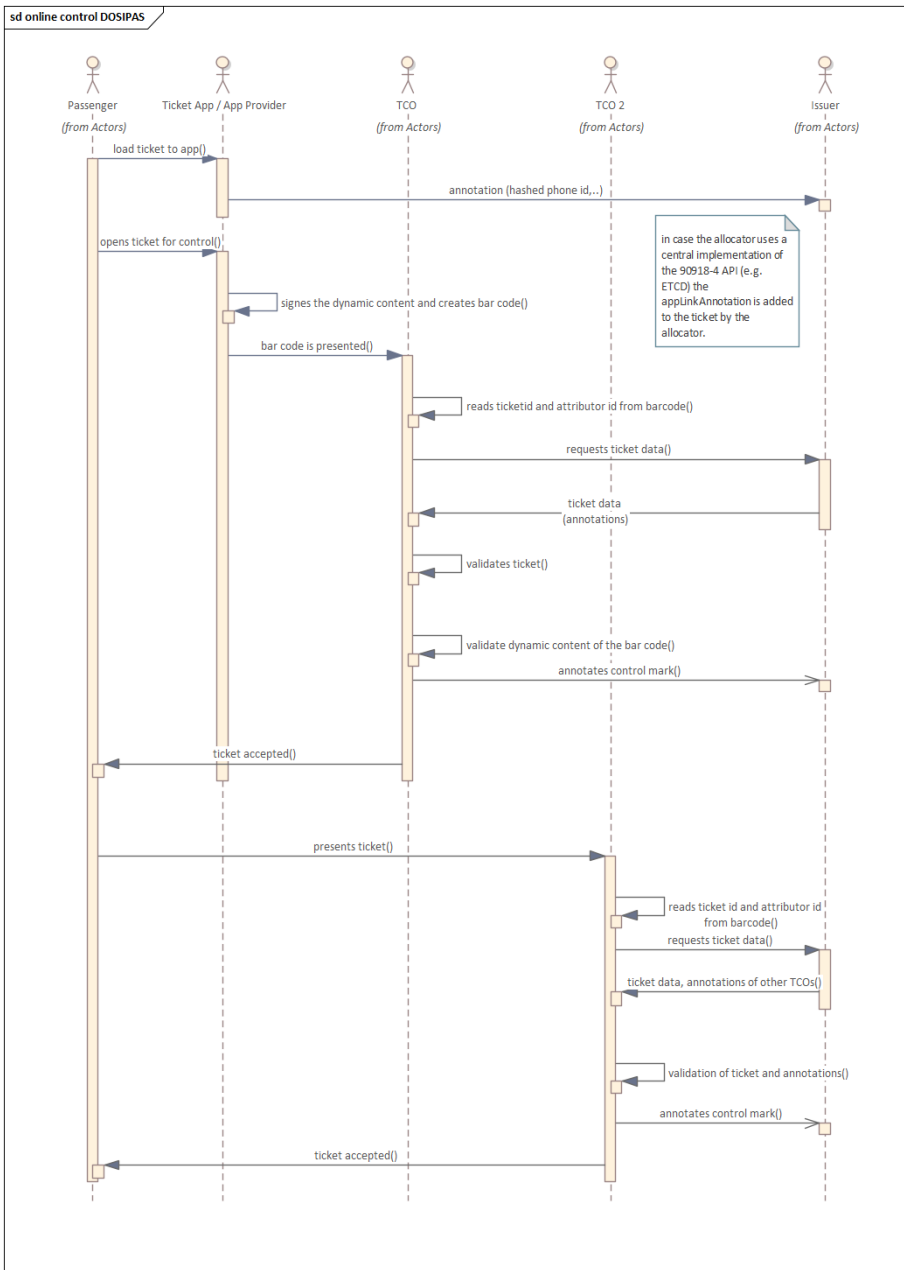


Figure 10 Validation of DOSIPAS bar code

Commented [JS15]: Not yet included in the TAP TSI

Commented [JS16R15]: CR for B.12 will be submitted by UIC

4.4. Travel Contract Modification

Based on the initial ticket data all modifications of the travel contract are documented as annotations to the ticket.

The TCO can make modifications according to the tariff conditions of the carrier.

4.4.1. Validity changes

- Extend the validity period
 - The deletion of the ticket and / or its personal data is delayed due to the new end of validity
- Extend the regional validity to other routes
- Extend the allowed services
- Allow alternative trains
- Remove the link to a specific train
- Extend the carriers allowed
 - The new carriers are allowed to access the ticket
- Upgrade the class (Booked class overcrowded and train manager decides to open higher class)
- Reduce the number of passengers
- Abandon the journey

The modifications of the ticket can be provided with a reason.

4.4.2. Service violations

It is also possible to document that the contract of travel could not be fulfilled by the carrier and thus the passenger is entitled to receive a compensation:

- Delay of a train
- Cancellation of a train
- Downgrade of a service

An annotation for a downgrade does not necessarily involve the train staff. The control application could automate this in case it knows of the product downgrade.

Commented [JS17]: Traveller to be replaced by passenger,
Allocator to be replaced by issuer

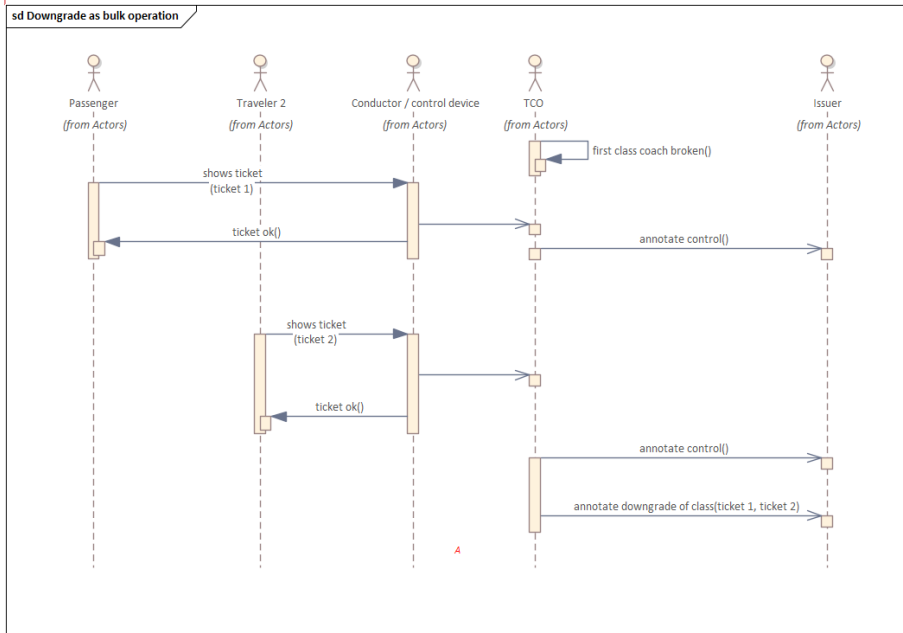


Figure 11 annotation of class downgrade as bulk operation

4.4.3. After sales operations

As the original ticket data are kept unchanged the following changes of the issuer are also noted as annotations.

- Cancellation
 - Providing an optional replacement ticket id
- Activation
 - Providing the activation time and date

An activation makes the ticket valid on the given date and time. The ticket must therefore be initially marked as not activated-. The passenger is allowed to use the ticket only after activation. (e.g. FIP ticket with activation for different days).

4.4.4. Others

It is possible to create a text annotation. However, it is recommended not to use this option to avoid misunderstandings. In case this option is provided the staff needs to be informed to comply with GDPR as the text will be processed and passed to other companies.

4.5. Interoperability with Security in Data (bar code) tickets

The online validation of an e-ticket must be interoperable with ticket control of a bar code. In this case the ticket must additionally provide a bar code with the ticket data (Security in Data – SiD).

Issuer A SiS → TCO A (SiS), TCO B(SiD), TCO C(SiS)

The Issuer provides the ticket data centrally and creates a bar code. The TCOs A and C use the online access to the ticket and annotations. The TCO B checks the bar code only.

Issuer A SiS → TCO A (SiD), TCO B(SiD), TCO C(SiS)

The Issuer provides the ticket data centrally and creates a bar code. The TCO C use the online access to the ticket and annotations. The TCOs A and B checks the bar code only (SiD).

The scenario is valid although TCO C has no access to control data of TCO A and B and there is a risk of misuse on the part of TCO A and B.

Issuer A SiD → TCO A (SiS), TCO B(SiD), TCO C(SiS)

The Issuer provides a bar code only. A TCO can make an annotation using the booking reference from the bar code. This would not allow the Issuer and the TCO who made the annotation to access the annotation. Other TCOs would not be included in case this information is not available. The Issuer A would be able to receive the ticket ids with annotation even in case he does not provide the ticket data.

4.5.1. *Offline bar code validation and online validation interoperability*

Issuer A SiS → TCO A (SiD), TCO B(SiS)

The control annotations of the TCO controlling offline will be received later than annotations of the online TCO. Annotations of the offline control might not yet be available at the time of the online control.

4.5.2. *Annotations to tickets not or not yet provided by the issuer (SiD)*

Issuer A SiD → TCO A (SiS), TCO B(SiS)

A TCO controlling a ticket with secured bar code (SiD) which has not or not yet been provided by the issuer needs to create an annotation to this ticket which subsequent TCOs and the issuer can read.

This option is allowed for tickets with secured bar code where the bar code has been validated and the signature is correct.

An add annotation request will create an “empty” ticket which contains the booking reference only. The annotation is added to this “ticket”.

The TCO has the option to add other TCO which shall get access to this ticket and annotation data. The TCO could read and validate a bar code and take the additional TCOs from the content of an FCB bar code.

Commented [JS18]: Traveller to be replaced by passenger,
Allocator to be replaced by issuer

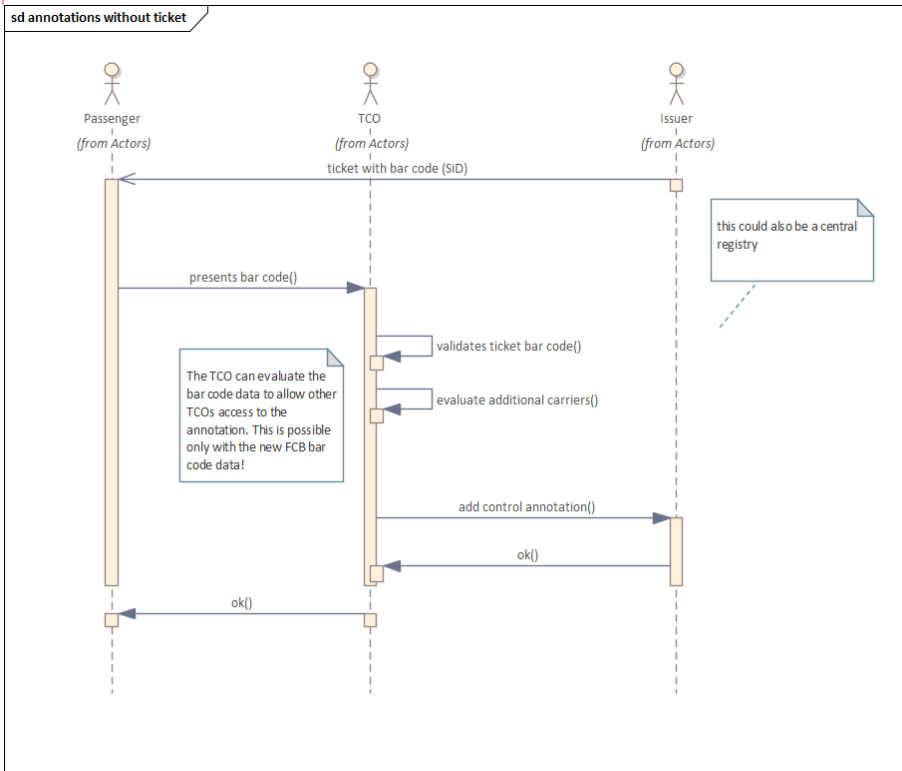


Figure 12 Control scenario starting with an issuer with security in data

4.6. Check-In

Check-in is used by a few railways to combine open tickets like NRT tickets with the advantages of IRT tickets linked to a specific train and place.

With the Check-in the ticket becomes:

- linked to a specific train, coach and place (this can change along a route)
- marked as in use

without personal contact with a conductor. As the check-in is done online with the central ticket database the validity of the ticket can be checked automatically concerning time and route. In case of tariffs applied to a specific passenger type (children, ...) an additional personal check is needed.

A check-in might be mandatory or optional. The check-in is made by the passenger via his ticket app, e.g. by using NFC-Tags at the place where he checks in or via entering the coach and place number manually.

The data of the check-in are transferred to the train staff to avoid the control of already checked persons and to trigger random checks for validating the procedures.

A check-in needs to be added to the ticket as an annotation.

Commented [JS19]: Maybe phrase should be checked. Check-in is already used by mandatory check.in for some trains (e.g. Eurostar)

Commented [JS20R19]: Self-checkin

Commented [CG21R19]: CheckIn can be used by customers (self-checkIn) and by trains staff (e.g. at DB).

Commented [CG22R19]: A proposal for clarification is added at the end of 4.2.2

Check-in is different from an activation of a ticket as it might be optional. E.g. a ticket is valid without check-in, the benefit for the customer is that he is not going to be disturbed by a control and that he can allocate a seat.

Commented [JS23]: Traveller and allocator to be replaced by Passenger and issuer

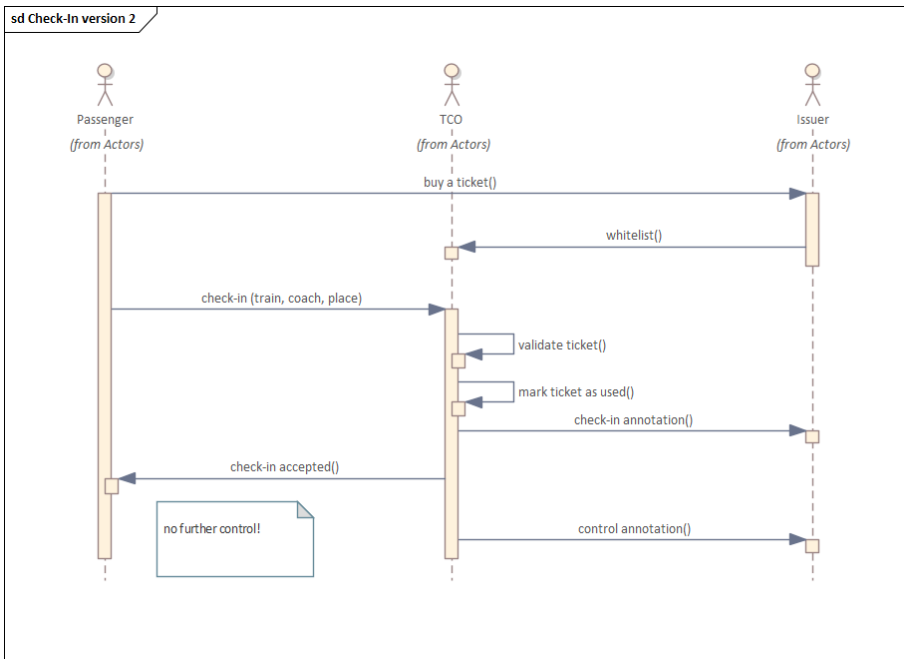


Figure 13 Check-in

It is assumed that the carrier / TCO manages the seat repository to handle check in on free places. In case the carrier / TCO does not handle the place inventory himself it is still possible to use the check in on the reservations. Check in on free places can be implemented via the TAP TSI B.5 interface using service to reserve specific places. The reservation system must then allow to reserve places during the train run.

The check-in can be integrated in the sales app where the customer bought the ticket.

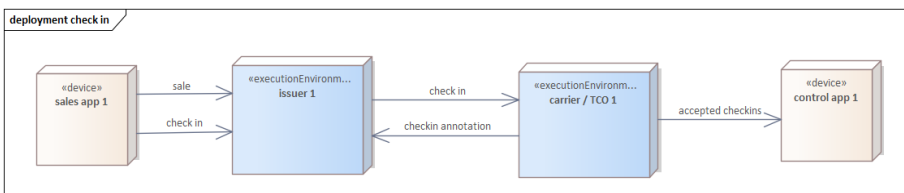


Figure 14 check in architecture

The check-in can be also integrated in a travel companion app of the customer where a traveler must register himself and provide the ticket id.

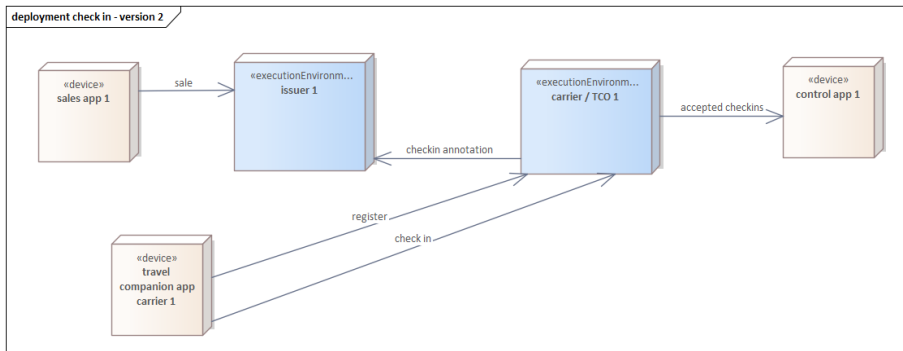


Figure 15 check-in architecture 2

The check-in service itself is not within the scope of this specification, but the information on a check-in made is part of the control information added to the ticket as annotation.

4.6.1. Check-In Annotation

The check-in annotation provides information on the train, travel date, route, coach and places where the passengers are located. It includes information on additional ticket validations required.

4.6.2. Check-Out Annotation

The check-out annotation indicates that a check-in had been reversed.

4.6.3. Train staff check-in

The passenger buys an open ticket and a reservation with supplement. The issuer of the open ticket and the reservation might be different.

The passenger enters the train and provides the ticket and the reservation to the first TCO. The TCO requests the ticket data from the issuers, validates the tickets and provides a check-in annotation to each of the issuers. The check-in annotation includes the train number and the coach and places which were used and provides a link between the open ticket and the reservation.

The issuers provide a ticket list including the annotations to the involved carriers / TCOs. The tickets can be forwarded to the conductors on the train by the local TCOs as the train is now known from the check-in annotation.

Thereby all conductors on the train can receive the reservation and the linked open ticket for control without asking the passenger during the night.

- Commented [JS24]: Not limited to night trains! Day trains can be used
- Commented [CG25R24]: The description was added as this was a dedicated requirement from night trains, however it is applicable in general and also used in night trains. Change: Night train check-In → Train Staff Ceck-In?
- Commented [CG26R24]:

- Commented [JS27]: Allocator / Traveller to be replaced

Commented [JS28R27]: Attributor: Issuer to be verified

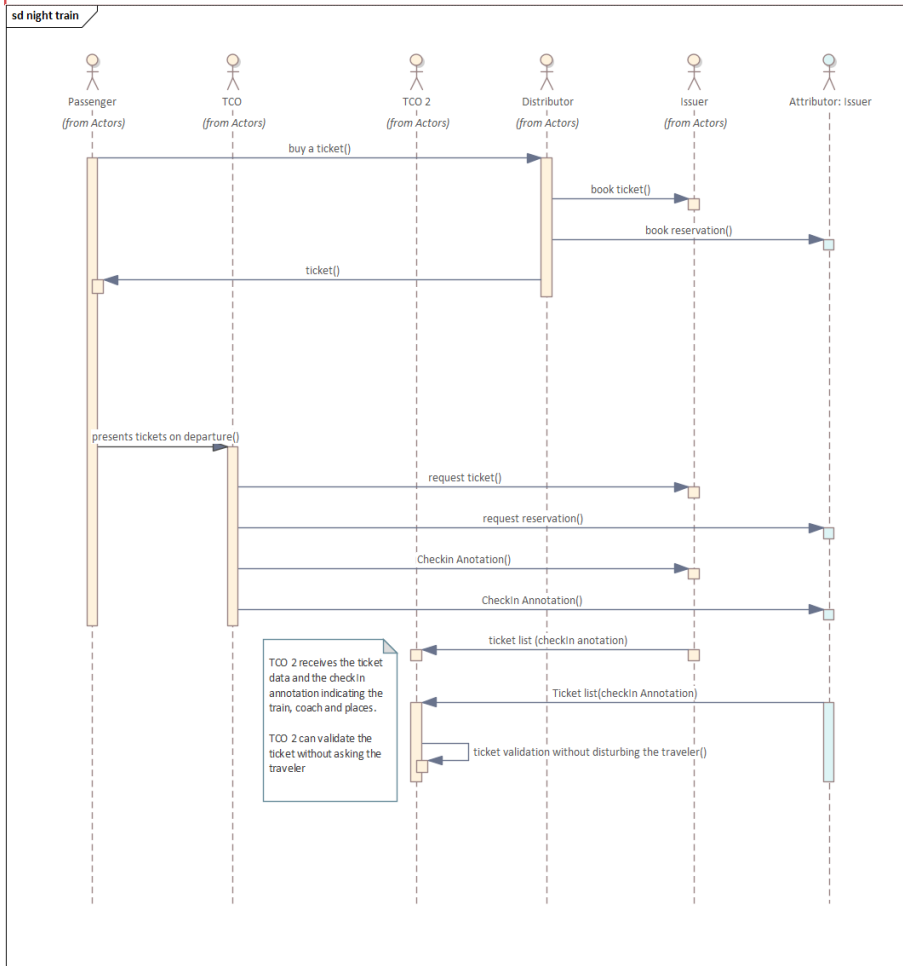


Figure 16 night train with reservation and open ticket for multiple TCOs

4.6.4. Activation Annotation

The activation annotation indicates that a ticket has become valid within a specific period. This applies to tickets which allow to be activated on a specific number of days by the customer (e.g. passes with a validity of n days within a month where the customer can choose the days later).

An alternative approach would be to exchange the ticket with each additional activation.

4.6.5. De-Activation Annotation

The de-activation annotation indicates that a ticket has become invalid again. It invalidates all previous activation regardless of the provided optional time frame of these annotations.

Possible scenarios are tickets where the customer centre needs to clarify the validity or reset activation errors made by the passenger.

The de-activation annotation can be set by the issuer of the ticket only.

4.7. Metadata

Metadata define parameter of the data exchange that need to be agreed bilaterally.

4.7.1. *freeze-periods*

Freeze-period for refunds:

Time period during which no payment for refunds is allowed as the status of the ticket might not have been delivered to the ticket data base. The time period is defined in relation to the start of validity:

- Minutes before start of validity when the freeze starts
- Duration in minutes

Freeze-period for cancellations:

Time period during which no payment for cancellations is allowed as the status of the ticket might not be delivered to the TCO/Carrier in time. The time period is defined in relation to the start of validity:

- Minutes before start of validity where the freeze starts

Latest delivery of control data:

Time up to when control data must have been delivered in minutes after control. In case the data were delivered too late a damage needs not to be compensated by the issuer.

- Minutes after control on a train

4.7.2. *control capabilities*

Data on the supported control capabilities of the involved TCOs of a carrier

- Carriers (included in NRT data) → which TCOs and control capabilities

The carrier/TCO must agree with the issuer whether an additional SiD process must be supported and for which pre-booking time onwards.

4.7.3. *usage of personal data*

Some TCOs might not need (some) personal data and thus they must not receive these data.

For a TCO:

- List of allowed fields of the personal data by tag name

5. Technical Design

5.1. Deployment architecture options

- Peer-to-peer: The issuer implements the standardized services directly with each TCO
- Multiple Registries: An environment with multiple local registries.

Commented [JS29]: Maybe to be reduced

Commented [JS30R29]: Options can be reduced, e.g. p2p and multiple registries

5.1.1. Peer-to-peer

The issuer implements the standardized services directly with each carrier/TCO

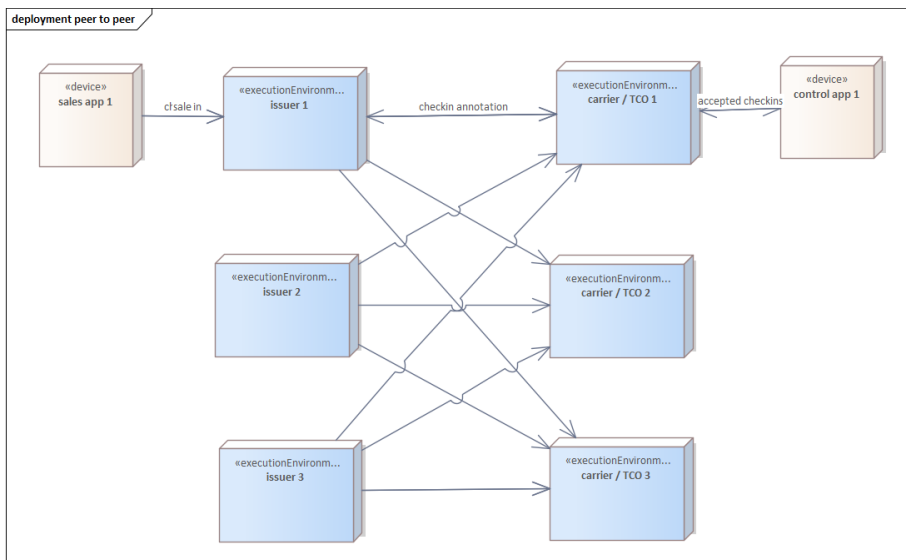


Figure 17 peer-to-peer architecture

Commented [SJ31]: Allocator → Distributor

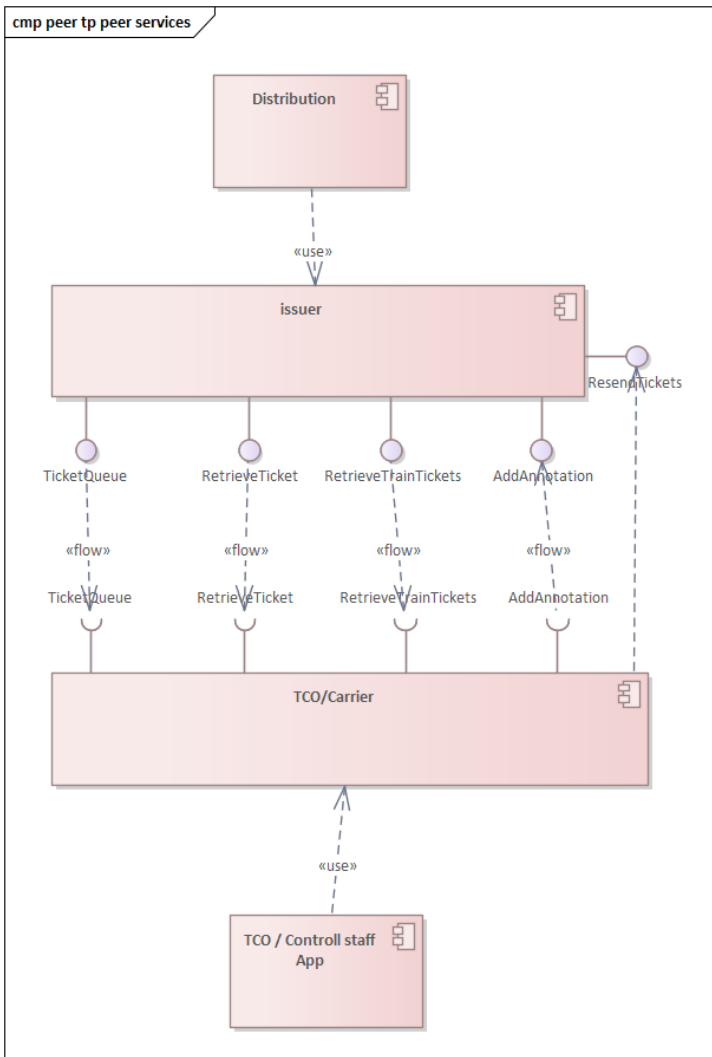


Figure 18 Services for peer to peer architecture

5.1.2. Multiple Registries

The solution allows multiple registries in order not to violate competition law.

In order to reduce costs and complexity it is recommended to use as few registries as possible.

In case of multiple registries, a TCO needs to identify the registry where the ticket seen on board might be located. If the TCO/Carrier has received the ticket via a queue already this information is already available to him.

In case the TCO/Carrier does not use the queue to receive all tickets but requests the tickets online only he needs to detect which registry he needs to access. To simplify that task each registry will provide a list of hosted issuers as a service.

An environment with multiple local registries.

Commented [JS32]: Maybe the preferred way for TAP?

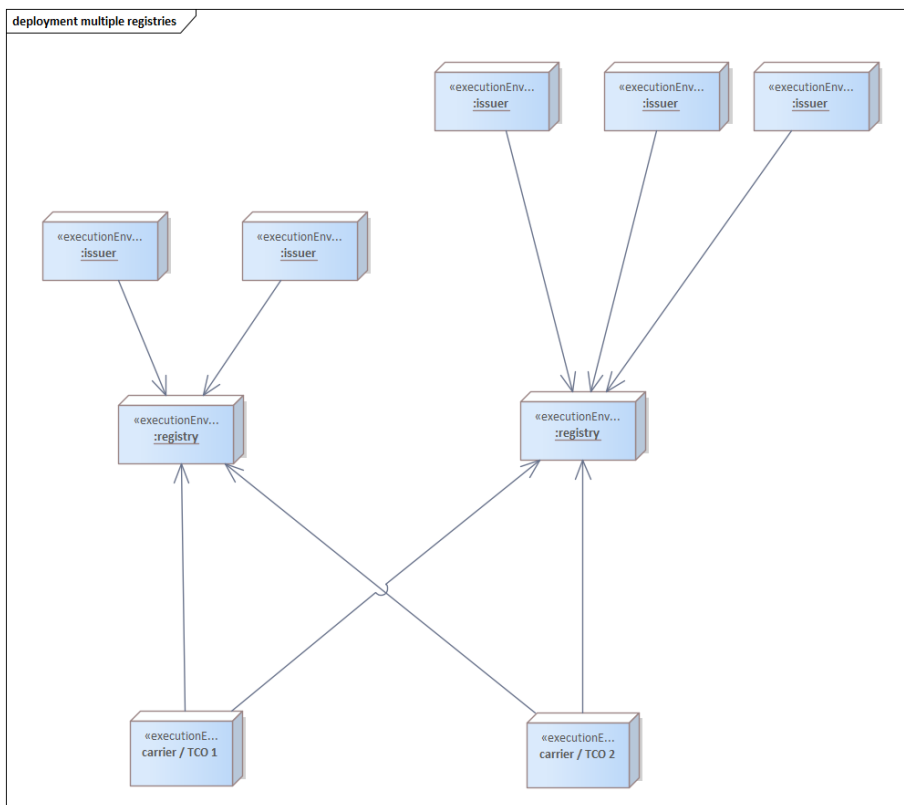


Figure 1923 multiple central registries

Commented [JS33]: Allocator to be replaced by distributor

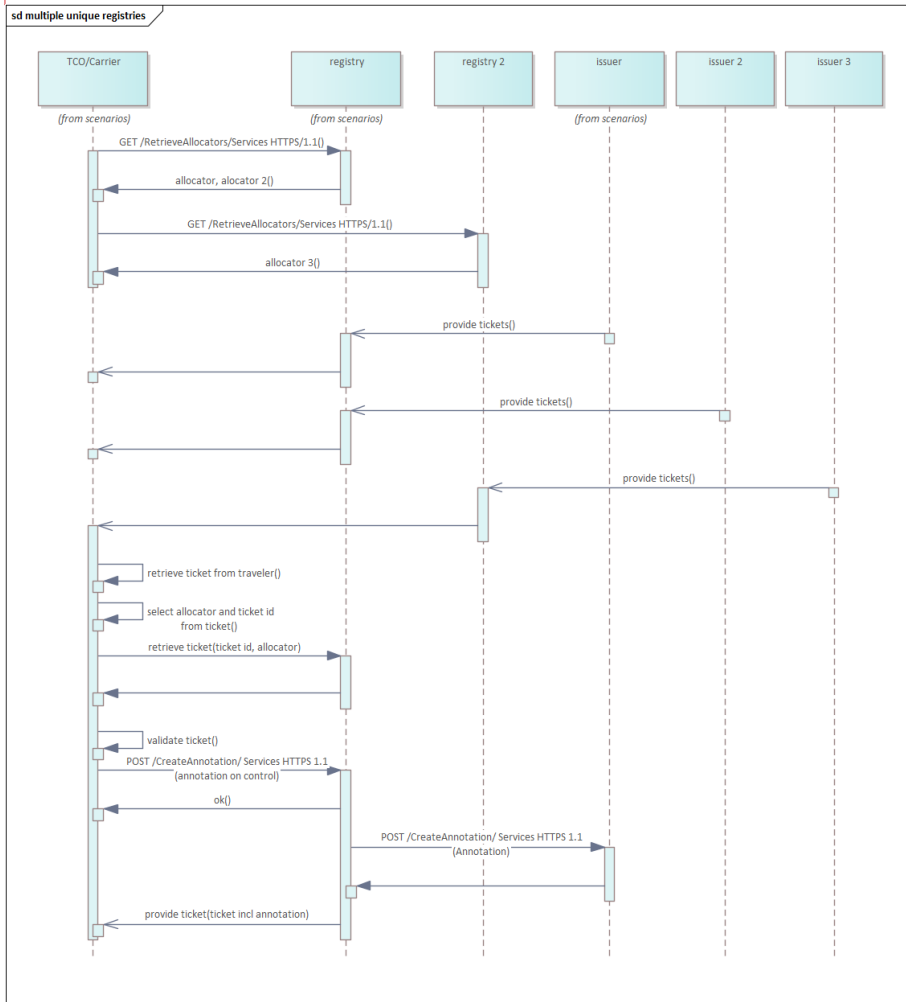


Figure 2024 Data exchange using multiple unique registries

One registry holding the tickets of an issuer is sufficient, however the exchange would also work with an environment including multiple registries and duplicated ticket data.

Commented [JS34]: Allocator to be replaced by issuer or distributor

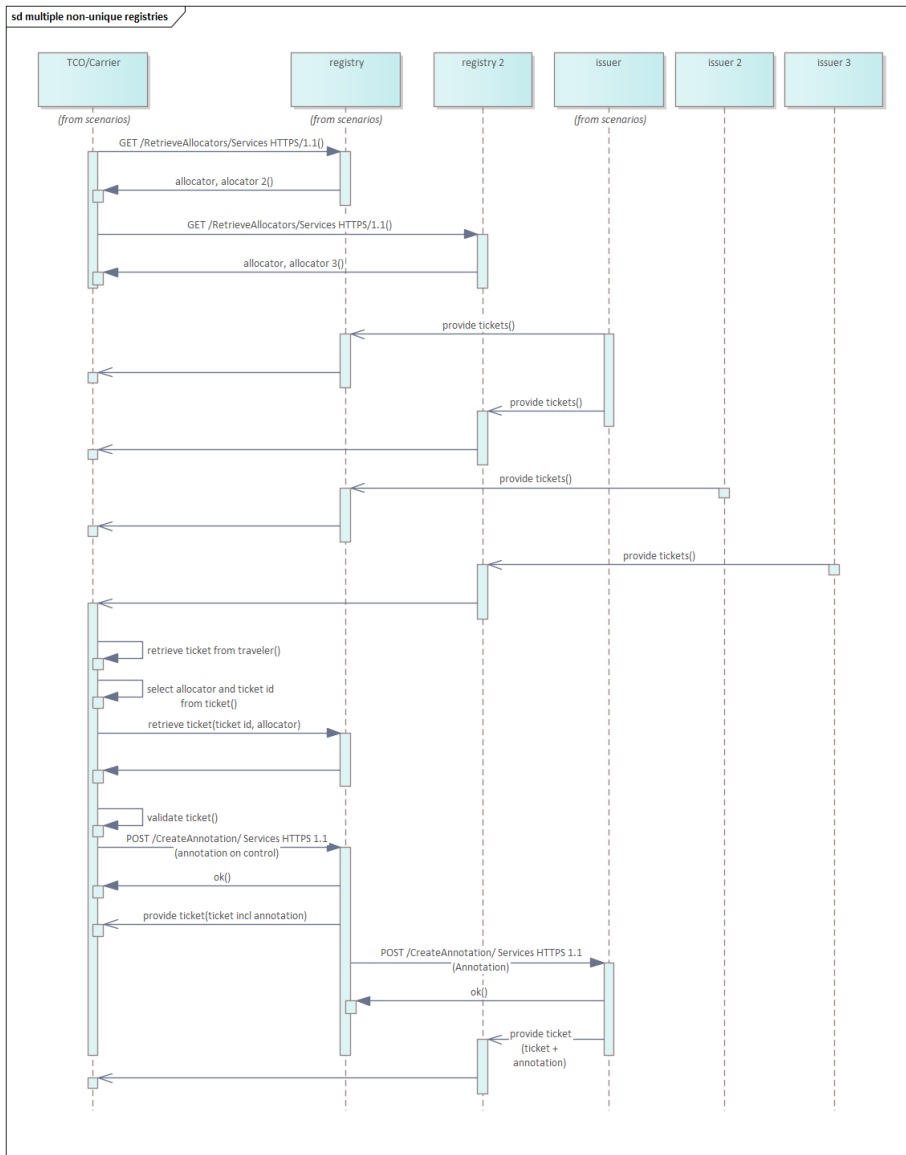


Figure 2125 data exchange using multiple non-unique registries

5.1.3. Minimal implementation option for a TCO using the registry

In case a TCO used the registry the minimal implementation to be made by the TCO would need:

A local device to:

- Manage the authorization of the train staff using the device
- Scan the bar code to retrieve the ticket id
- Request the ticket online from the registry
- Send an annotation to the registry

A minimal implementation of the TCO can avoid implementing a ticket data base. He does not need to implement functions to find the issuer system and to retrieve the ticket.

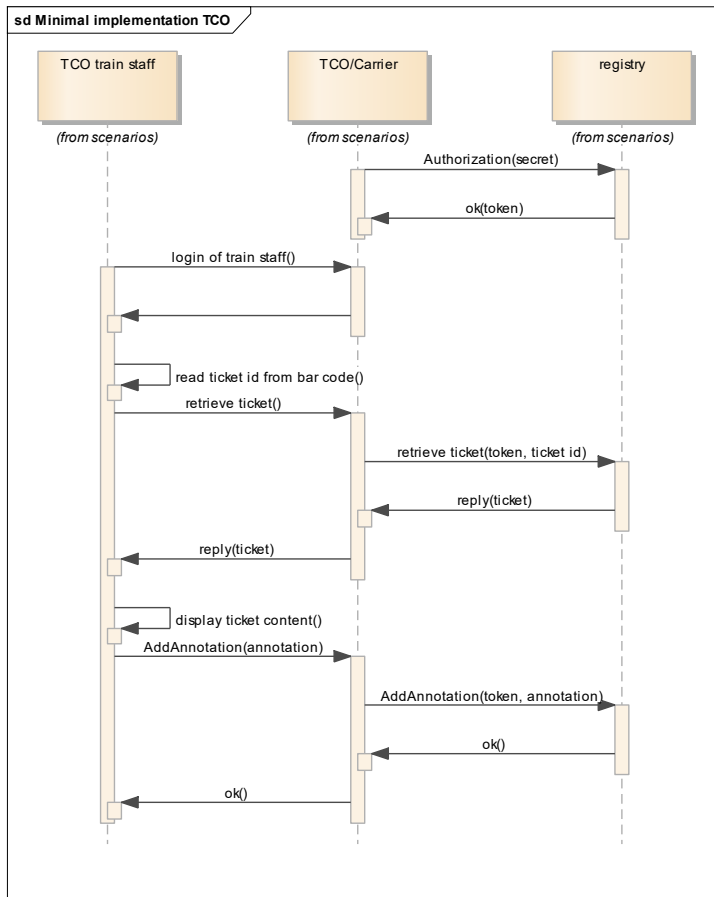


Figure 2226 Minimal TCO implementation

5.1.4. Minimal implementation option for an issuer using the registry

In a minimal implementation the distributor could implement the receiving of annotations without providing tickets. This would allow him to replace proprietary file transfers of control marks by the faster queue transfer.

Depending on the existing issuer interfaces a registry could provide mapping function to access the ticket status.

Commented [JS35]: Allocator to be replaced by issuer

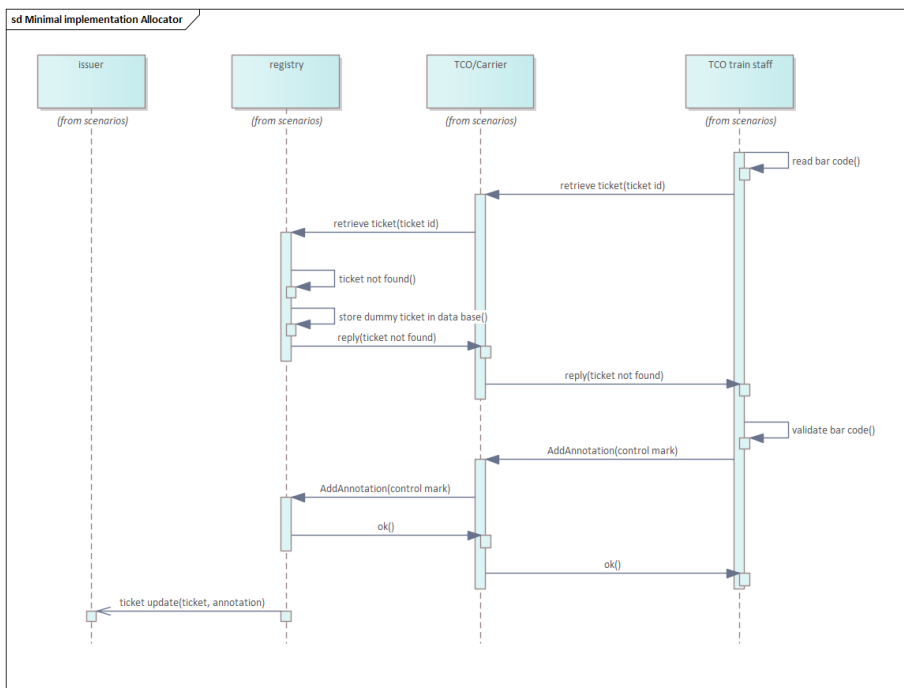


Figure 2327 Minimal Issuer implementation - receive control marks only

5.1.5. Full implementation for an issuer using the registry

For a full implementation the issuer would additionally need to provide the ticket data and to provide updates of the ticket data in case of cancellations.

Commented [JS36]: Allocator to be replaced by issuer

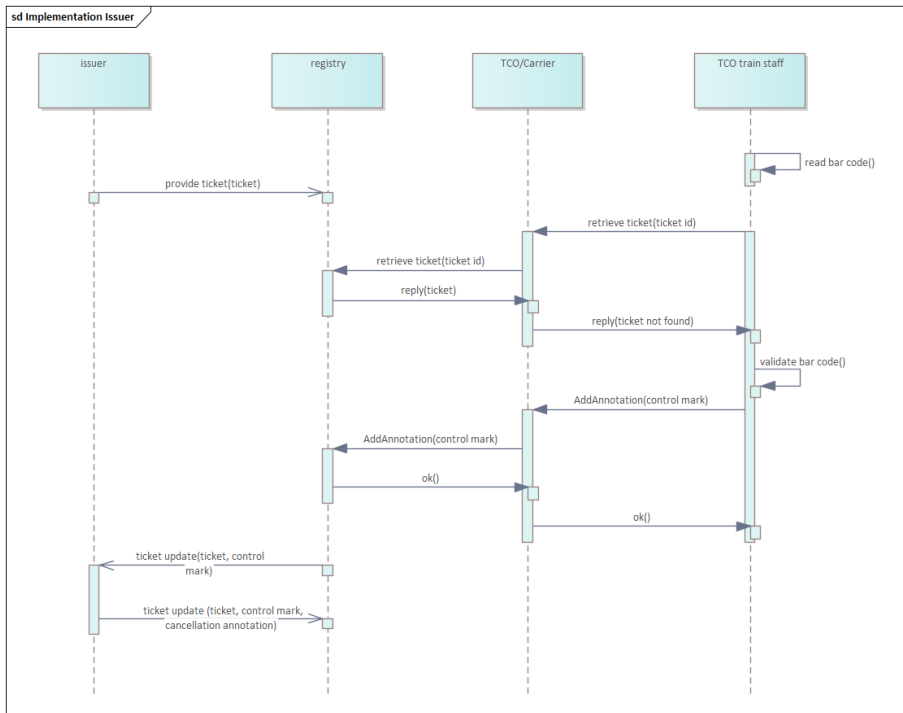


Figure 2428 Full implementation for an issuer using a registry

5.2. Data structures

The data structures defined are used to exchange ticket and annotation data. The technical data structures are defined as JSON schema in Appendix A. The data structure description given here uses a graphical notation for easy reading. The master of the data structure definition is always the JSON schema!

5.2.1. Code lists

Code lists for the content of the data are references at the data structure definitions. The following general rules apply:

- Company codes

Companies (carriers, distributors, ...) are encoded using the company code.

- Service brands
Service brands are encoded using the service brand code list B.4.7009.
- Class of travel (1,2,C,P,T) is encoded according to the code list of TAP TSI B.5.24
- Service level is encoded according to the code list of TAP TSI
- Stations can be encoded with different code lists as the code list named in the data.
However, it is highly recommended to use the same codes as in the time table
- Countries are encoded as 2A ISO 3166-1 country code unless it is stated differently

- Dates and time is encoded as UTC unless it is stated differently

5.2.2. Schema versions

The versioning is using semantic versioning for versions higher than 1.2.1:

Major version:

1

Minor version:

1.1

Minor minor version:

1.1.1

Major version difference indicate a breaking change.

Minor version differences indicate additional tags added or tags removed.

Minor minor version differences indicate change of comments.

As ticket and annotation data might be stored over a long period of time upcoming schema versions must be compatible with old data for 2 years.

During the compliant period data structures defined in the schema files will always be kept in new versions. Data structures or elements not used any more will be defined as optional and marked as “depreciated” in the description.

The schemas provided in Appendix A are defined to validate data compliant with the corresponding or earlier versions:

- Old data are compliant with new schema versions
- New data might fail when validated with an older schema version

Schemas are used to document the data structure and for code generation. It is recommended not to use schema validation within the applications as this could lead to errors concerning data not even used in the applications.

Data providers (issuers) should validate with a version they support. There is no need to validate with the latest version unless you want to provide data elements available in that version only.

The schema version of the data for anonymous ticket, personal data or an annotation might be created at different times and schema versions. The schema version is included in the SignedDataDef. This allows the use of schemas with breaking changes.

Commented [JS37]: Should remain in the change management rules.

Commented [JS38R37]: Versions are needed to be stored in the ticket database

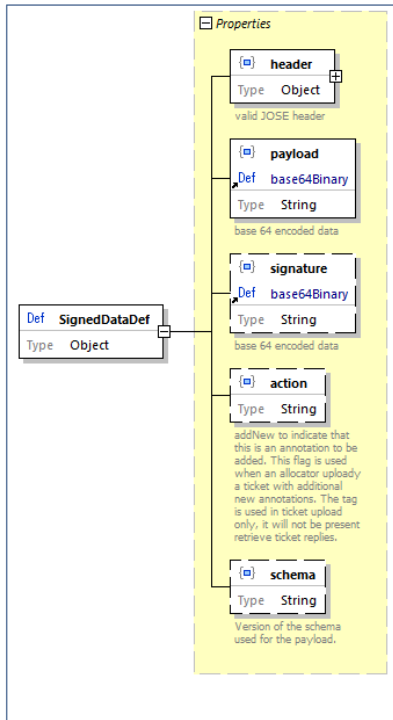


Figure 2529 indication of schema version

5.2.3. Proprietary extensions

Proprietary extensions are allowed to be included with type string or type object. The proprietary extensions must use a name starting with "P_" followed by the company code responsible for the definition and a name starting with "_" (e.g. P_1234_myContent).

The naming convention is controlled by:

```
"patternProperties": {
  "^P_": {"anyOf": [
    { "type": "object" },
    { "type": "string" }
  ]}
},
"additionalProperties": false,
```

In order to use a more robust validation that is compliant with future versions you need to replace this by:

```
"additionalProperties": true,
```

New elements will then be accepted, but the naming convention is not checked any more.

5.2.4. Booking Reference

The booking reference must provide all data to identify the ticket uniquely across all involved systems. This includes:

- Issuer:

Unique identification of the issuer. A company code must be used.

- Issuing Date:

Date and time when the ticket was issued in UTC. The issuing date is used to identify the ticket, as booking ids itself are unique for a limited time range of a few months only.

- Booking Id:

Unique id of the ticket, for Reservations the reservation number which was exchanged with the reservation messages as defined in TAP TSI TD B.5.

- Train number and departure date:

To support reservations of systems where the reservation number is unique only for a train and departure date.

- SystemCode (optional):

Id of the system managing the ticket in case an issuer runs multiple systems, e.g. during a migration to another system supplier.

Commented [JS39]: Allocator to be verified: Distributor to be used

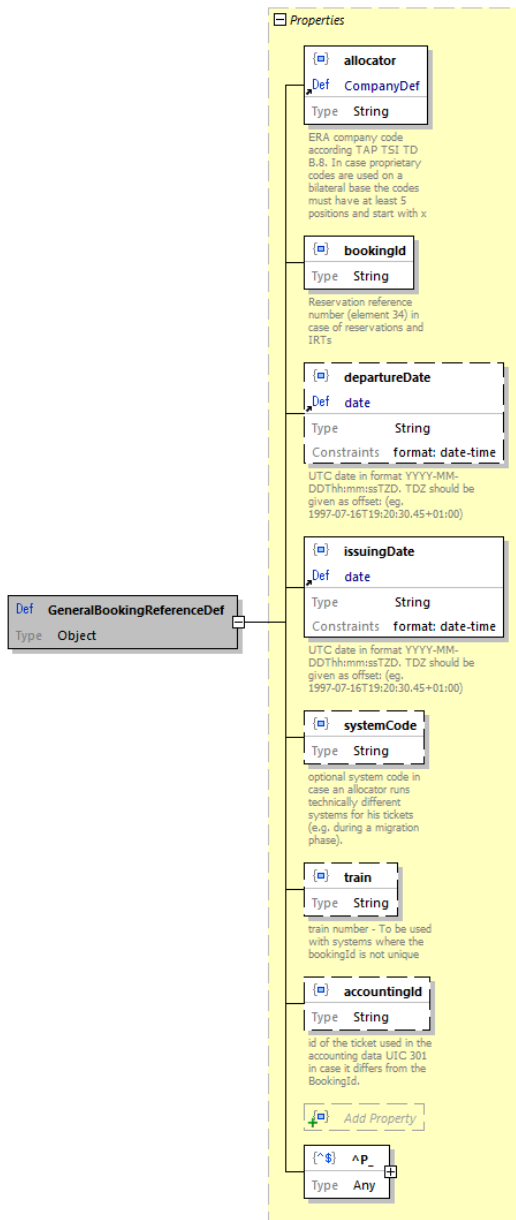


Figure 2630 general booking id

5.2.5. Ticket

The data needed to control a ticket are assumed to be the same as in case of a ticket with barcode. Therefore, the same ticket data as defined for the flexible content barcode are assumed to be provided for control online.

The ticket data contains all data that can be part of the FCB data content for home print tickets used to control home print tickets defined in TAP TSI TD B.12.

These data have been extended by the personal data defined for e-ticketing of IRTs in TAP TSI TD B.5. The option to provide an image of the passenger for authorisation has been added.

The data have been separated in a data structure containing anonymous ticket data and a data structure containing personal data. This allows to delete the personal data and to keep the anonymous data.

5.2.6. Anonymous Ticket

The data structure of the ticket follows the FCB ticket data structure:

TicketReference	The identification of the ticket
ExpiryDate	The final date where the data need to be deleted
AllowedAccess	List of Undertaking that are entitled to receive the ticket data. This is a list of the carriers involved in the ticket. Note: This information is especially needed in case a central registry is managing the ticket data for multiple TCOs.
IssuingDetails	Data specific on the issuer and the issuing itself (company, sales channel, timestamp, ...)
TransportDocument	The actual travel contract details. The different documents that can be included are: Open Ticket, Pass, Reservation, car carriage reservation, voucher, customer card, group ticket countermark, parking ticket, FIP-ticket, station passage.
RequiredControl	How the ticket should be checked (e.g. need to check passport or id card or customer cards.
PersonalDataSignature	Signature of the personal data that belong to this ticket. See chapter "Data Integrity".
SignatureParams	Parameters used to sign the data. See chapter "Data Integrity".
Trip	The trip for which the ticket was sold and where the ticket is valid.

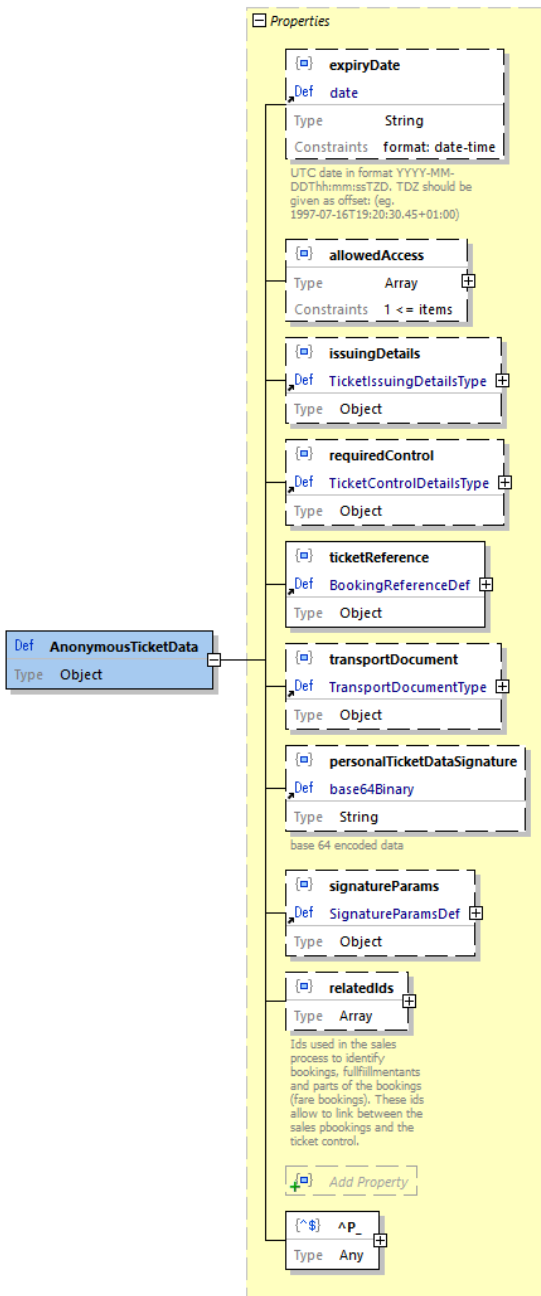


Figure 2734 Anonymous ticket data

structure

The anonymous ticket data might include additional ids from the sales process to provide a link to the sales systems. The Ids correspond to ids defined in TAP TSI TD B.13 (OSDM).

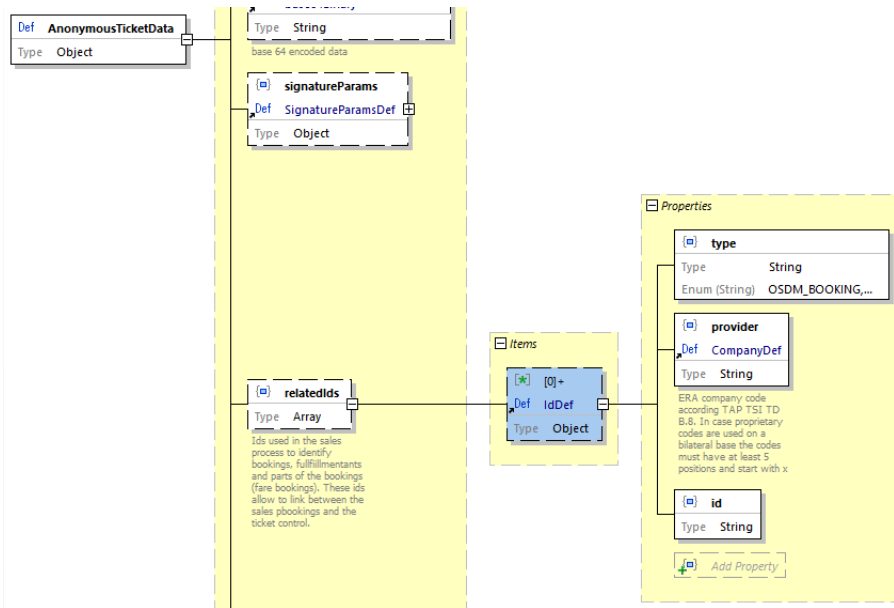


Figure 2832 AnonymousTicket related ids

The anonymous ticket might include the description of the trip for which the ticket was sold and where the ticket is valid. This trip might be used for automatic validation of the ticket e.g. in a check-in process.

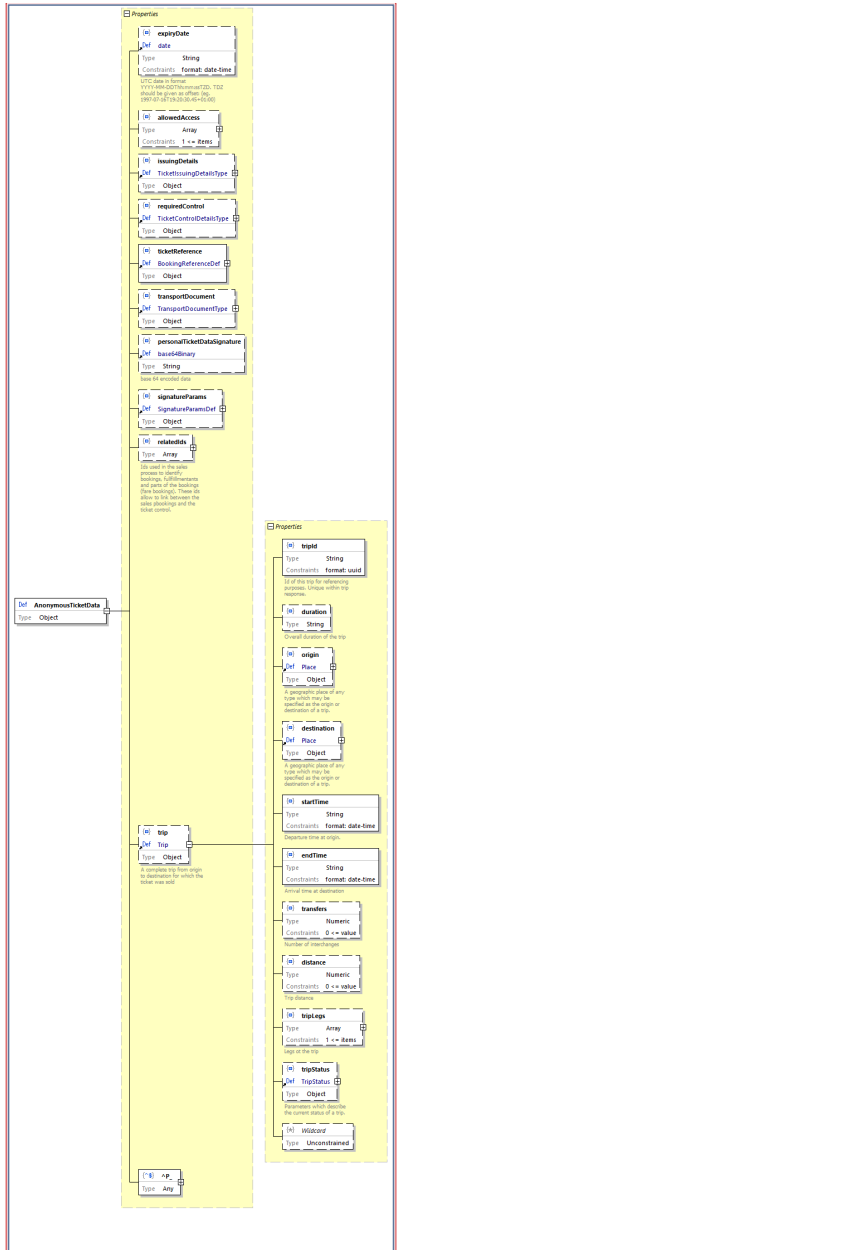


Figure 2933 trip included in the ticket

Commented [JS40]: To be checked!

5.2.6.1. Transport document

The transport document structure contains the actual travel contract details. The different documents that can be included are: Open Ticket, Pass, Reservation, car carriage reservation, voucher, customer card, group ticket countermark, parking ticket, FIP-ticket, station passage.

Only one of these documents is included.

A Token can be added to support other types of identifications (e.g. procedures to link a ticket to a phone).

Commented [JS41]: Are these ticket types complete? Bike reservation?

Commented [JS42R41]: Bike contained in Reservation. Reference to TD B.12 useful for ticket types

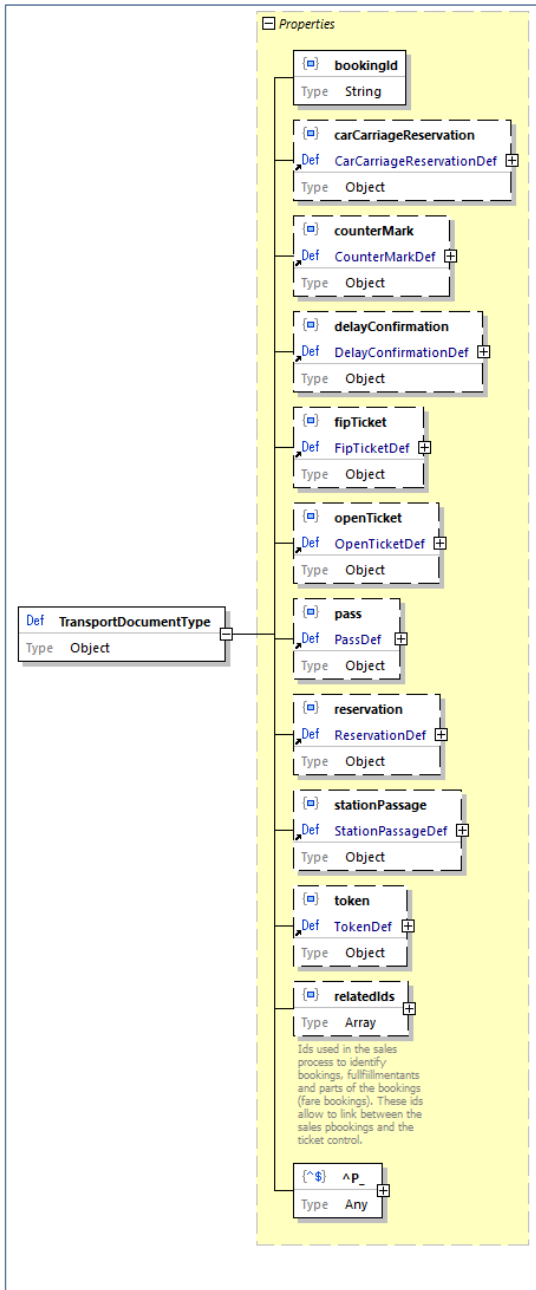


Figure 3034 TransportDocument data structure

The transport document might include additional ids from the sales process related to the specific document. The ids correspond to the ids used in TAP TSI TD B.13 (OSDM).

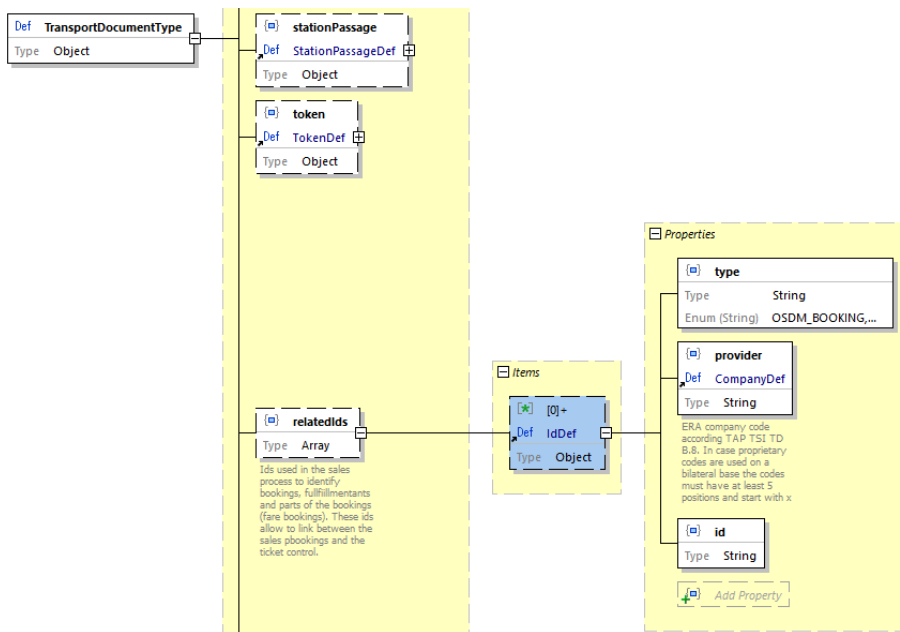


Figure 3135 TransportDocument additional ids

5.2.6.2. *Reservation (IRT, RES)*

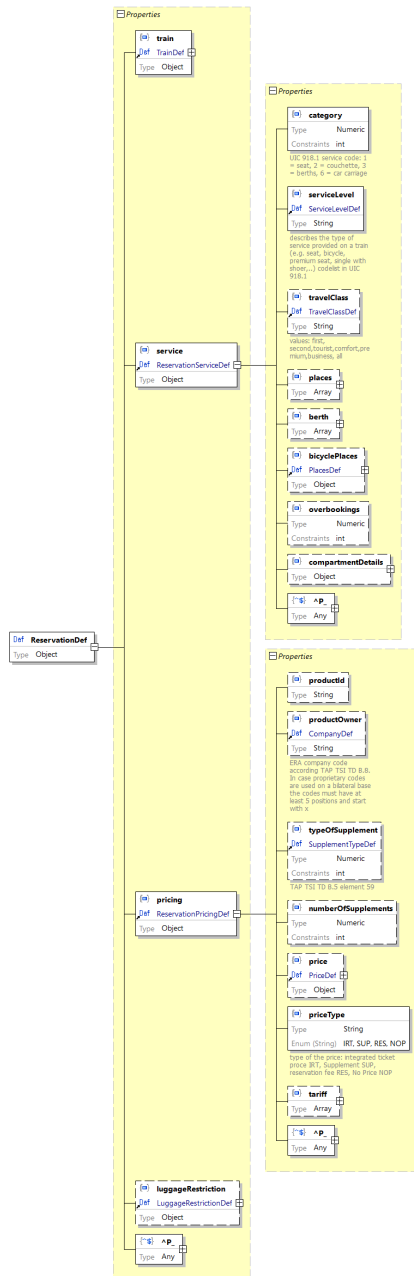
The reservation data structure can cover reservations for Seats, Couchettes and Berths. The code tables for the content are defined in TAP TSI Code lists.

Figure ~~3236~~ Reservation data structure

5.2.6.3. *Car carriage reservation*

The data structure covers car carriage reservation. The code tables for the content of the data elements are defined in TAP TSI code lists.

Note: The trailer plate and the vehicle plate has been moved to the personal data of the passenger to keep the ticket data anonymous.



Generated by XMLSpy www.altova.com

Figure 3337 CarCarriageReservation data structure

5.2.6.4. Open Ticket (NRT)

The data of the open ticket correspond exactly to the data of the FCB.

ValidFrom	Start of validity (UTC)
ValidUntil	End of validity (UTC)
FromStation	Section where the route starts (point-to-point tickets only)
ToStation	Section where the route ends (point-to-point tickets only)
activated	False: the ticket needs to be activated to become valid
activatedDays	List of days where the ticket has already been activated
Service	Details on the services that can be used: Carrier accepting the ticket, travel class, service level (Business, Premium, ..), included or excluded service brands.
externalIssuerId	Additional identifier to be used with the ticket to support local transport schemes
externalAuthorizationId	Additional identifier to be used with the ticket to support local transport schemes
RegionDescription	Textual description of the region where the ticket is valid
Region	Structured description of the region where the ticket is valid
Return	Region and Region description for an included return trip
includedAddOnTicket	Ticket data for included additional tickets (e.g. city transport added to a far distance ticket)
LuggageRestriction	Luggage restrictions
Pricing	Tariffs and Price details

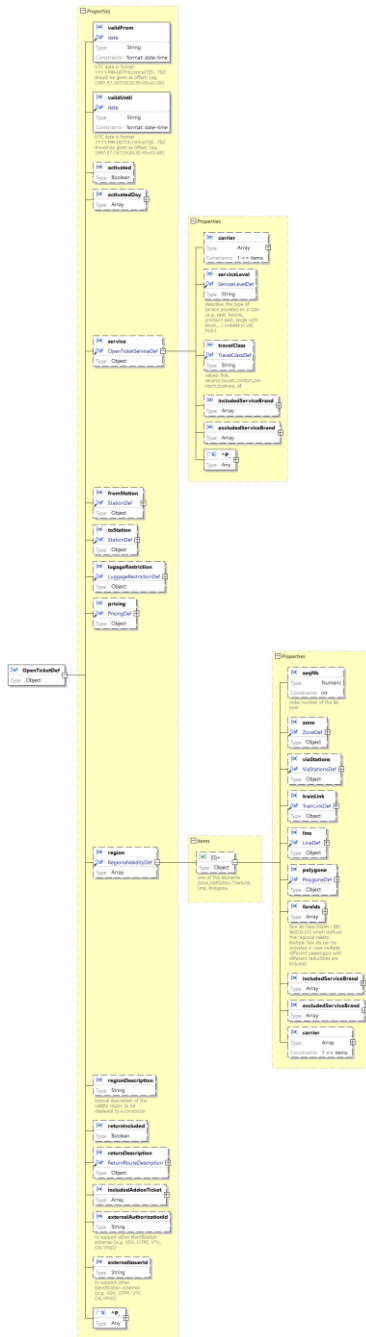


Figure 3438 OpenTicket data structure

5.2.6.5. Railpass

PassType	Type of the pass. Code list: "Interrail", "Eurail", <Company code>+<code> for passes defined by a company
PassDescription	Readable name of the pass
ValidFrom	Start of validity (UTC)
ValidUntil	End of validity (UTC)
ValidityPeriodDetails	Option to exclude time ranges from the validity period (e.g. not valid between 9:00 and 17:00)
activated	False: the ticket need to be activated to become valid
activatedDays	List of days where the ticket has already been activated
NumberOfPossibleTrips	Limitation of the number of trips allowed with the pass
NumberOfTravelDays	Limitation of the number of travel days allowed with the pass
NumberOfValidityDays	Number of validity days in case the validity starts with an upcoming activation.
TravelClass	Class of travel (code list from TAP TSI code list B.5.24)
Carrier	List of carriers accepting the pass
includedCountries	List of countries where the pass is valid
includedServiceBrands	List of service brands allowed by the pass
excludedServiceBrands	List of service brands excluded for the pass
Region	Structured description of the region where the ticket is valid
Pricing	Tariffs and Price details

Commented [JS43]: New code list to be created

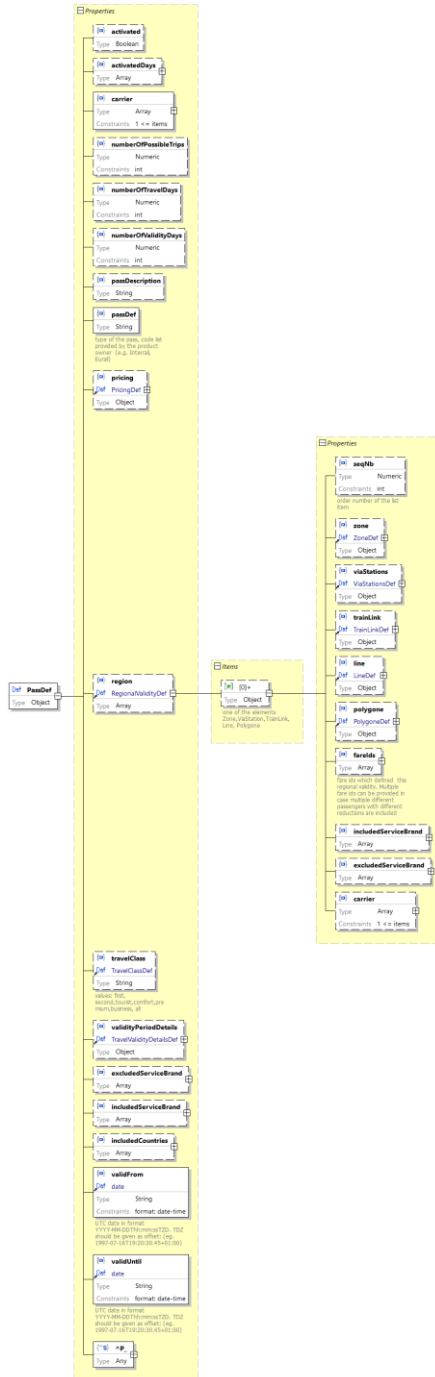
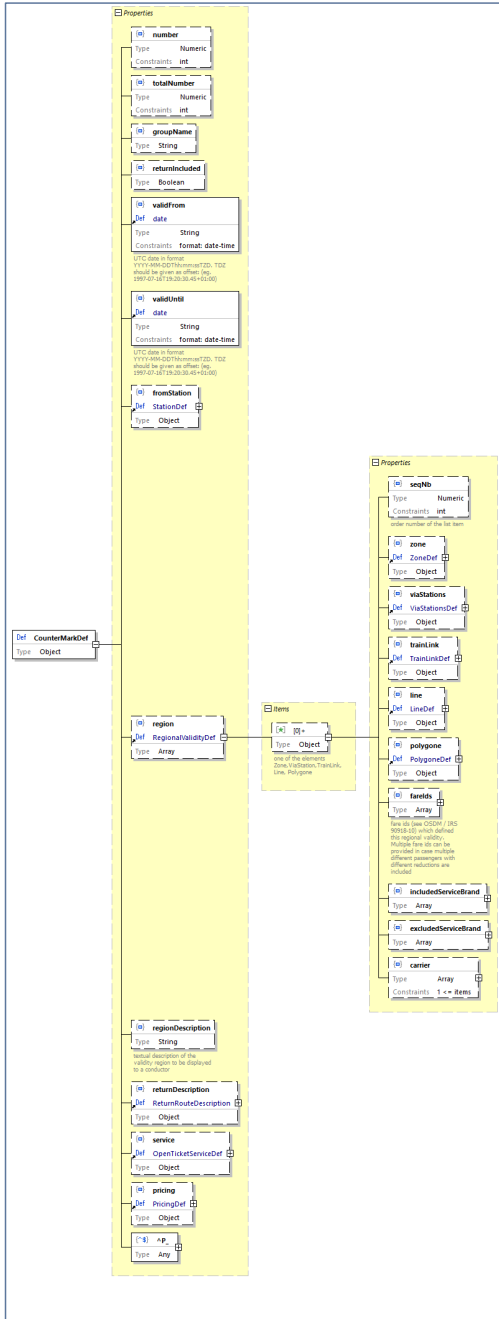


Figure 3539 Pass data structure

5.2.6.6. Countermark

In case countermarks are still used for the members of group tickets these can be issued as e-tickets with this data structure. The link to the “real” group ticket is made via the reference in the RequiredControl tag of the ticket data.

GroupName	Group name
number	Sequential number of this countermark
totalNumber	Total number of countermarks issued for the group ticket
ValidFrom	Start of validity (UTC)
ValidUntil	End of validity (UTC)
FromStation	Section where the route starts (point-to-point tickets only)
ToStation	Section where the route ends (point-to-point tickets only)
Service	Details on the services that can be used: Carrier accepting the ticket, travel class, service level (Business, Premium, ...), included or excluded service brands.
RegionDescription	Textual description of the region where the ticket is valid
Region	Structured description of the region where the ticket is valid
Return	Region and Region description for an included return trip
Pricing	Tariff details, the price details are not included



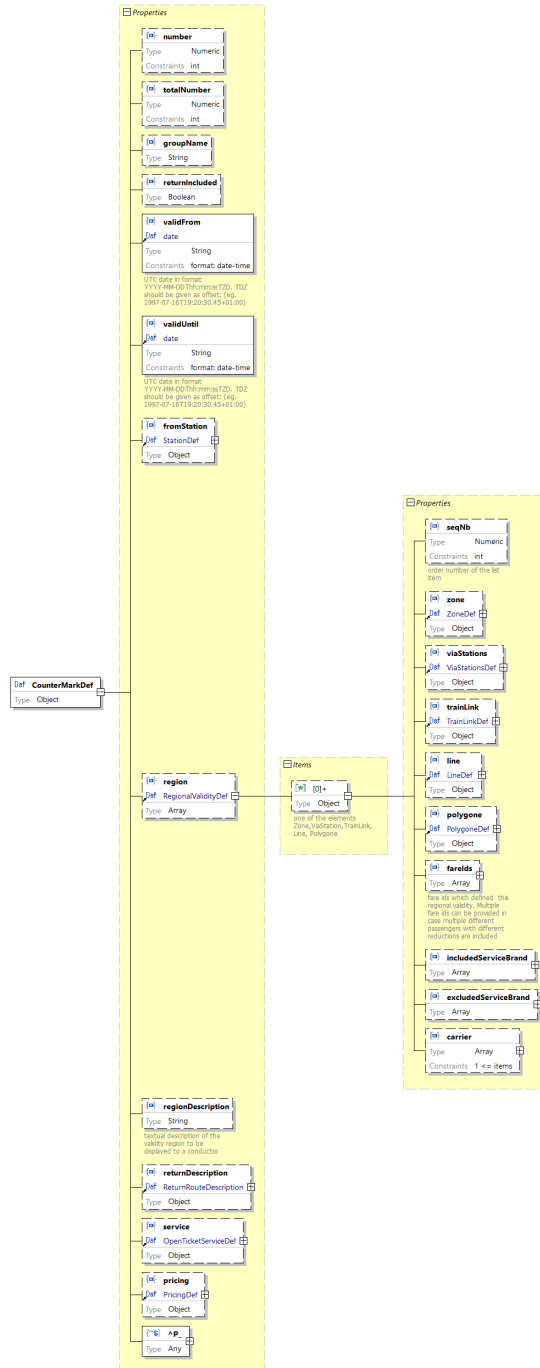


Figure 3640

Countermark data structure

5.2.6.7. Delay Confirmation

Delay confirmation for e-tickets will be added as annotations to the original ticket. However, it is possible to issue a delay confirmation also in the case of a security paper ticket. In this case this data structure can be used.

Commented [JS44]: Security paper?

Commented [CG45R44]: yes

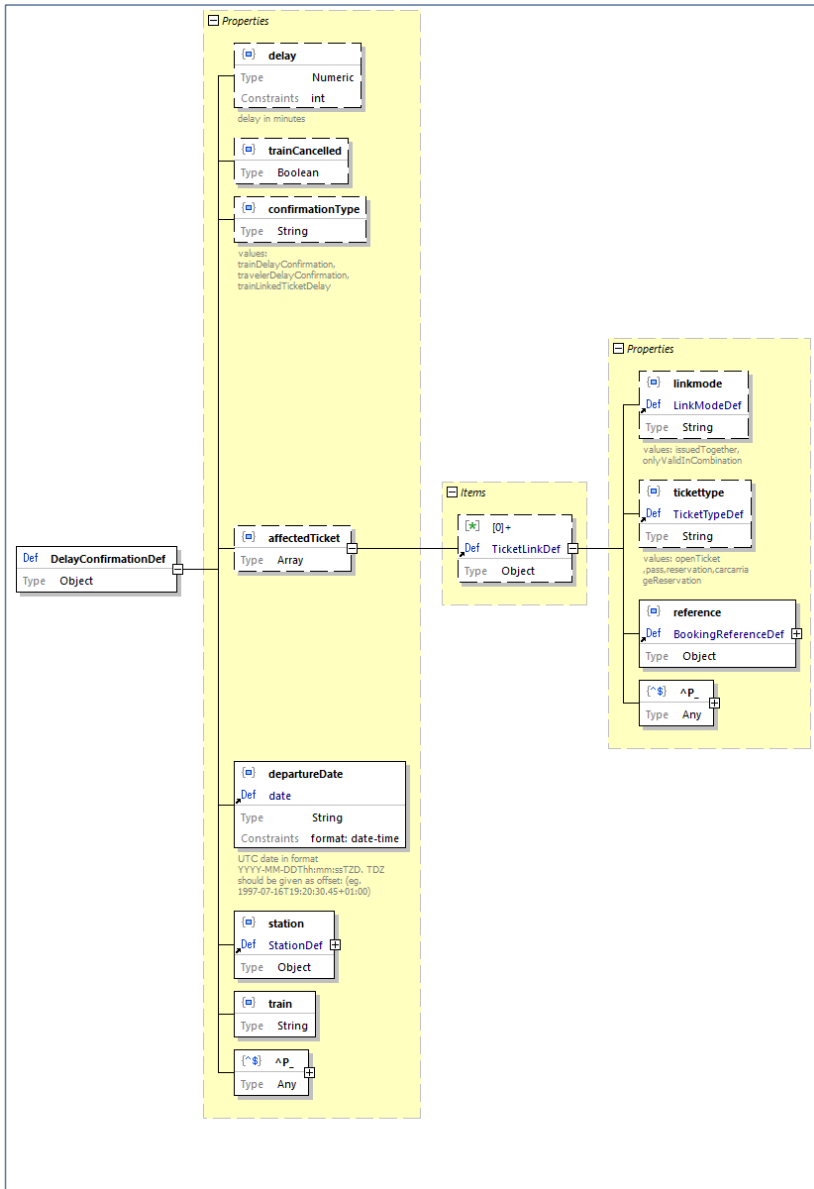


Figure 3744 DelayConfirmation data structure

5.2.6.8. *FiP Ticket*

numberOfTravelDays	Number of possible travel days (one travel day allows traveling on that day and the next)
includesSupplements	Supplements are included
ValidFrom	Start of validity (UTC)
ValidUntil	End of validity (UTC)
activated	False: the ticket need to be activated to become valid
activatedDays	List of days where the ticket has already been activated
TravelClass	Class of travel (code list)
Carrier	List of carriers accepting the ticket

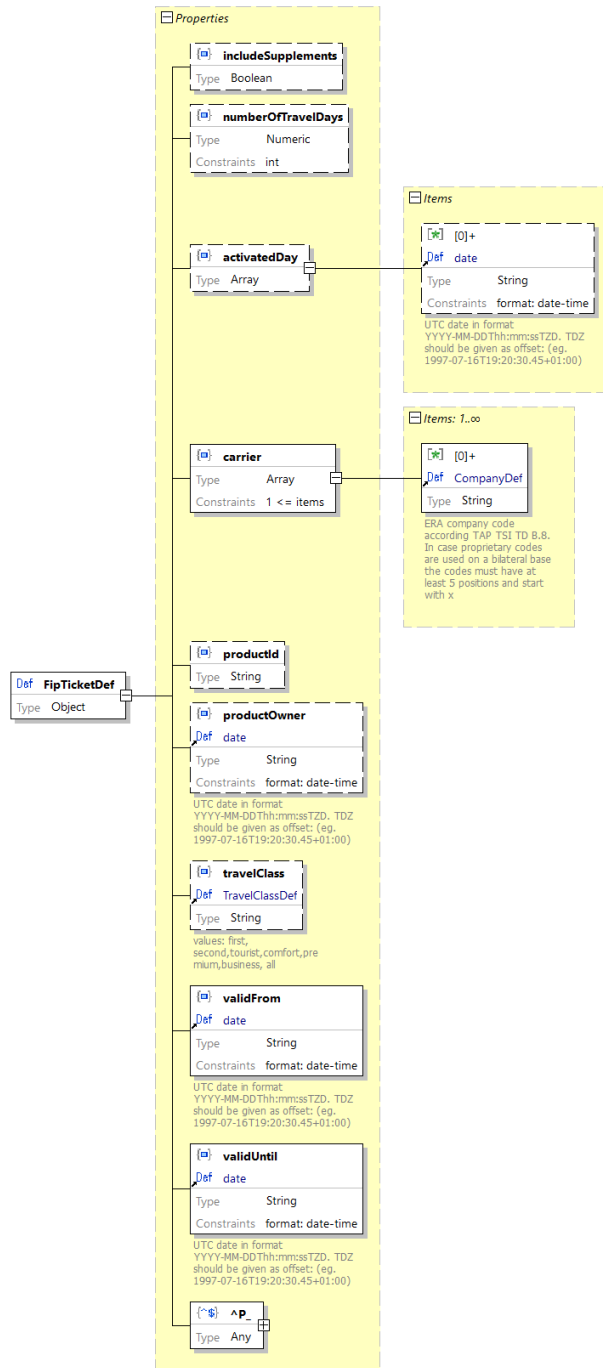


Figure 3842 FIPTicket data structure

5.2.6.9. Travel validity description

The travel validity describes the time range during which the ticket is valid. It describes the time period of validity and optionally excluded times (e.g. peak hours).

It can also describe the validity for travel depending on the departure or arrival time of a train. In that case the ticket is valid when the arrival (or alternatively the departure) time is in the given time range. This validity might be limited to specific service brands (e.g. night trains).

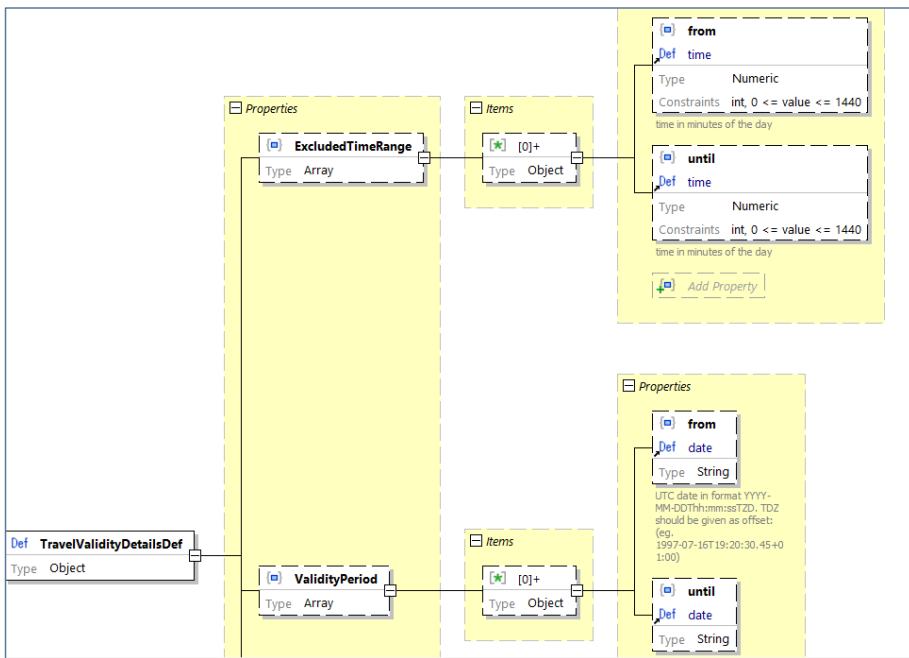


Figure 3943 Travel Validity Ranges

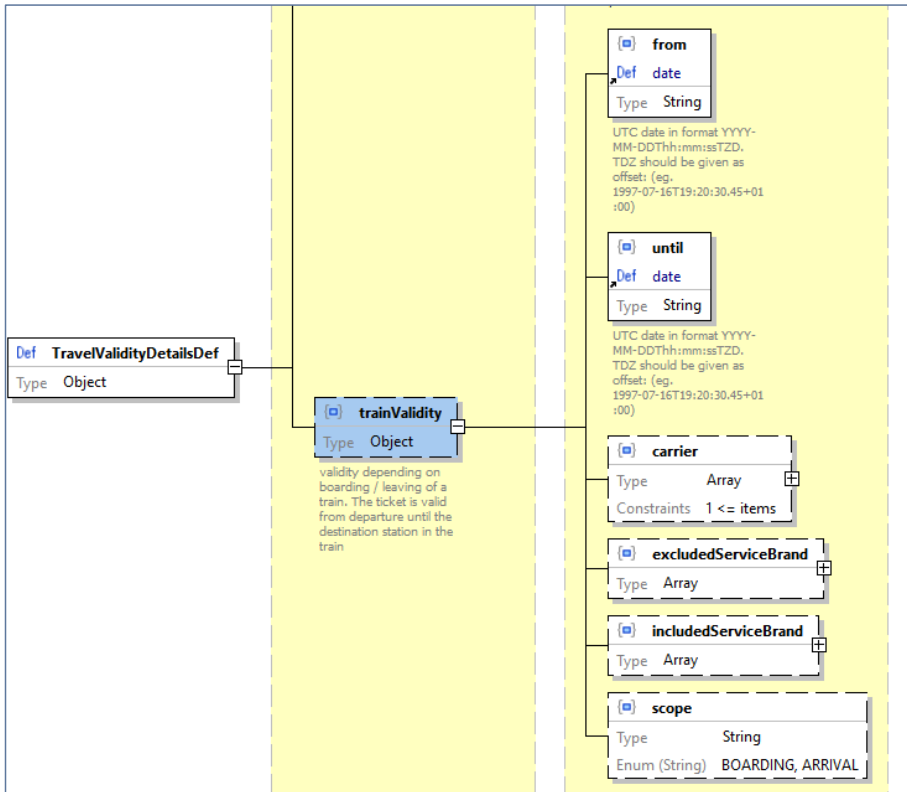


Figure 4044 Travel Validity on Boarding or Arrival

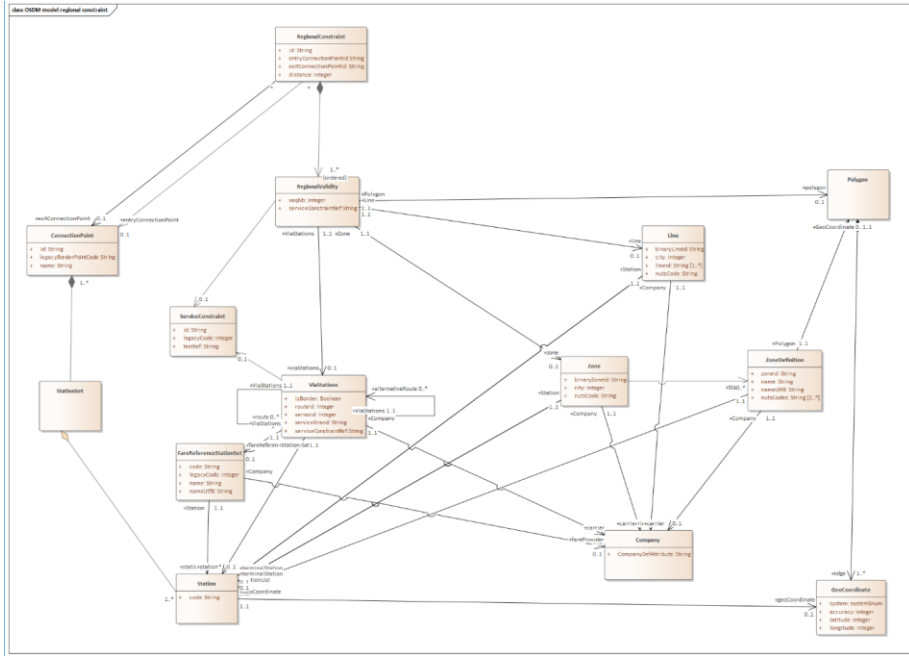
5.2.6.10. Regional validity description

The regional validity description is used in open tickets, countermarks and passes to define the region and / or route where the ticket is valid.

The regional validity is described as an ordered list of different types of region descriptions:

TrainLink	Validity on a route of a train given by train number, departure date and time and from-to stations
ViaStations	A structured form of describing the routes defined in TAP TSI B.1 price data. It models routes by lists of stations on the rout allowing to include multiple alternative routes.
Zone	A geographical zone defined by either a code of the responsible carrier or a NUTS code. It is possible to add mandatory entry or exit stations to the zone.
Line	A line defined by a line responsible carrier. It is possible to add mandatory entry or exit stations to the line.
Polygone	A polygone defined by geocoordinates

An object within the Regional validity array contains one of these objects.



Commented [CG46]: Copied from B14 to illustrate ViaStation Object

Figure 4145 Model of regional Validity

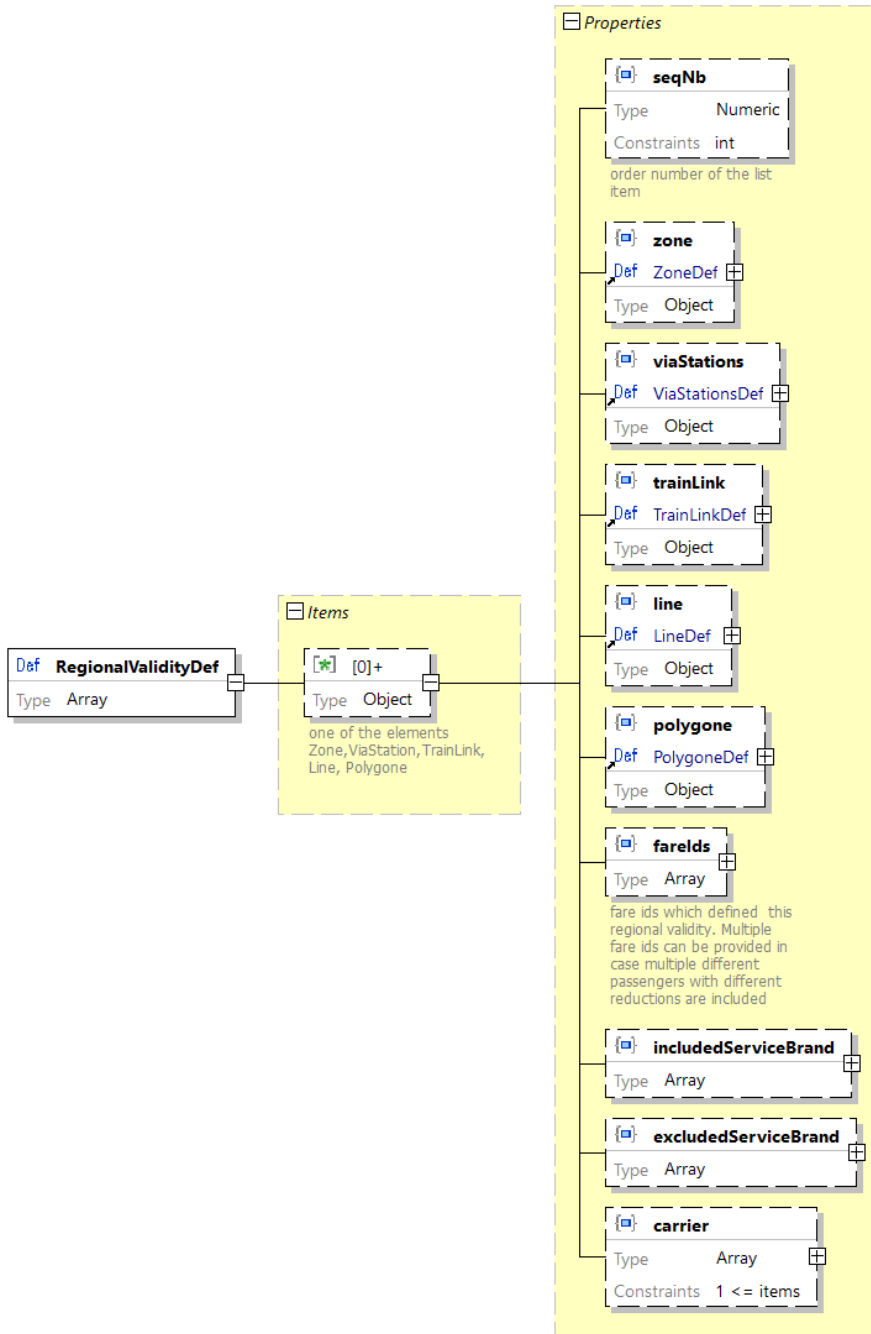


Figure 4246 RegionalValidity data structure

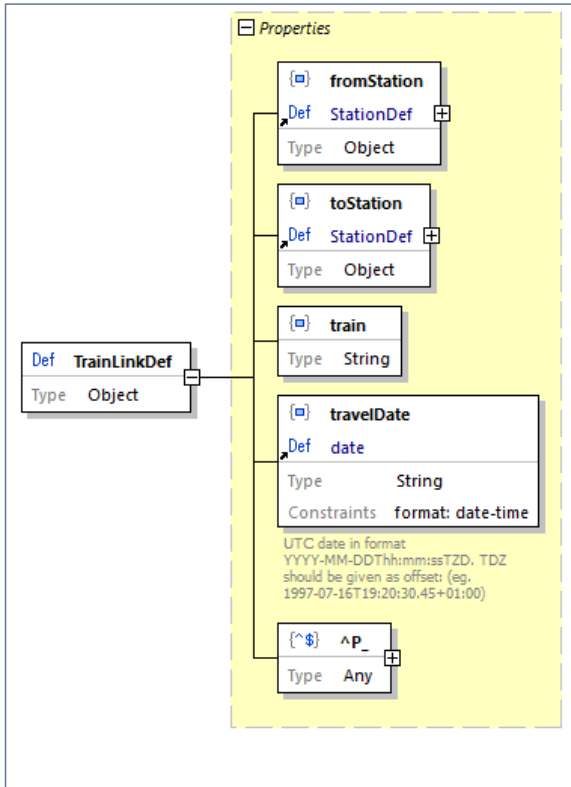


Figure 4347 TrainLink data structure

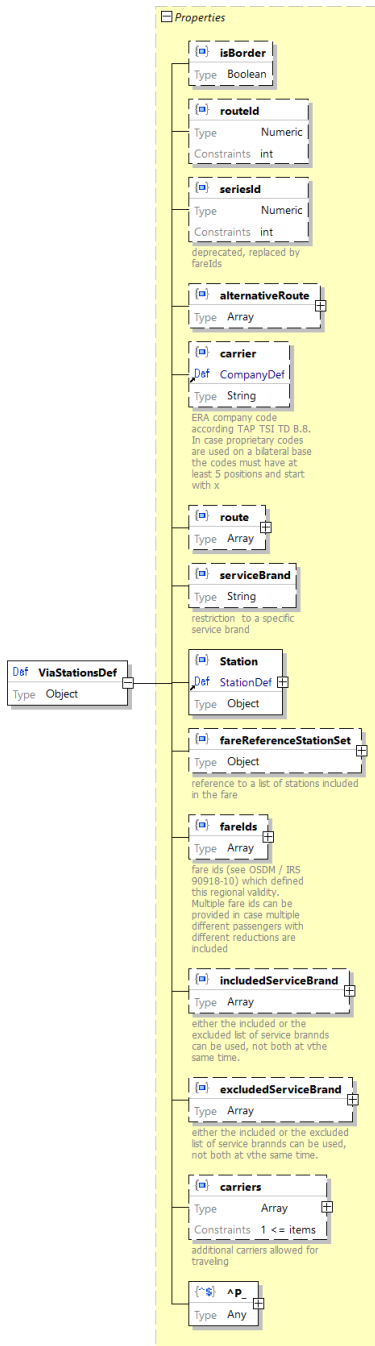


Figure 4448 ViaStation data structure

The Via station might include the full definition of a fare reference station by providing a list of all included stations.

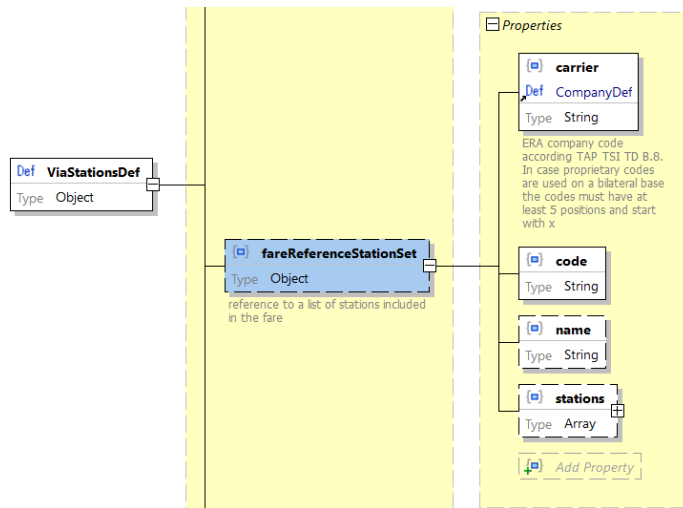


Figure 4549 ViaStation - included Fare reference station list

The via station might include restrictions on the service brands applicable to the part of a route described by the via station.

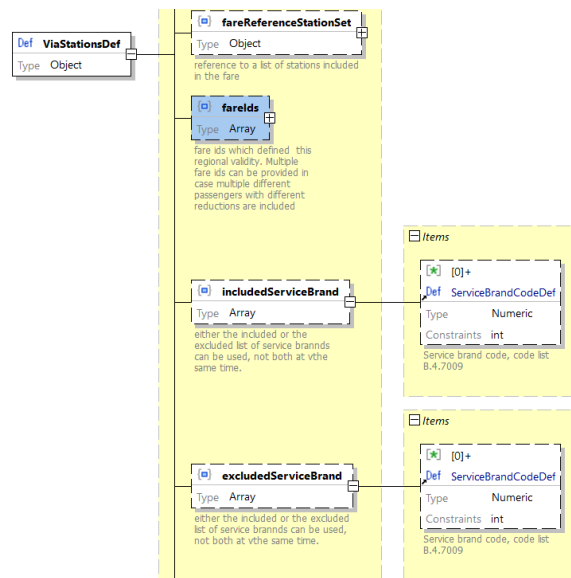


Figure 4650 ViaStation - service brand restrictions

Commented [JS47]: Fare reference or via station according to the timetable?

Commented [CG48R47]: A fare reference station set is not a station but a set of stations. It can be part of a route description (as in B.13) but is not in the time table.

Commented [JS49]: If via station is a point on the route, how the service brands can be applied to a point?

Commented [CG50R49]: I have added the data model and an example with object model. ViaStation is defined recursively. It can either represent a station, a fare reference station set a route or alternative routes. Due to the recursive definition the complexity of possible routes is not restricted. This definition corresponds to B14 and B9.

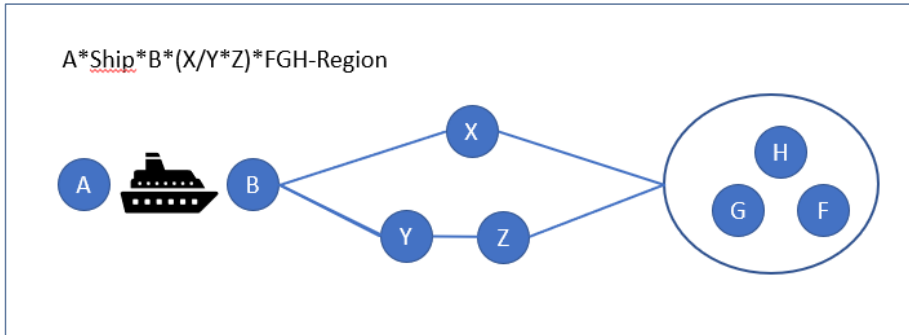


Figure 4754 route example with via stations and fare reference station set

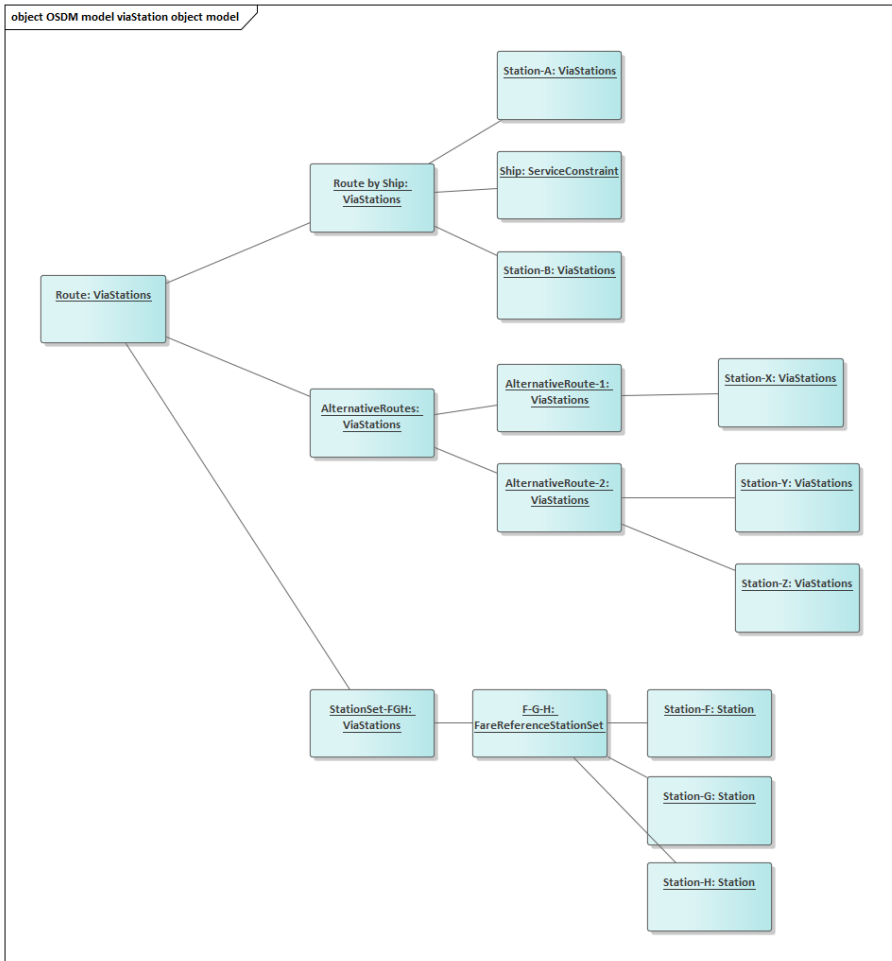


Figure 4852 Object Model of the Route example

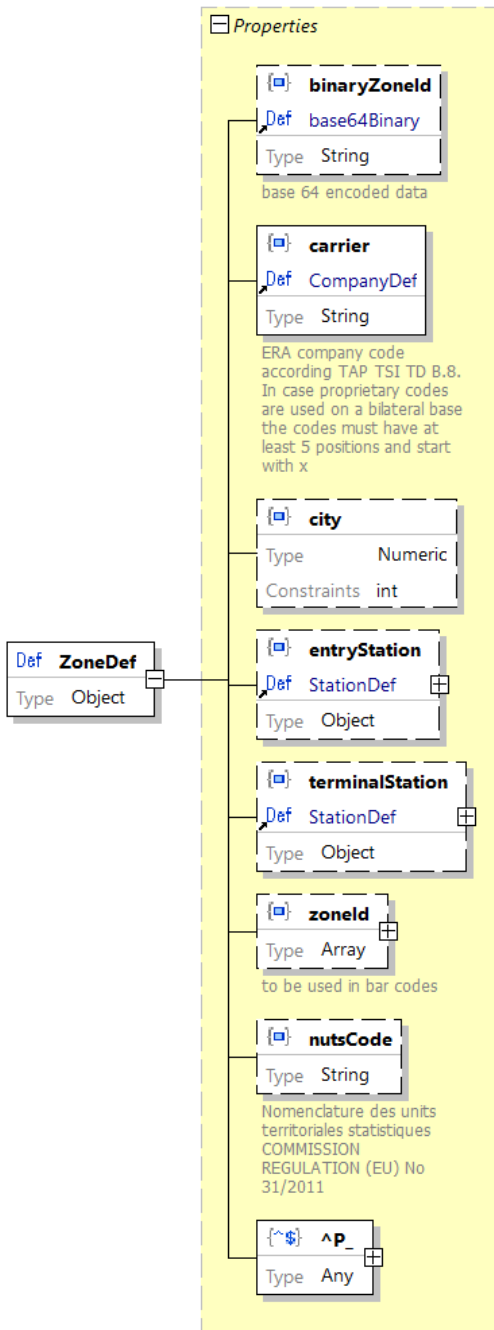


Figure 4953 Zone data structure

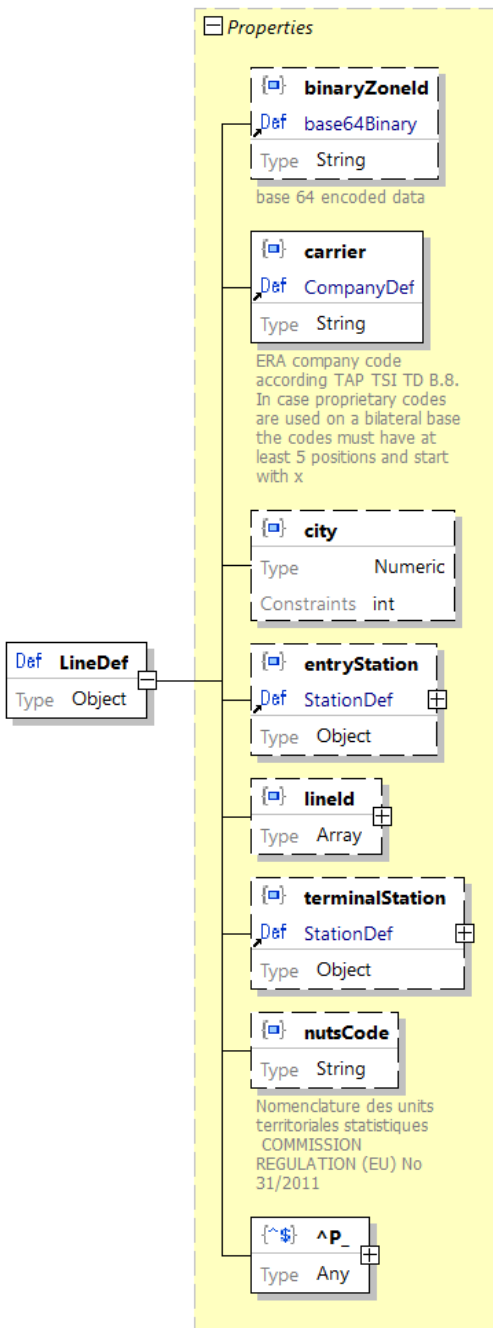


Figure 5054 Line data structure

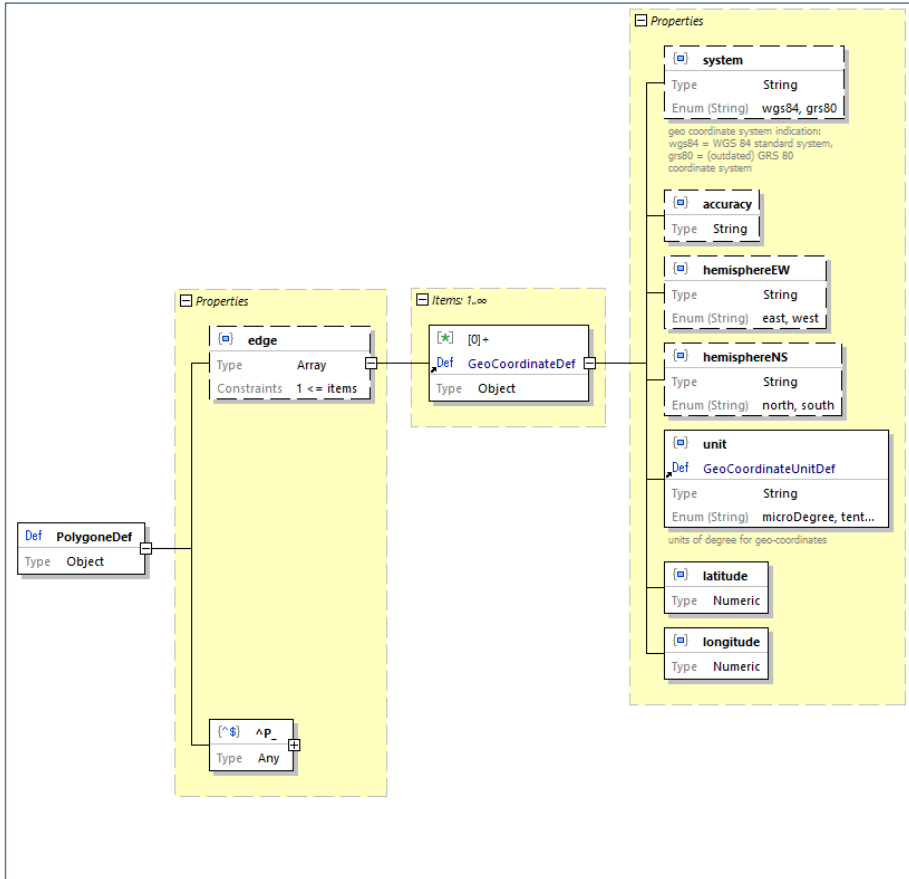


Figure 5155 Polygone data structure

5.2.6.11. Tariff description

A common data structure for tariff information is used for all tickets. The tariff data provide the link of the anonymous ticket to the personal data of the passenger.

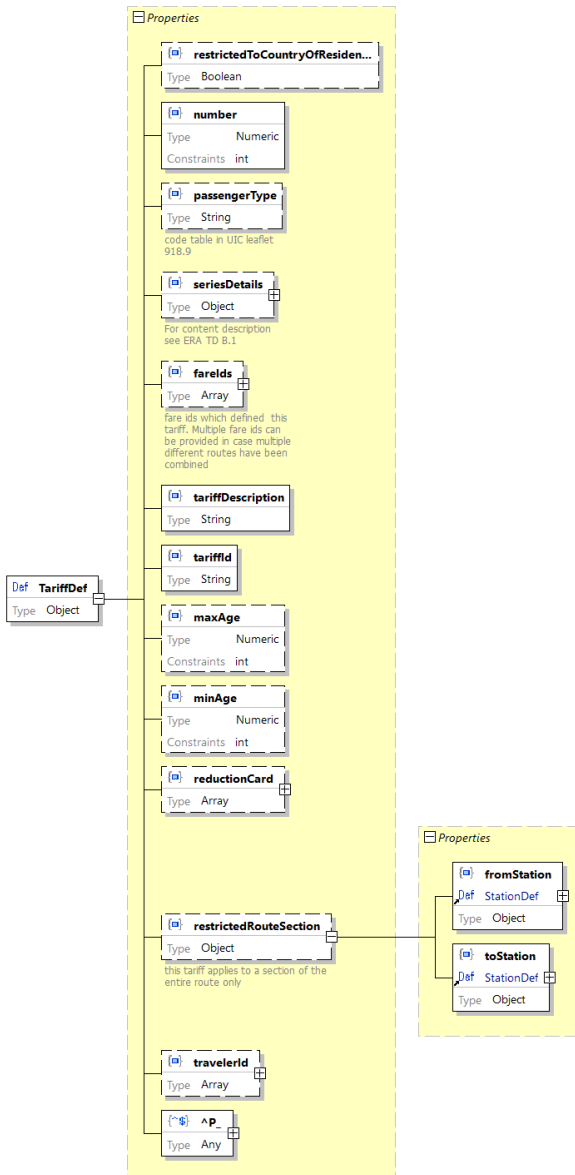


Figure 5256 Tariff data structure

5.2.6.12. Price description

Currency	ISO 4217 currency code
Amount	Float value of the amount
VAT	Optional: can provide the VAT information including the Country (2A ISO country code, amount and percentage as a float and the VAT company id.

Commented [CG52R51]: Vat is an array, so multiple countries and percentages can be included

Commented [JS51]: Different VAT depending on the transport mode not able to be accommodated.

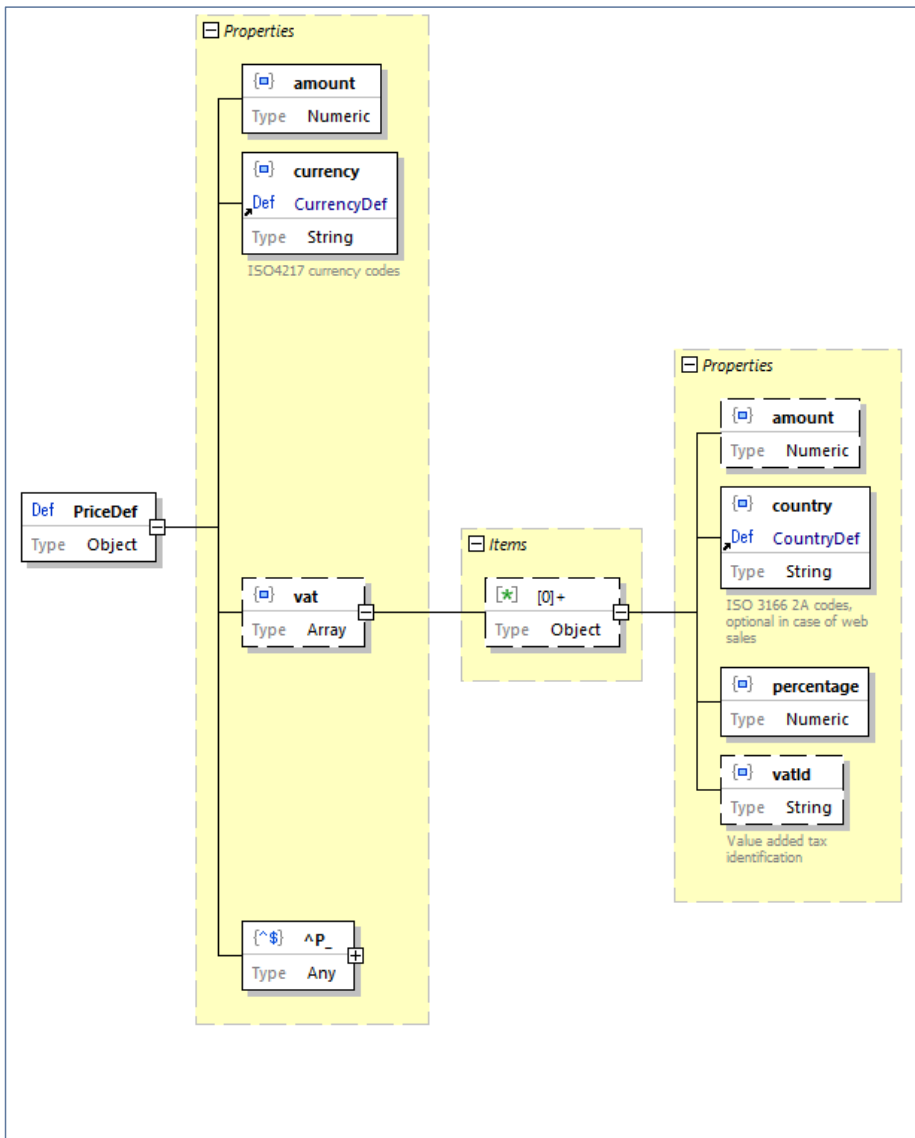


Figure 5357 Price data structure

5.2.7. Trip

Description of a trip (following TAP TSI B.13 and OJP). The trip for which the ticket was sold can be added to a ticket.

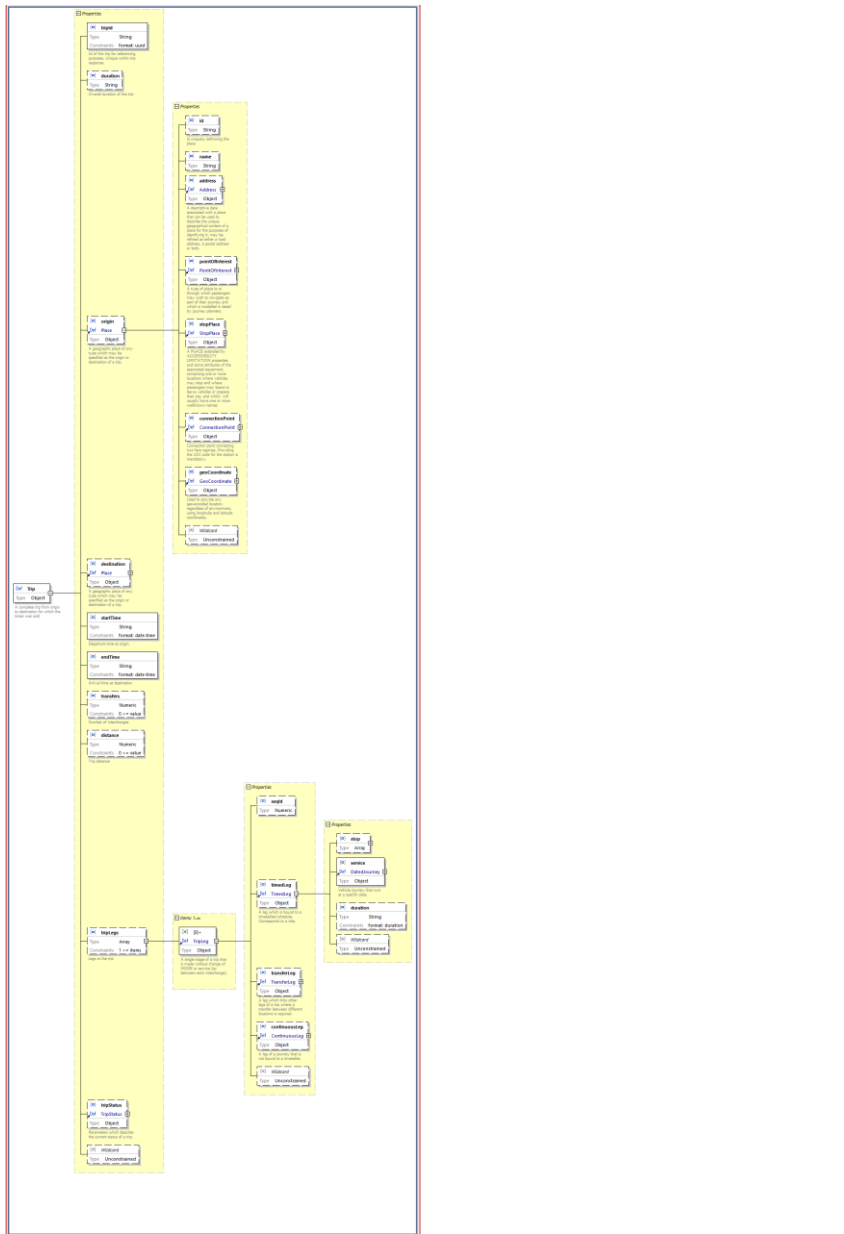


Figure 5458 Trip description

Commented [JS53]: Missing item

Commented [JS54]: Not part of the JSON scheme.

Commented [CG55R54]: Currently a separate but linked file trip.json, will be part of definitions.json in the next version (March 2022).

5.2.8. Personal ticket data

The personal ticket data include all ticket data subject to the GDPR. The data consist of a list of passengers- For each passenger it can contain:

id	Sequential id of the traveler to link to the tariff data of the anonymous ticket data. The id is unique within the ticket only.
PassengersDetails	Details of the passenger like name, e-mail,... This data structure is defined in TAP TSI TD B.5.
PassengerPassport	Details of the passengers passport or id card document. This data structure is defined in TAP TSI TD B.5.
Image	An image to authorize the passenger
Card	Customer cards either used to authorize the passenger or to grant a reduction.
VehiclePlate	Plate of the car in a car carriage reservation
TrailerPlate	Plate of a trailer in a car carriage reservation

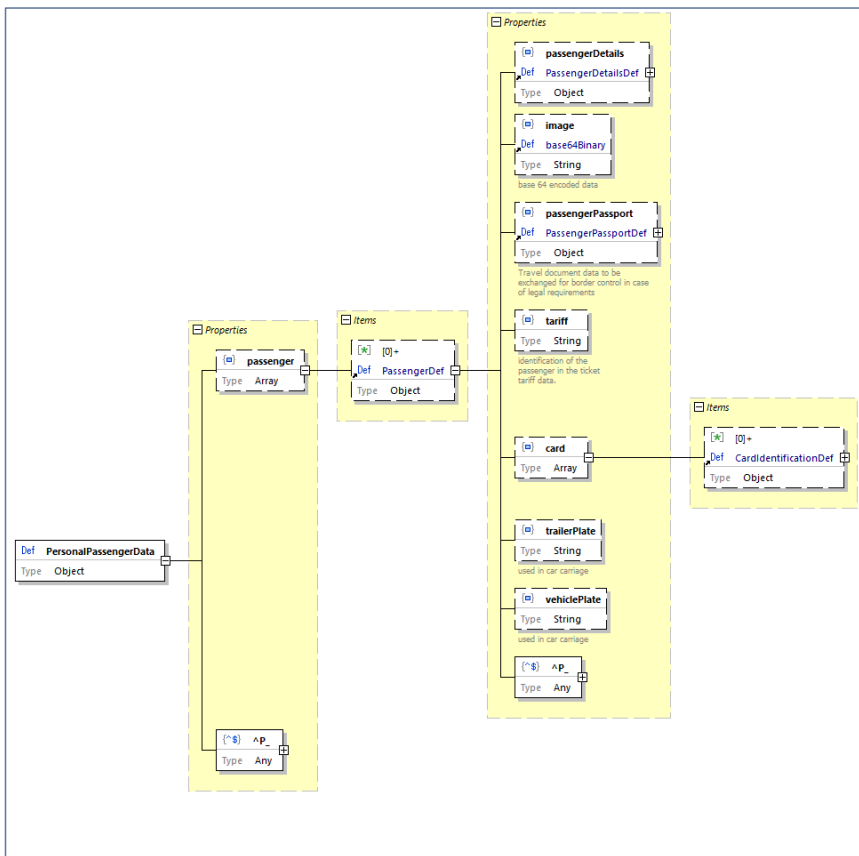


Figure 5559 PersonalData data structure

5.2.9. Annotation

Annotations become part of the overall ticket. An annotation is visible to all companies that are allowed to see the ticket.

TimeCreated	Date and time in UTC when the annotation was created locally
Location	Location where the annotation was created
Controler	Trains staff or device that created the annotation
<i>annotations</i>	One of the Different structures for annotations on <ul style="list-style-type: none">• Control marks• Validity extension• Delay confirmation• Declaration of non-use of the ticket• Check-in• Check-out• General remark• Cancellation• Activation• FraudDetection
Signatures	Signatures and Signature Parameter to ensure that the ticket and previous annotations cannot be modified.
Id	Unique id of the annotation. It is recommended to use an uuid

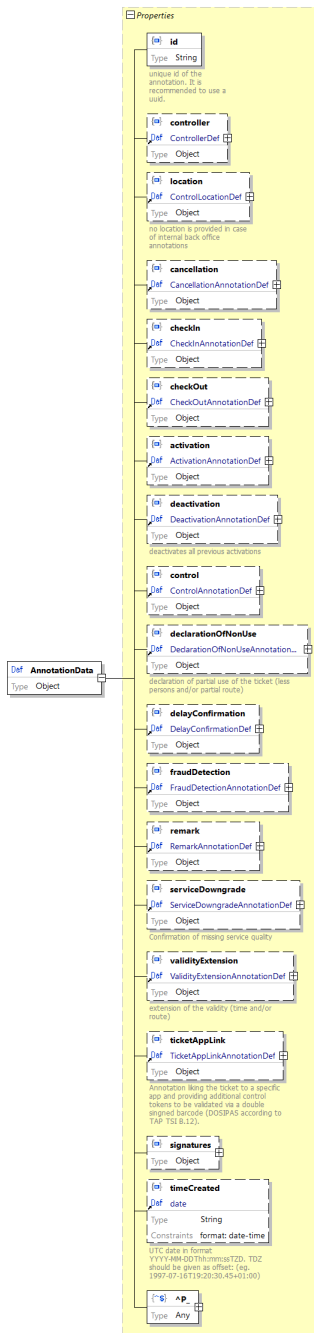


Figure ~~5660~~ Annotation data structure

5.2.9.1. Location

The location where an annotation is made can be on board of a train between two stations or at a station office. The location can also be provided as geo coordinates.

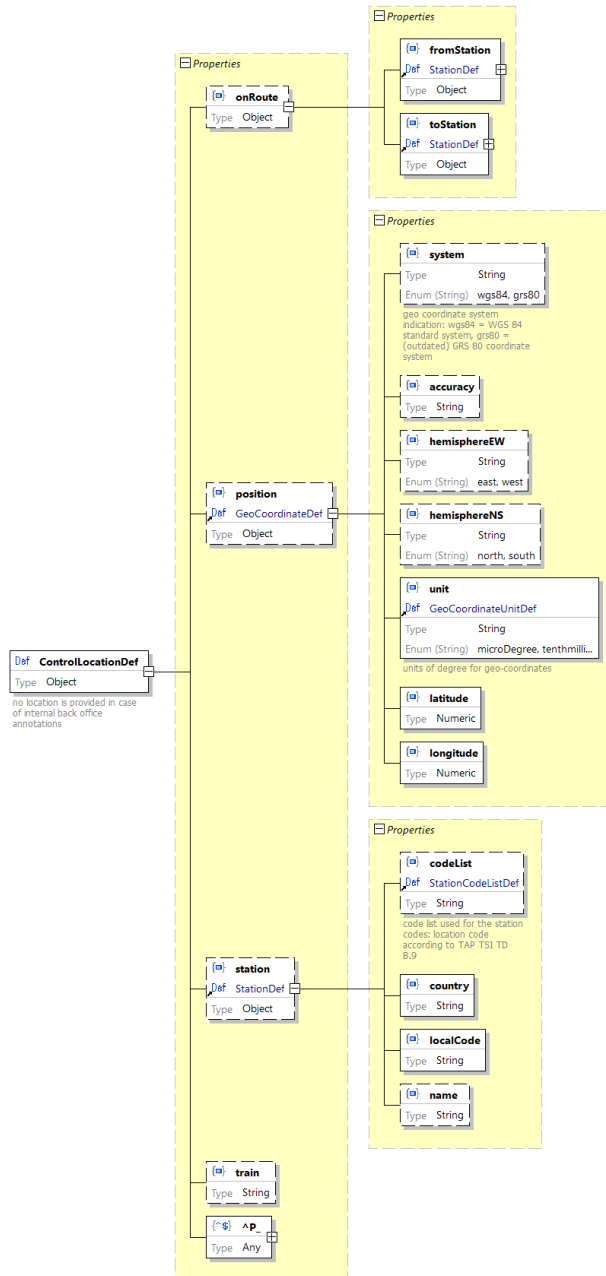


Figure 5764 Location of an annotation data structure

5.2.9.2. Controller

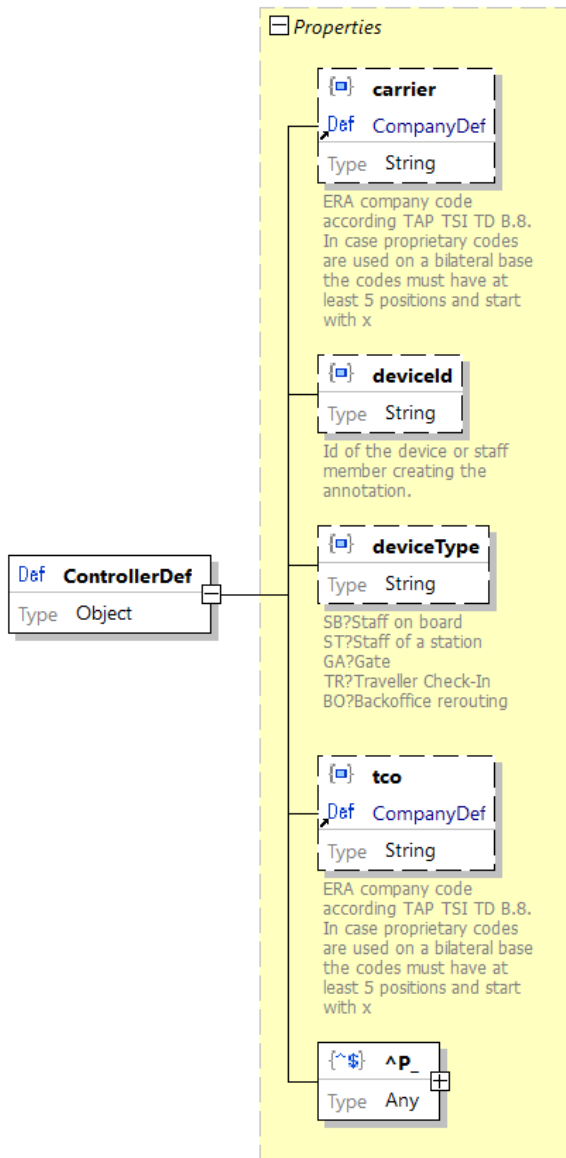


Figure 5862 Annotation Controller data structure

5.2.9.3. Control marks

Control annotations provide information on the scope and the result of the control. They can provide information on actions taken by the staff.

Scope	<p>Scope of the control:</p> <ul style="list-style-type: none"> • F - Full control • P - Partial control • PI - This ticket was seen as Check-In • PO - This ticket was seen as Check-Out • PR - Route is checked • PC - Carriers are checked • PS - Class of travel / service is checked • PV - Validity (time) is checked • PF - Tariffs are checked • PT - Train number is checked • PS – Service brand is checked
Result	<p>Result of the control:</p> <ul style="list-style-type: none"> • OK - Control is ok • KOR - Route is not ok • KOC - Carrier is not ok • KOS - Class of travel is not ok • KOV - Validity (time) is not ok • KOF - Tariffs are not ok • KOT - Train number is not ok • KOS - Service brand is not ok
Action	<p>Type of the action taken:</p> <ul style="list-style-type: none"> • FI - Fine issued • TI - Valid ticket was issued (incl. Ticket Id) • TL - passenger left the train • TC - Ticket collected (only in case of secure paper ticket combined with e-ticket (e.g. ÖBB ticket))
CompleteUsage	<p>Indication that the ticket was completely used.</p> <ul style="list-style-type: none"> • DetailedCheckRequired = Detailed check needed: The ticket is probably not usable any more • TicketConsumed = Ticket definitely not usable anymore. The ticket has been used and cannot be used any more after the given date and time.

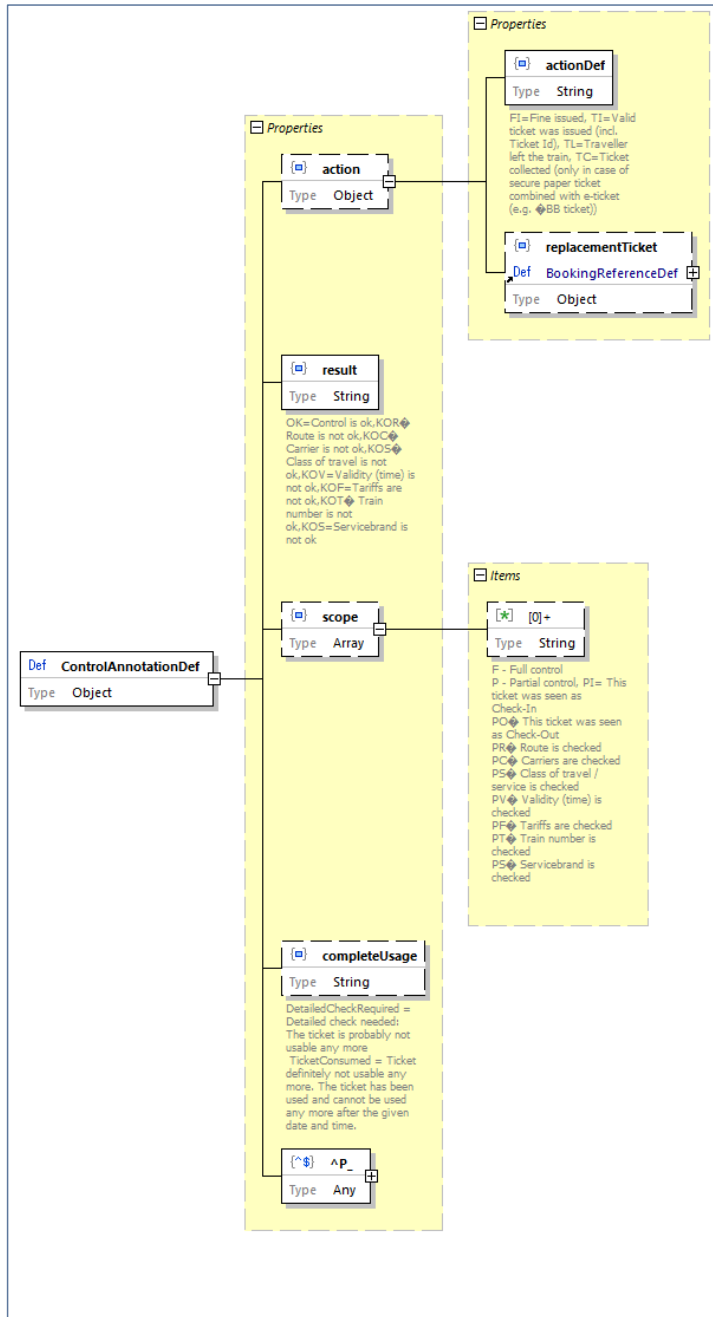


Figure 5963 control annotation data structure

5.2.9.4. Validity extension

The validity extension annotation can extend the validity of a ticket.

trainLinkRemoved	A restriction of the original ticket to specific trains becomes invalid
ClassUpgrade	New Service level allowed. Code list in TAP TSI code lists.
AdditionalServiceBrands	List of service brands additionally allowed to be used
AdditionalCarrier	Additional carriers whose trains are allowed to be used.
AdditionalRegion	An additional region where the ticket is valid. The Data structure is the same as used for Region in general.
AlternativeTrainLink	TrainLinks additionally allowed to be used.
RemoveTrainLink	TrainLinks of the original ticket which have been replaced.
Reason	Reason for creating the annotation (see chapter "Annotation Reason").

Commented [JS56]: Code list to be specified

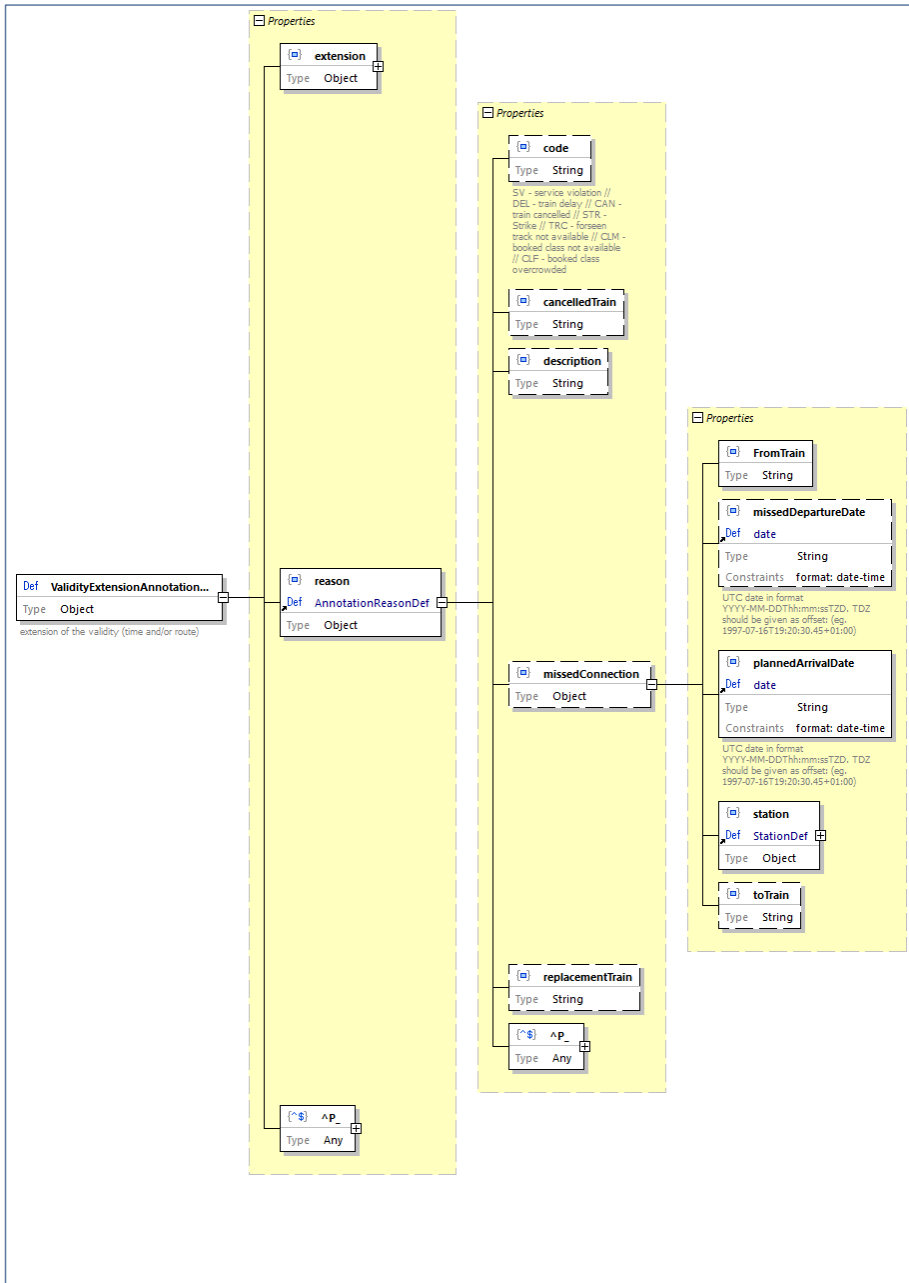


Figure 6064 ValidityExtension data structure

5.2.9.5. Service downgrade

The service downgrade annotation documents a downgrade of the used service. It provides the new service level and information on the reason.

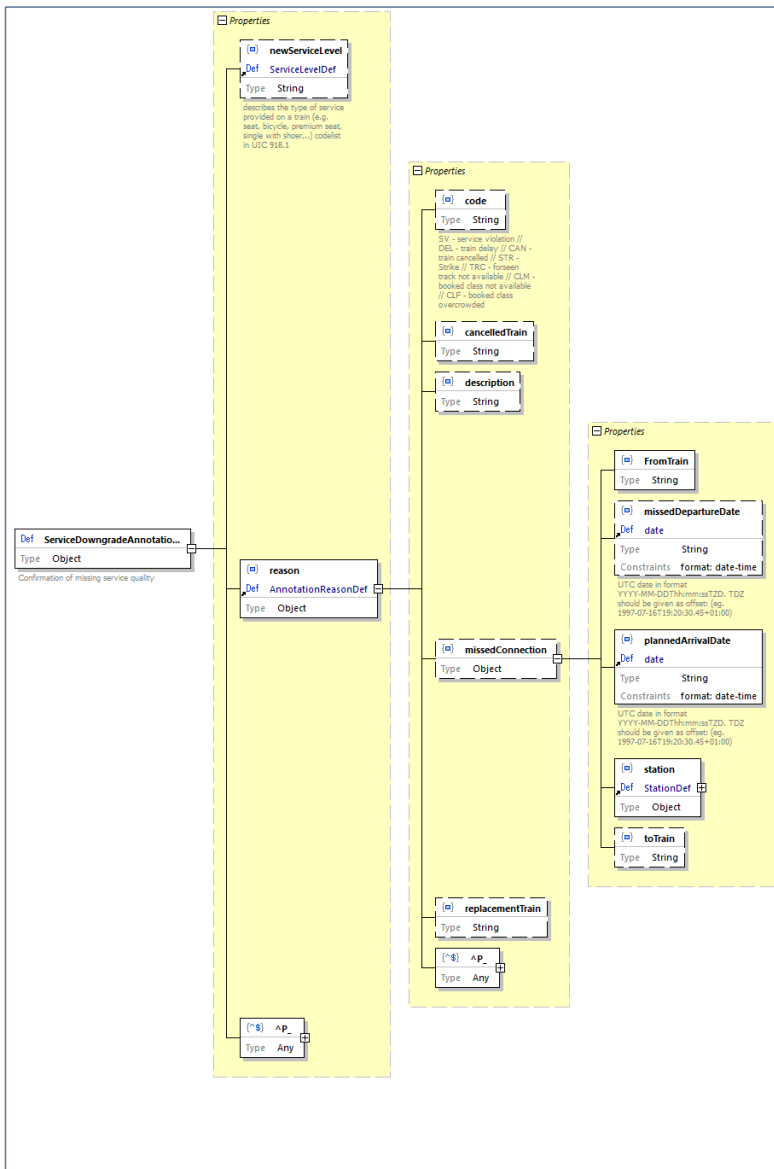


Figure 6165 Service downgrade annotation data structure

5.2.9.6. Delay confirmation

Confirmation that a train was delayed. It can be used to indicate that the passenger as on board of the delayed train or that the ticket was linked to the delayed train without knowing whether the passenger took the train.

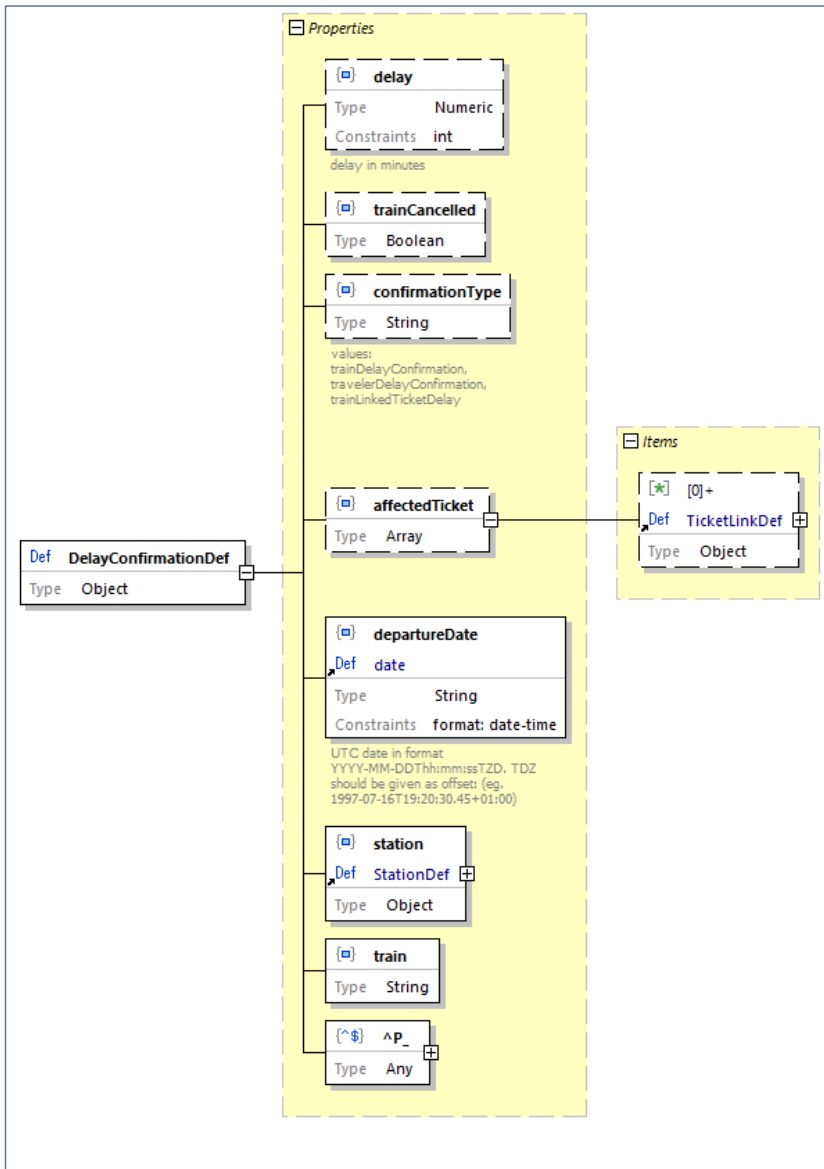


Figure 6266 Train Delay confirmation.

5.2.9.7. Declaration of non-use of the ticket

This annotation documents that the journey was abandoned or that not all passengers used the ticket. Depending on the fare conditions the customer might be entitled to a refund. This annotation limits the further use of the ticket. The ticket is not valid for the original route or number of passengers anymore.

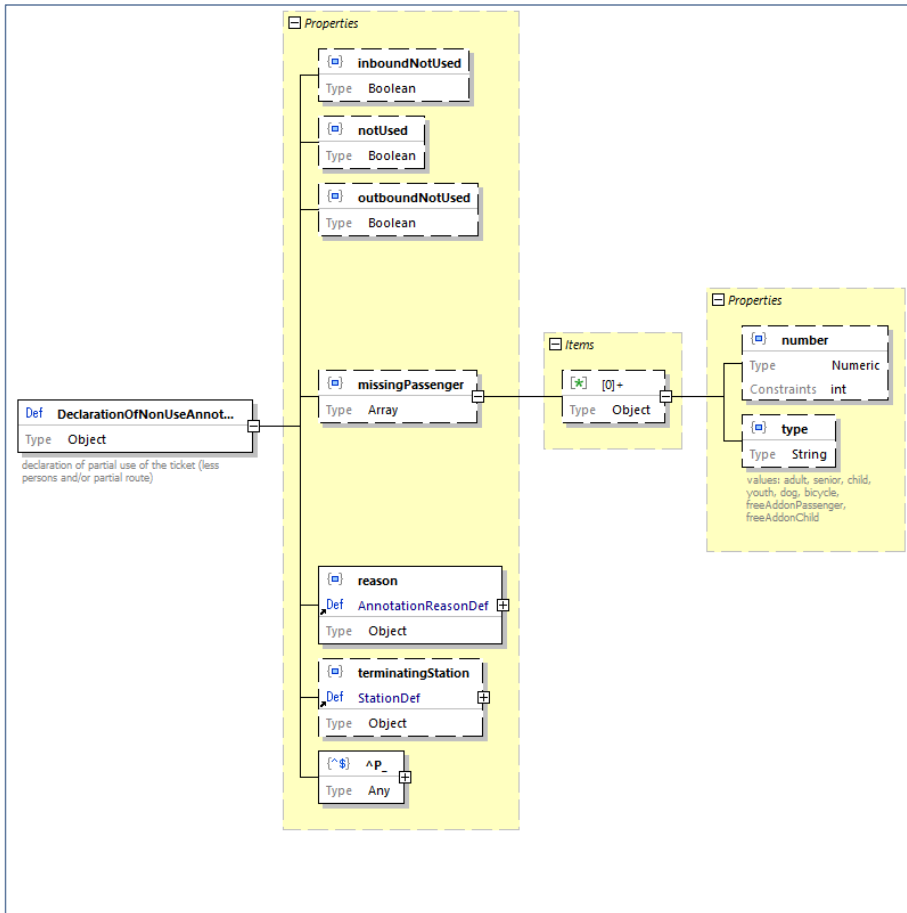


Figure 6367 Annotation documenting not using the ticket (partially).

5.2.9.8. Check-in

id	Id of the check-in. This id is used in case of a check-out to identify the check-in
Issuer_TCO	Company managing the check-in process
TicketCheckNotRequired	Indication that the validity has been checked during check-in and no further action is required from the train staff.
OnlyTravelerTypeToBeChecked	Indication that the validity has been checked during check-in but the train staff should check the passenger type (e.g. child).
SelectedForRandomSample	Indication that the validity was checked and ok but the passenger should be checked to test the validation process.
Train	Train number where the check-in was made
DepartureDate	Departure date and time at the check-in Station
From – to station	Route of the check-in
Reservation	Reference to a reservation in case the check-in was on a reserved place of the passenger

Commented [JS57]: Maybe a detailed definition of the check-in is necessary, such as the detailed use case description, the difference to other actions such as activation, passing a station gate with a barcode, comfort-checkin...

Commented [CG58R57]: Proposal added at the end of 4.2.2

Commented [SJ59]: Is the allocator managing the check-in process? Not the TCO?

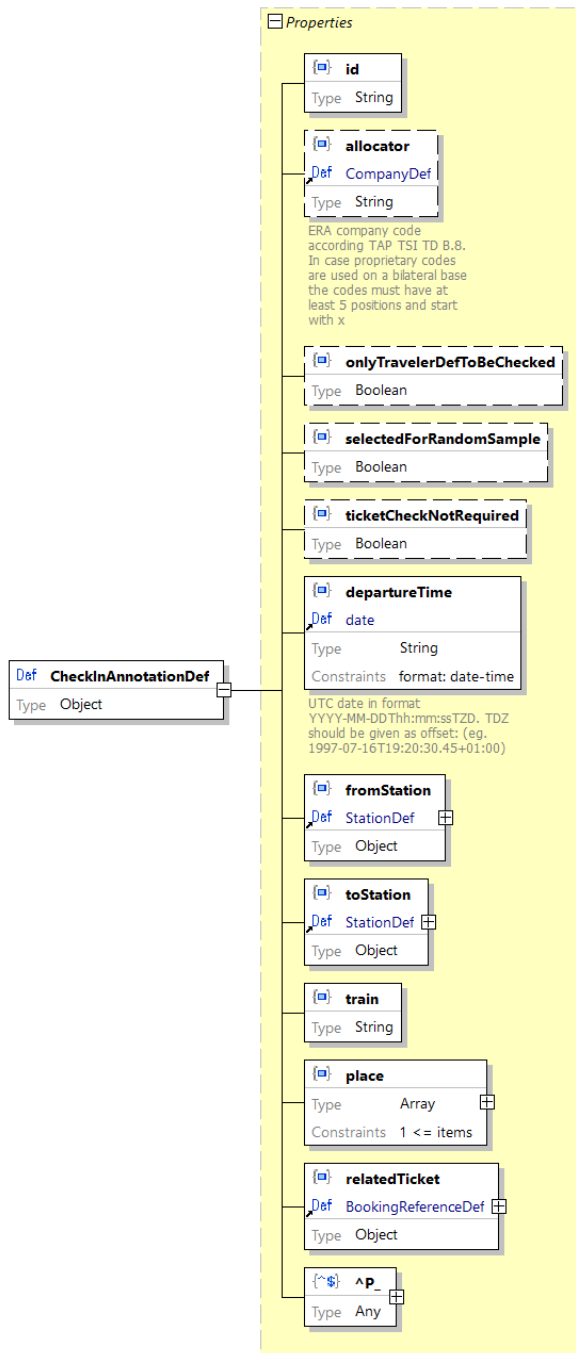


Figure 6468 Check-in annotation data structure

5.2.9.9. Check-out

The check-out annotation invalidates a previous check-in.

id	Id of the check-in. This id has to be the same used in for the check-in
Issuer_TCO	Company managing the check-in process

Commented [SJ60]: Is the allocator managing the check-in process? Not the TCO?

Commented [JS61]: No proprietary codes allowed anymore!

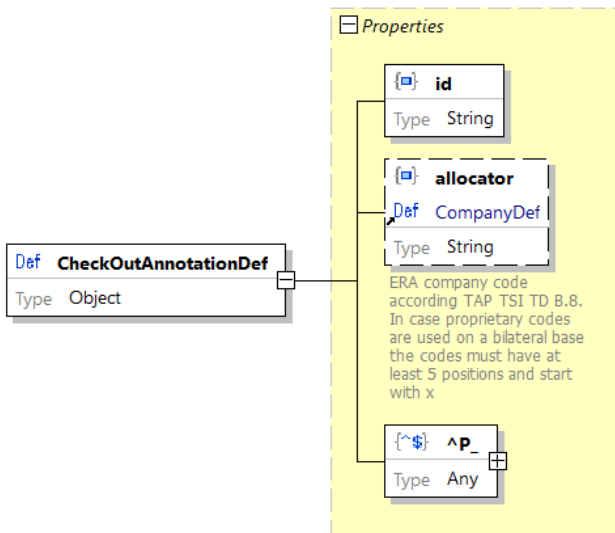


Figure 6569 Check-out annotation data structure

5.2.9.10. General remark

The Remark annotation provides a simple text field for annotations.

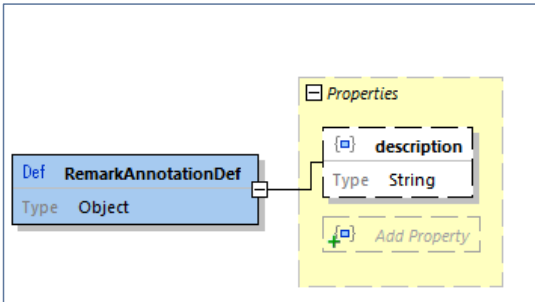


Figure 6670 Remark annotation data structure

5.2.9.11. Cancellation

The cancellation annotation documents that the ticket has been cancelled. It provides the cancellation date and time. In case of an exchange the reference of the new ticket can be provided.

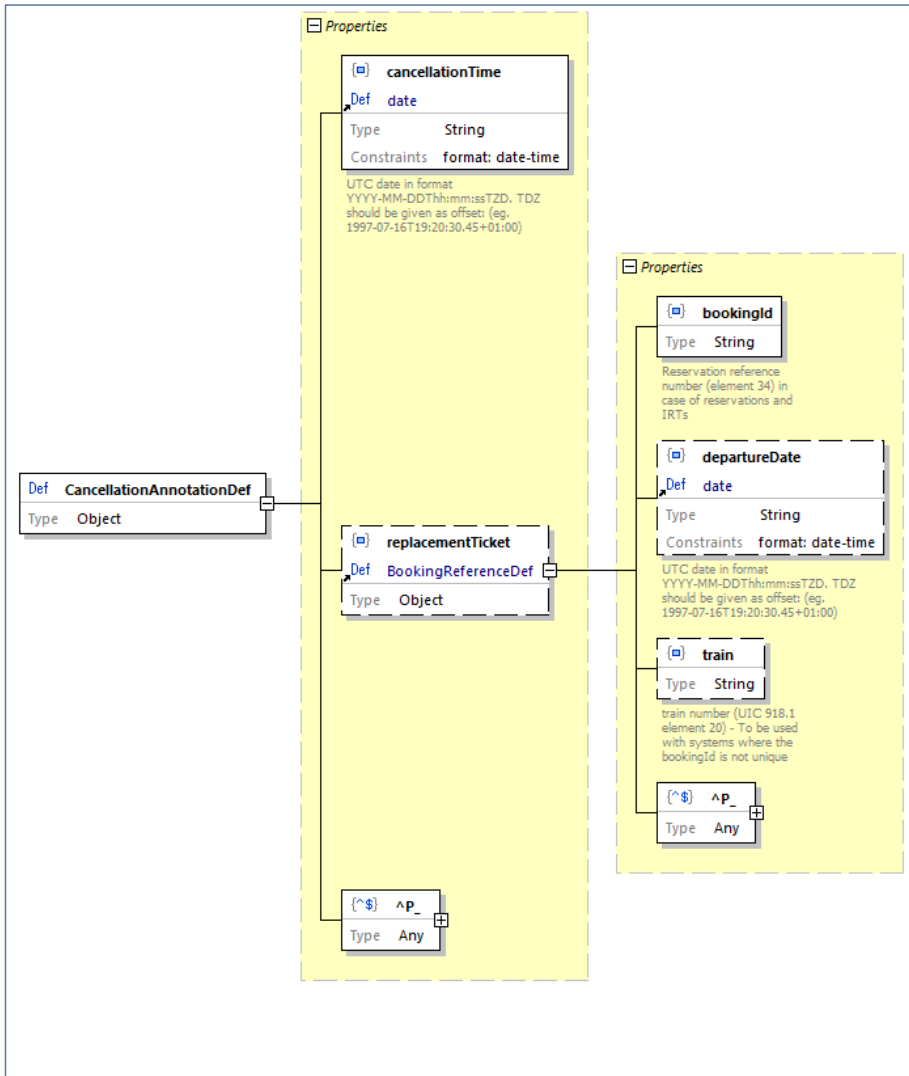


Figure 6774 Cancellation annotation

5.2.9.12. Activation

The activation annotation documents an activation of a previously not or not completely activated ticket.

Commented [SJ62]: A process description of the activation is needed!

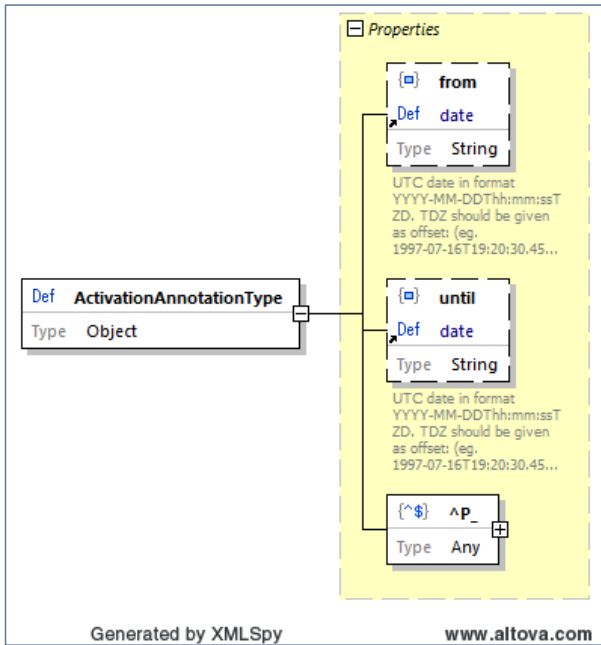


Figure 6872 Activation annotation data structure

5.2.9.13. De-Activation

The de-activation annotation documents a de-activation of a previously activated ticket. It deactivates **all** previous activations of the ticket.

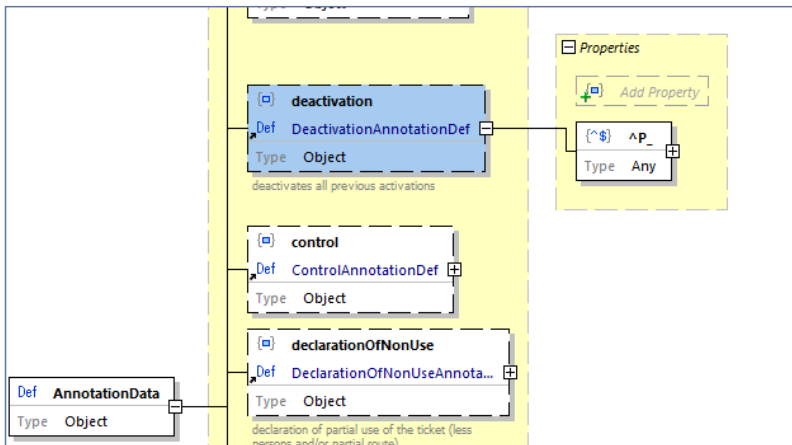


Figure 6973 De-activation annotation

5.2.9.14. Fraud Detection

The fraud detection annotation provides information on detected fraud to all TCOs. The TCO or the original issuer can make an annotation.

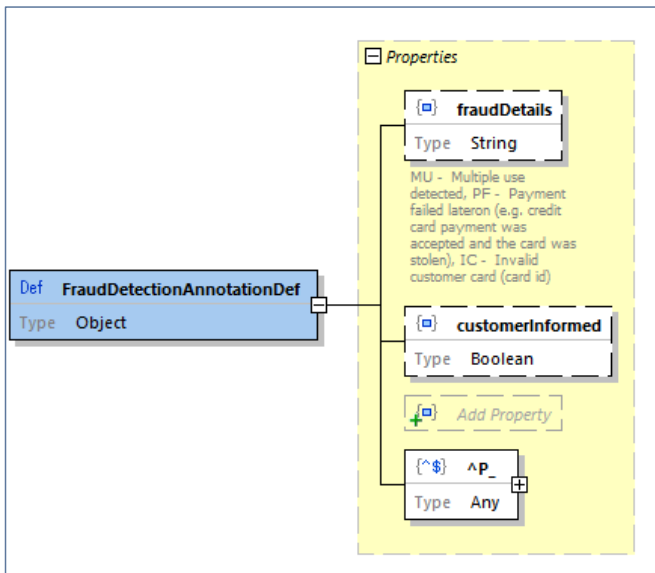


Figure 7074 FraudDetection annotation data structure

Commented [JS64]: DOSIPAS not yet included in the TAP TSI

5.2.9.15. AppLink Annotation

This annotation links the ticket to an app and personal items that can be controlled via the dynamic bar code content defined in TAP TSI TD B.12 (DOSIPAS). The dynamic content will be integrated in the bar code by the app at control time and will be signed by the app according to TAP TSI TD B.12

This annotation is used by TCOs who are able to handle the DOSIPAS bar code in combination with app providers who are able to create the DOSIPAS bar code. Other TCOs and issuers will ignore this annotation.

The following data can be assigned to the ticket via this annotation:

Tag	description
id	Id of the annotation to be used for replacements of this annotation by a new one.
replacedId	Id of the applink annotation that is replaced by this annotation.
appId	Id of the app to which the ticket is linked. This element can be added in the DOSIPAS dynamic content according to TAP TSI TD B.12.
validationToken	A list of tokens that can be used to validate the dynamic bar code. These tokens can be part of the dynamic content of the bar code.

	<p>Token values must be hashed to ensure that these data are not to be considered as personal data. It is not allowed to use e.g. phone numbers or passport-ids directly.</p> <p>Predefined values in line with TAP TSI TD B.12cover:</p> <p>PHONE_ID: the hash value of a phone id (e.g. IME, phone number,..).</p> <p>E_PASS_ID: the hash value of an electronic passport which will be evaluated at control time by the app.</p>
supportsChallenge	<p>True: The TCO can ask the traveller to enter a code in the app and recreated the bar code and the app will include the code in the dynamic bar code content.</p>

Commented [SJ63]: Renaming to PHONE_ID or E_PASS_ID possible?

Commented [CG65R64]: Will be in the next CR for B.9

Commented [SJ66R64]: To be included in B.12 before integration of B.14

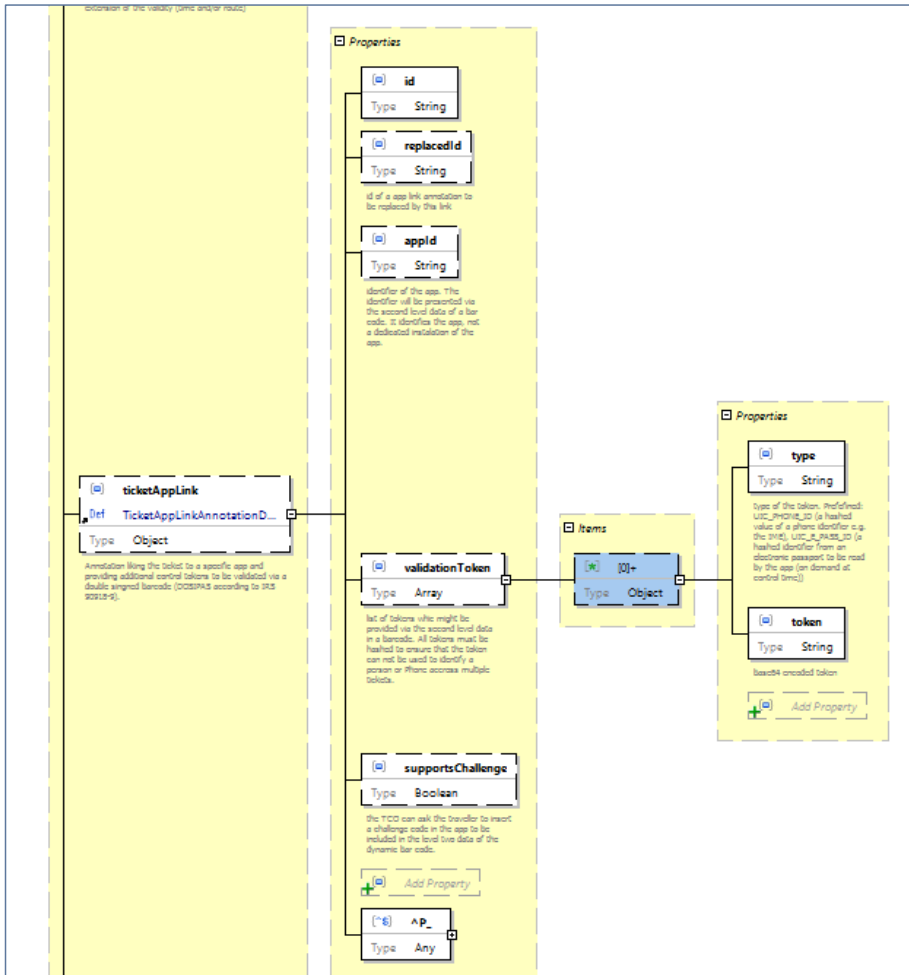


Figure 7175 ApLink annotation

5.2.9.16. Annotation Reason

Annotations can be provided with a reason and details on the involved trains.

Reason.Type	Reason for the annotation: <ul style="list-style-type: none">• SV - service violation• DEL - train delay• CAN - train cancelled• STR - Strike• TRC - foreseen track not available• CLM - booked class not available• CLF - booked class overcrowded
CancelledTrain	Number of the cancelled train
MissedConnection	Details on the missed connection
Description	Textual description
ReplacementTrain	Train number of a train replacing the original train

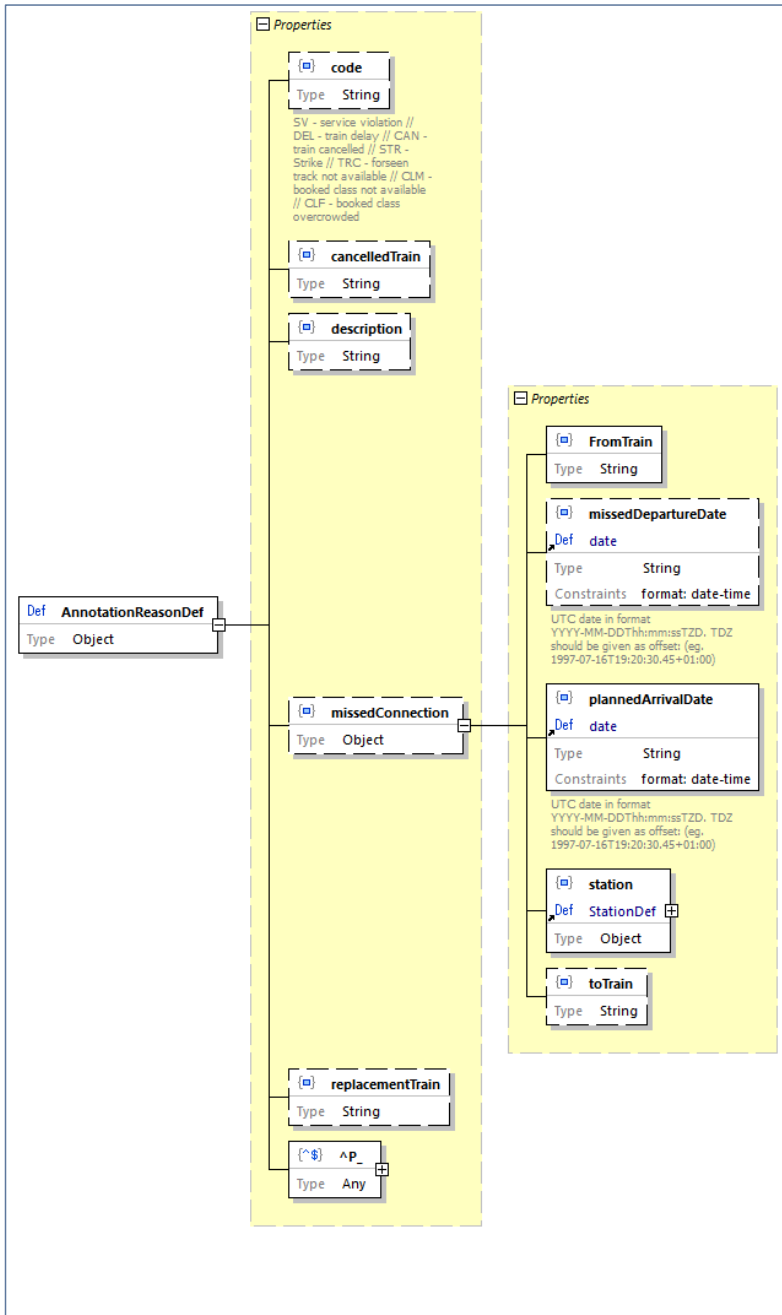


Figure 7276 AnnotationReason data structure

6. Technical architecture

6.1. Authentication and Authorization

JWT (JSON Web Token) is used for Authentication implementing the OAUTH-2 specification (<https://oauth.net/2/>)¹.

~~Certificates used must be officially signed, self signed certificates are not allowed.~~

6.2. Data Integrity

The data integrity can be secured by a “block chain” approach:

- The ticket data are signed by the issuer generating the ticket.
- To allow personal data to be deleted the signature of the ticket data does not include the personal data part but a signature of the personal data.
- Annotation data include the ticket signature (or a hash value of the signature) and the signatures of previous annotations. The annotation data are signed by the TCO creating the annotation

The ticket data can be validated with the public key of the Issuer. The annotation data can be validated by the public key of the TCO which created the annotation. Verifying the signature of the annotation also verifies the signature of the original ticket and the previous annotations as their signatures are part of the signed data (block chain design).

The use of the signatures is recommended but optional.

As the block chain is defined separately for each ticket the complete deletion of a ticket cannot be detected.

Technically the signatures will be “JSON Signatures” according to JWS (RFC 7515) <https://tools.ietf.org/html/rfc7515>.

The ticket data contain the signed data blocks of the anonymous ticket data, the additional personal ticket data and the attached ticket annotations. The data structure is defined according to the JSON Web Signature standard.

In case no signatures are used the contained signature is omitted and the algorithm indicated is “none”.

Commented [JS67]: Signed by whom?

Commented [CG68R67]: Usually done by the operating team of the applications. No specific requirements for this API.

¹ JWT allows the use of a third party identity provider IP and avoids an authentication with each request. The procedure is:

- Client → ask for a token (user, password) → IP (Authentication, provides an encrypted temporary service access token containing the credentials to access the services and a token to request new access tokens)
- Client → ask for a service using a token → Service validates the token via the public key of the IP.
- When the service access token expires the client asks for a new token
- When the token expires the client asks for a new token with user and password)

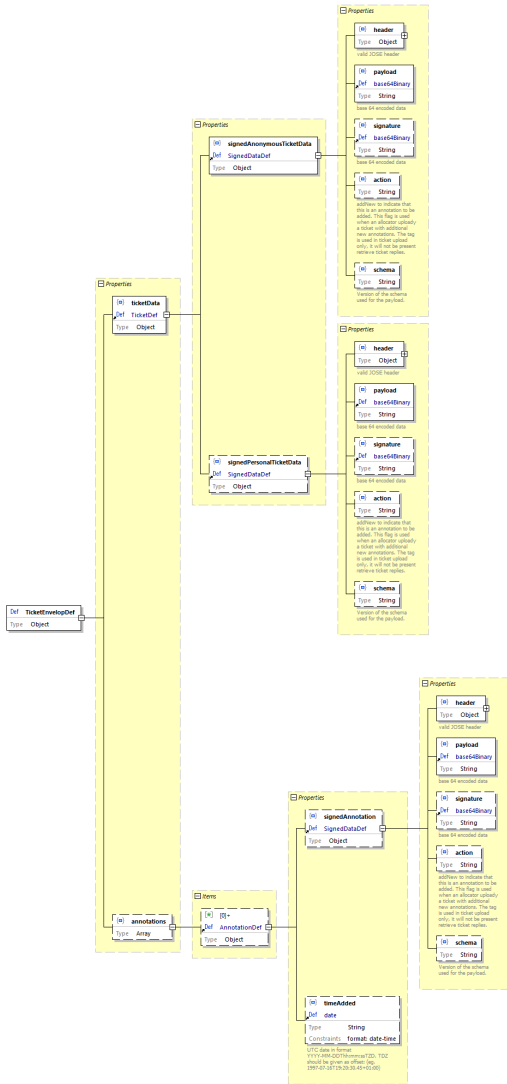


Figure 737 Ticket Data Signatures

The anonymous ticket data contains the parameter of the signature algorithm to avoid signature exchange attacks. It is assumed, that the personal ticket data are signed with the same algorithm. The signature of the personal data is included to ensure that personal data cannot be modified independently.

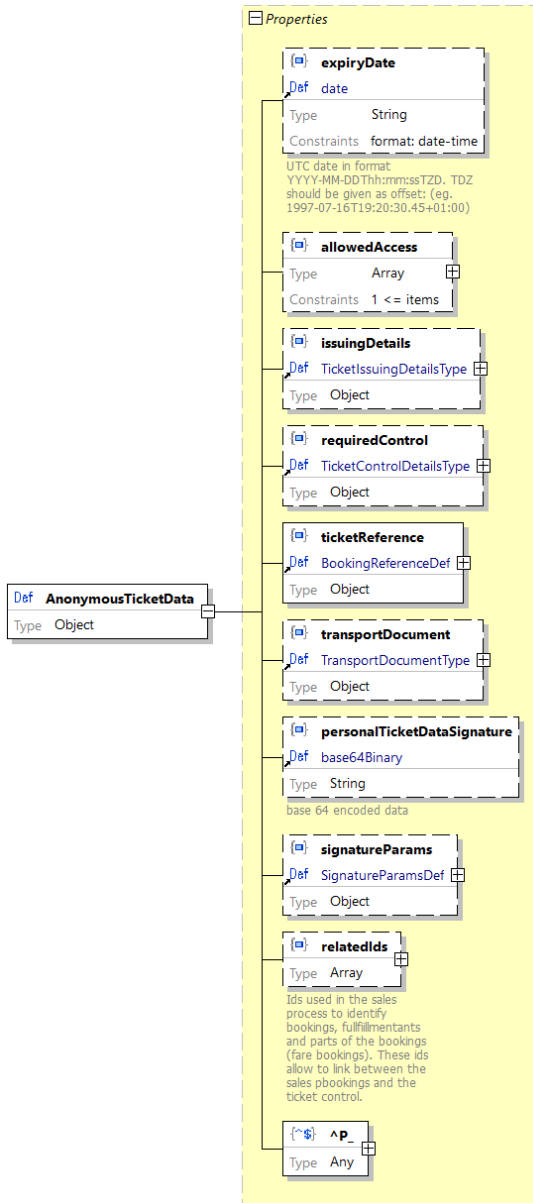


Figure 7478 Ticket Signature Chain and Signature Parameter

The annotation data describes an annotation. They contain the signature algorithm parameters to avoid algorithm exchange attacks. The signatures of the ticket and those of the previous annotation(s) are included to ensure that these data cannot be modified later on.

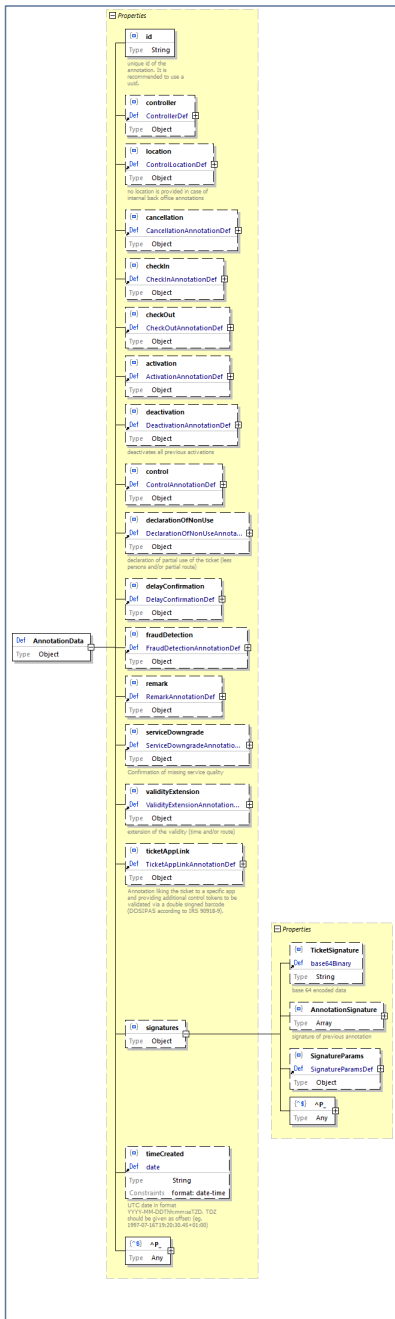


Figure ~~7579~~ Annotation Signature Chain and Signature Parameter

Signatures of the ticket will be provided by the issuer, signatures of annotations will be provided by the Organization creating the annotation which can be a TCO (e.g. for control annotations) of the issuer (e.g. for cancellation annotations or detected fraud on the payment).

In case the ticket includes personal data the personal data part will have a separate signature. The anonymous ticket data part will include the signature of the personal data part. The Ticket signature is a signature on the anonymous data part only. This allows to validate the data content even in the case the personal data have been deleted according to the GDPR regulation.

The validation of the ticket data is thus made in two steps, first the anonymous ticket data part is validated with the ticket signature. Then the personal data part can be validated with the personal data signature contained in the anonymous data part. Thereby the entire ticket data are validated.

In case the personal data have been deleted the anonymous data can still be validated the same way.

The Annotation data can be validated with their signature. This validates also the signature of the original ticket data and of previous annotations and thus no part of the ticket and annotations can be exchanged or modified without violating the signatures.

6.3. GDPR compliance

The ticket data might contain personal data in case they are needed by the TCOs / carriers.

All personal data have been located in the tag "PersonalData" on the ticket data. This part of the ticket can be deleted from the ticket without violating the signatures that guarantee the data integrity.

The issuers and TCOs must delete the personal data in accordance with the GDPR.

In case a central registry architecture is used the central registry must delete the personal data part one Month after the end of validity of the ticket, whereas the anonymous ticket data can be kept longer.

to fulfill the GDPR requirements an TCO / carrier storing the personal data for a longer period and other purposes must ensure that the issuer can inform the customer properly.

6.4. Data transfer

Synchronous services will be implemented as REST services following the REST level 2. The message body will be encoded as JSON (Content-Type: application/json). All communications must use https with TLS version 1.2.

Asynchronous data transfer is implemented by queues. The queues must implement the AMQP 1.0 specification (<https://www.amqp.org/about/what>).

On bilateral agreement other queue technologies might be used between two systems.

Queue authentication and encryption must use TLS version 1.2.

6.5. Services to be provided

The following services are defined:

6.5.1. Retrieve a ticket

Request:

GET /RetrieveTicket/Services HTTPS/1.1 {...}

Reply:

Tickets found:

HTTP/1.1 200 OK

Tickets not found (the application could not find the ticket but is not sure that it does not exist)

HTTP/1.1 409 NOK (http : conflict)

Ticket does not existing

HTTP/1.1 404 NOK (http : not found)

Request body:

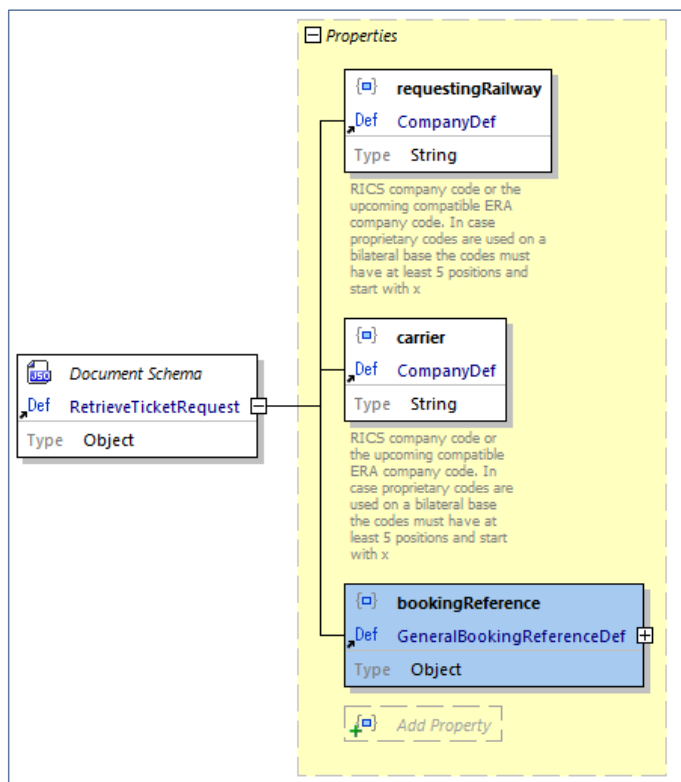


Figure 7689 Retrieve ticket request structure

Commented [CG69]: The technical part of the REST service definitions will be replaced in the next version (March 2022) by a openApi specification (OpenApi version 3.1, yml format) to allow code generation.

Commented [SJ70R69]: Yml-File to be provided

Reply body:

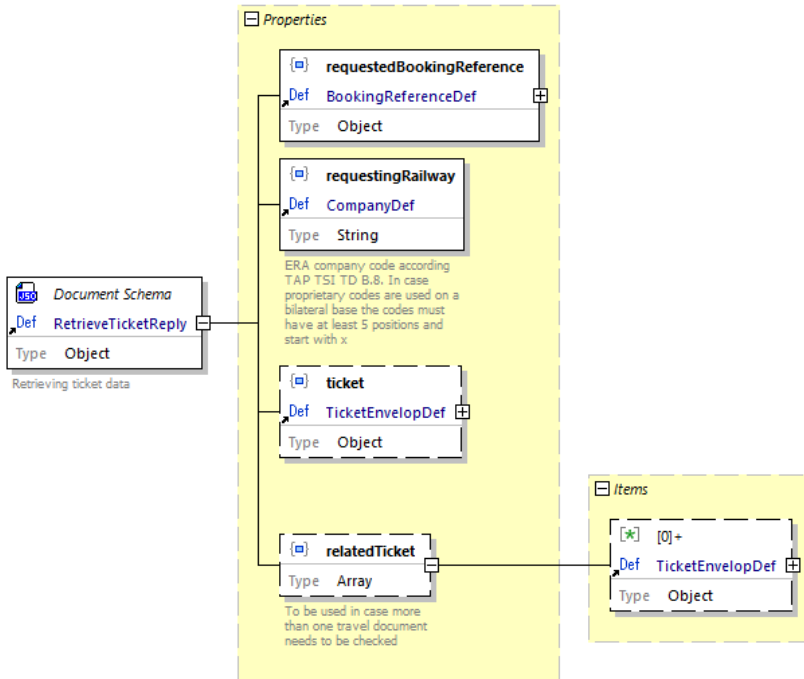


Figure 778- Retrieve Ticket - reply data structure

6.5.2. Retrieve tickets linked to a train

Service description:

The service delivers the list of tickets where the requesting carrier is involved.

The list includes:

- Reservations for the specified train number and where the departure date fits to one of the run dates
- Any ticket with a check-in annotation for the specified train number where the date fits to one of the run dates
- Any open ticket with a train link to the specified train number and the run date.

Request:

GET /RetrieveTrainTickets/Services HTTPS 1.1 {..}

Reply:

Tickets found:

HTTP/1.1 200 OK

Tickets not found (the application could not find the ticket but is not sure that it does not exist)

HTTP/1.1 409 NOK (http : conflict)

Tickets do not existing

HTTP/1.1 404 NOK (http : not found)

Request body:

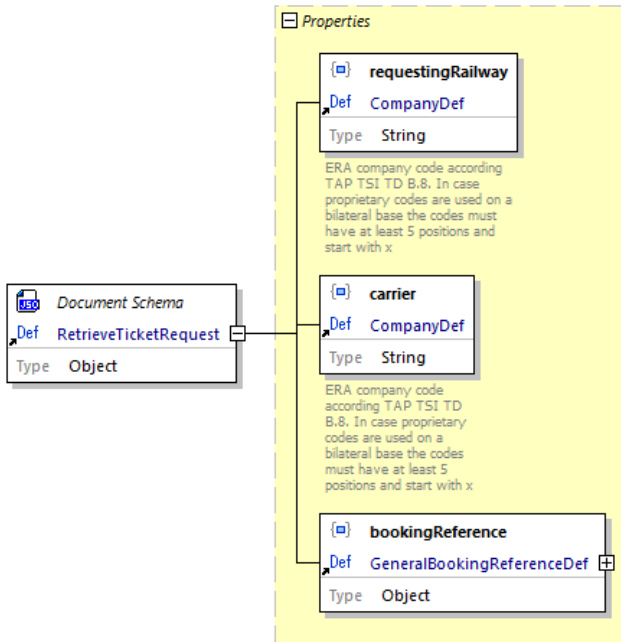


Figure 7882 Request train tickets - Request

Reply body in case of tickets found:

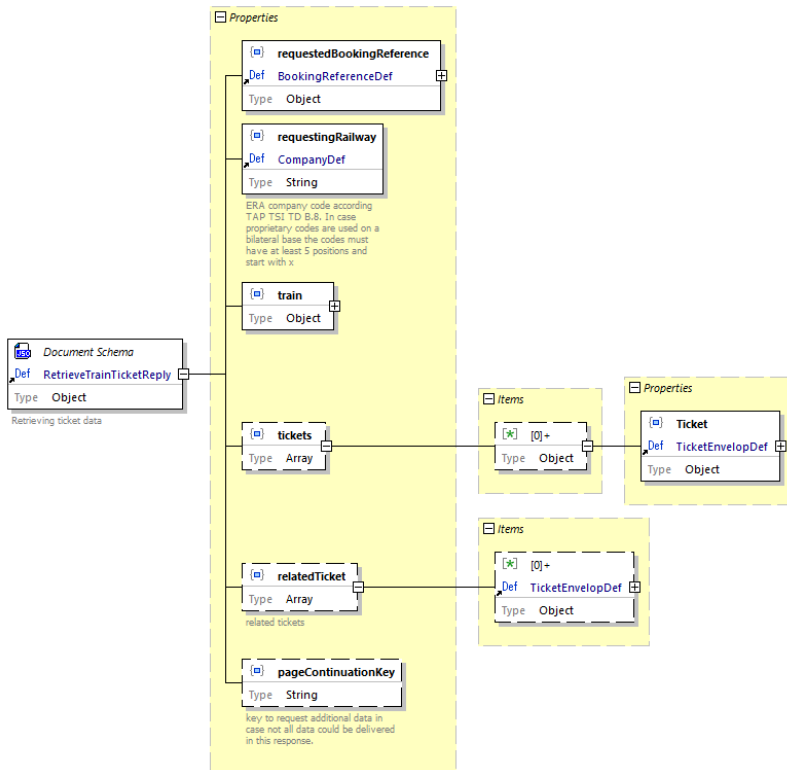


Figure 7983 Request train tickets - reply

6.5.3. Request the list of issuers hosted in a registry

Request:

`GET /RetrievalIssuers/Services HTTPS/1.1`

Reply:

HTTP/1.1 200 OK

Content-Type: application/json {..}

A system not hosting any issuers ticket should not provide the service, so there is always at least one issuer included.

Commented [SJ71]: Allocator or issuer?

Commented [JS72]: Shall be renamed to RetrievalIssuers

Commented [CG73R72]: Requires a change in implementations. Cn be done with the next version.

Reply body:

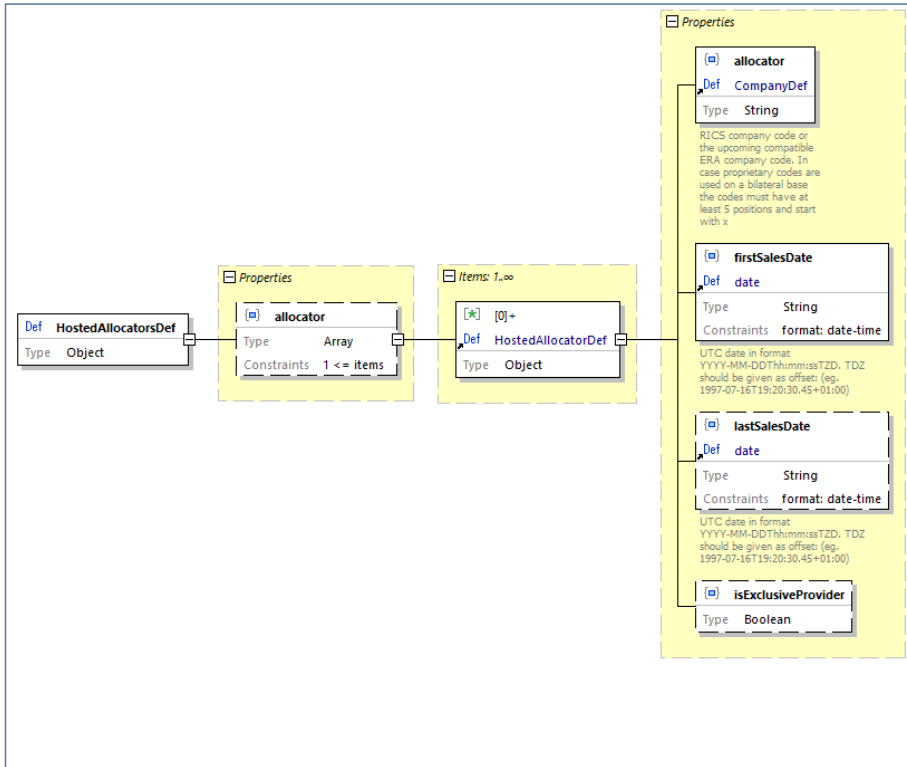


Figure 8084 Hosted Issuers request

6.5.4. Request the list of TCOs connected to a registry

Request:

`GET /RetrieveTCOs/Services HTTPS/1.1`

Reply:

HTTP/1.1 200 OK

Content-Type: application/json {...}

A system not connecting any TCO should not provide the service, so there is always at least one TCO connected.

Reply body:

Commented [JS74]: Should be renamed to RetrieveTCOs
Commented [CG75R74]: Requires a change in implementations. Can be done with the next version.

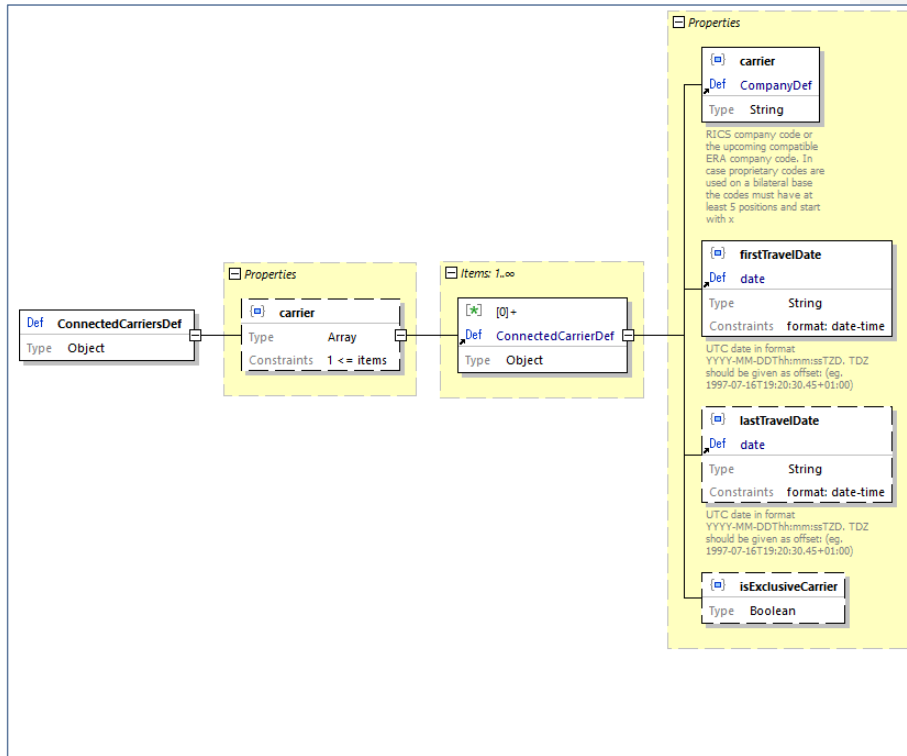


Figure 8185 connected carriers reply

6.5.5. Resend all tickets again via the message queue

A TCO might ask to receive the tickets provided via the message queue again. He can ask to:

- get the tickets delivered on a specific date (UTC)
- get the tickets valid on a specific travel date (UTC)

The provider of the data might refuse to resend the data in case this service is misused or used too often.

Request:

PUT /ResendTickets/{} Services HTTPS 1.1

Reply

Request accepted:

HTTP/1.1 200 OK

Rejected due to too many requests:

HTTP/1.1 429 NOK (http too many requests)

Request body:

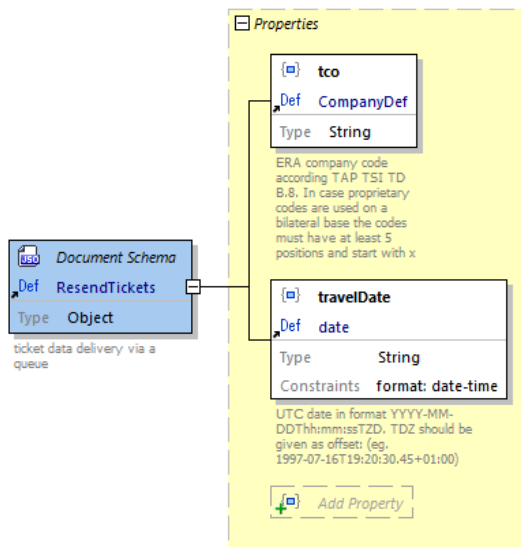


Figure ~~8286~~ request to resend tickets

Reply body:

None

6.5.6. Create an annotation

The service creates a new annotation. The annotation can be created only if the TCO/carrier is involved in the ticket or by the issuer of the ticket, otherwise the request is rejected with an http authorization error.

The request must have a unique id to avoid adding the same annotation multiple times. It is recommended to use a UUID as message id. In case signatures are used the signature could be used as message id as well.

In case the request fails it can be repeated using the same message id. The receiver of the message will add the annotation in case it has not been added before. The reply will in both cases be the same (OK).

Request:

POST /CreateAnnotation/ Services HTTPS 1.1 {..}

Reply:

Annotation created:

HTTP/1.1 201 Created

Ticket not found:

HTTP/1.1 424 Failed dependency

Request Body:

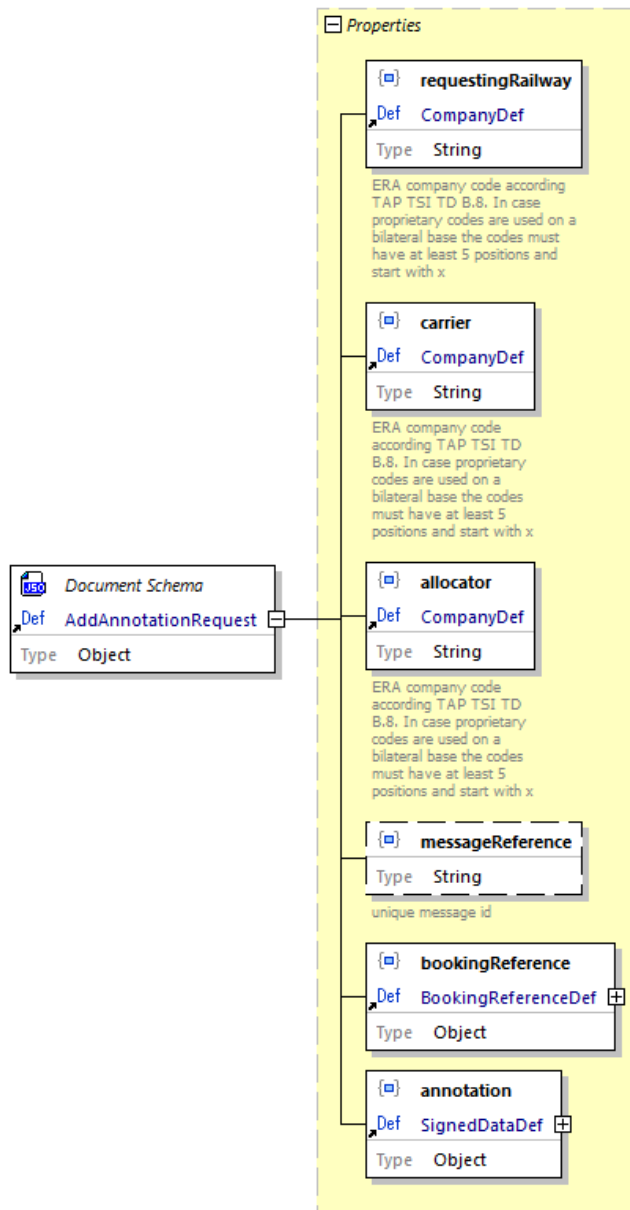


Figure 8387 AddAnnotation request

6.6. Message queues

Queue names do not need to be standardized. A pilot implementation might give best practices.

6.6.1. Ticket Queue

The ticket queue provides the tickets and updates of the ticket. The entry always provides the entire ticket including the ticket data and the annotations.

The ticket delivery provides a technical id to the ticket provided by the system delivering the data. A UUID can be used for that. This id allows a fast and direct identification of the ticket to update the content.

A sequential id is provided numbering the delivered updates. This allows the receiving system to avoid replacing a ticket with an older version accidentally. The sequential id must be used in case there a parallel read processes on the queue.

Only tickets where the TCO is involved will be delivered to the TCO. In case a TCO does not need personal data the personal data will be removed from the ticket before delivery.

If an issuer provides a ticket again with additional annotations, he must indicate these annotations as new.

The value "addNew" is added in the annotation to indicate that this is a new object to be added. The tag will not be present in retrieve ticket replies.

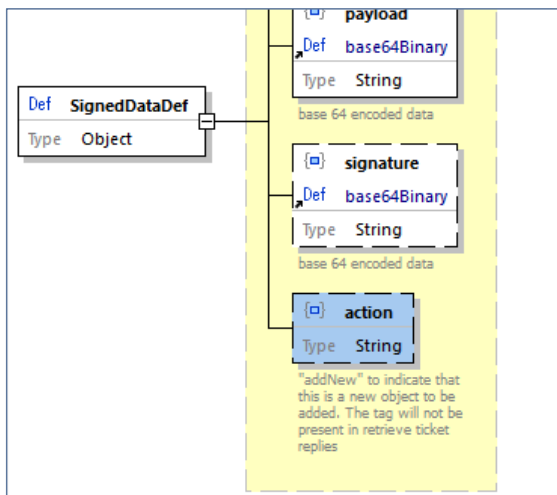


Figure 8488 indication of new annotations

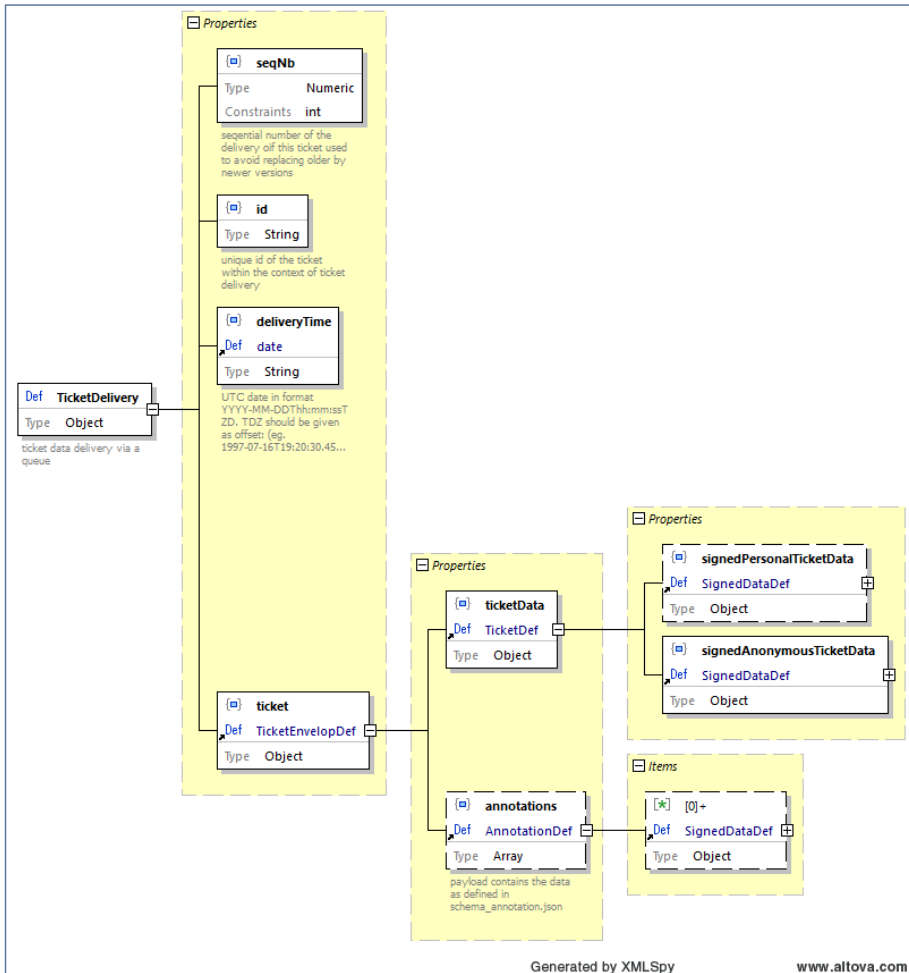


Figure 8589 Ticket delivery

The ticket queue might also be used to provide error messages on data uploaded via a queue. The error message will be provided on the queue of the company that uploaded the data.

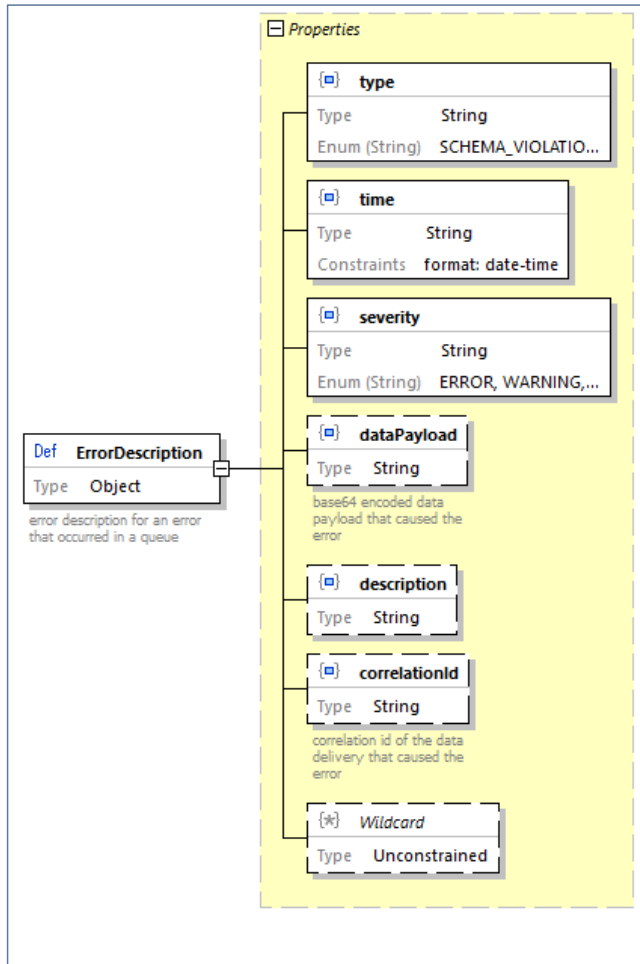


Figure 8690 error message

7. Required Service Levels

The required service levels hereafter are minimal obligations in order not to discourage implementations. More ambitious agreements should be made where possible.

The web services and queues must be available 24x7.

The required availability is 99.9% unless higher levels are agreed bilaterally.

A registry must anonymize the ticket data one month after the end of validity

A registry must delete the ticket data after the ticket expiry date set by the issuer.

Response times of web services (unless shorter times are agreed bilaterally):

5 sec for 95% of transactions

Delivery times of queues (unless shorter times are agreed bilaterally):

Delivery within 60 sec. of 99.9% of tickets or annotations (except for initial bulk delivery)

The provider of the registry must provide permanently a stable test system with the same functionality for integration tests with the participating railways.

Disaster recovery needs to be agreed bilaterally.

Commented [JS76]: IS this necessary for interoperability?

Commented [CG77R76]: A 24x7 availability should be required as trains run also 24x7.

Commented [CG78R76]: Whether the exact values of availabilities and response times should be in can be discussed, but in case of too bad figures an interoperability in real live will not be given any more.

8. Acronyms

A4RT	A4 Rail Ticket layout, described in TAP TSI TD B.11
AMQP	Advanced Message Queuing Protocol https://www.amqp.org/about/what
EWT	East West tariff Tariff used for Non-Integrated-Reservation-Tickets. The fare data model follows TAP TSI TD B.1.
FCB	Flexible Content Bar Code Barcode specification that contains ticket data for control as structured data and is therefore machine interpretable. The Specification provides a data model of a ticket for control. FCB covers various ticket type (IRT, NRT, RPT,..). (TAP TSI TD B.12)
EWT	East West tariff
FCB	Flexible Content Bar code
FST	Flexible size ticket described in TAP TSI TD B.11
JWS	JSON Web Signatures Specification to include digital signatures on JSON data structures. The signatures include the parameters of the algorithm, the signature itself and the encoded JSON data as base64 encoded UTF8 string. Internet Engineering Task Force (IETF) Request for Comments: 7515 Category: Standards Track ISSN: 2070-1721 https://tools.ietf.org/html/rfc7515
JWT	JSON Web Token Specification to transport authentication information used by the OAUTH2 authorization protocol. JSON Web Token - RFC 7519
NRT	Non Integrated Reservation Tariff Tariff used for Non-Integrated-Reservation-Tickets. The fare data model follows TAP TSI TD B.1.
NRT	Non-Integrated Reservation Ticket Ticket not including an integrated reservation.
OAUTH 2	Standard for authorization. https://oauth.net/2/

SiP	<p>Security in Paper</p> <p>A ticket (representing the contract of carriage) is unique and printed on secured paper to avoid modification or creation by other than a railway company. The security is provided by the quality of the security elements included in the paper and the quality of the stock control process that controls the access to blank secure paper.</p>
SiD	<p>Security in Data</p> <p>A ticket contains security elements. These are created/calculated based on the content of the ticket, resulting in a non-compliant security element in case of falsification or modification. SiD tickets are usually easy to regenerate or to copy. As SiD does not provide copy protection additional measures must be taken to avoid double use. The tickets are personalized and the validity of the ticket is limited.</p>
SiS	<p>Security in System</p> <p>The contract is on a server. Every operation (creation, check, modification, ...) on the ticket is conducted on the record(s) on the server or a synchronized replica. The access to the contract requires an authentication of the passenger. The ticket control id (key to the ticket) or personal data of the passenger (name, date of birth,..) are used to retrieve the ticket.</p>
SiV	<p>Security by Visual elements.</p> <p>The ticket is controlled by a visual element printed with the ticket data on blank paper or displayed on a device. To use an image as a security feature the costs to create the complex image must be higher than the price of the ticket.</p>
TCO	Ticket Controlling Organization
TLT	<p>Train linked ticket</p> <p>Ticket not including a reservation but restricted to a train run (or multiple train runs along the route)</p>
TLB	<p>Ticket Layout Barcode</p> <p>Barcode specification describing the “printed” layout of a ticket. It is not machine interpretable and does not provide ticket data, only a ticket display.</p>
UML	<p>Unified Modelling Language</p> <p>A specification defining a graphical language for visualizing, specifying, constructing, and documenting the artifacts of distributed object systems.</p> <p>OMG Unifier Modelling Language Superstructure v 2.1.2</p>
UUID	<p>Universally Unique Identifier</p> <p>Standard to create a unique id. The specification is published as ISO/IEC 9834-8:2005.</p>

9. Glossary

e-Ticket	<p>The electronic representation of the travel contract on a data base.</p> <p>The home print ticket (A4RT or FST) where the contract of travel is represented in a printed or displayed bar code is not an e-ticket according to this definition.</p> <p>Synonym: dematerialized ticket</p>
Integrated Reservation Ticket (IRT)	<p>Means a kind of train ticket restricted to a specific train on a specific date/time. A IRT ticket can only be sold by means of an on-line transaction between the sales terminal and the attributing system where the relevant train is hosted</p> <p>All tickets for a train are managed in one central system of the issuer.</p> <p>The ticket is valid on that train on a certain day only.</p>
Non-integrated Reservation Ticket (NRT)	<p>This is a way of selling train tickets meant for international or foreign sales, where the issuer can produce the ticket locally, without any on-line transaction with an attributing system. The NRT tickets are always open tickets, i.e. the contract of carriage is valid on any NRT train serving the route marked on the ticket, within a defined validity period. To issue a NRT ticket the issuer needs a list of OD's ("series") and one or more tables of prices corresponding to distance ranges. Reservations can (in some cases must) be purchased together with the ticket</p> <p>Multiple issuers can create tickets for the same route independently.</p> <p>The ticket might be applicable to a route with many trains or a zone or a list of trains or combinations of these. The validity might be more than one day.</p> <p>Some conditions allow a partial refund on unused parts of the ticket route. Refund can be done via the distributor/issuer. These conditions depend on the carriers and the allocator (i.e. providing the option of reducing the number of passengers or to interrupt the journey).</p> <p>NRTs not linked to a train might be reused in case the use is not tracked.</p>
Ticket	<p>Medium to carry the travel contract or a reference to the travel contract. The ticket might provide proof of the travel contract via its security features.</p> <p>The tickets are sold by distributors/issuers².</p> <p>The assembling of the ticket is done by the distributor(s)^{2*}. The issuer holds the master ticket data/contract of the sold ticket.</p> <p>A ticket can include multiple carriers in the travel contract.</p> <p>The control of one ticket is done by one or many Ticket Controlling Organizations (TCO)^{2*}. Other means of ticket checking (e.g. gates) will also be named TCOs.</p>

² See chapter [Actors](#)

Ticket annotation Annotation	An amendment made to a travel contract changing the ticket status or validity or adding information relevant for refunds. There is a broad range of annotations that can be made by a TCO or an issuer. Ticket annotations are today usually handwritten on the ticket paper. To provide a solution for annotations with e-tickets is a major part of this specification. Annotations in this document are intended to be made in digital form only.
Ticket identification	Dataset needed to identify a ticket. Depending on the scenarios implemented these could be a reference number or a name or an identification in the context of a train.
OSDM	Open Sales and Distribution Model TAP TSI TD B.13

10. Bibliography

REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)

GDPR General Data Protection Regulation (EU) 2016/679

ICAO Doc 9303 Machine Readable Travel Documents Part 3

TAP TSI Technical document B.8 - STANDARD NUMERICAL CODING FOR RAILWAY UNDERTAKINGS, INFRASTRUCTURE MANAGERS AND OTHER COMPANIES INVOLVED IN RAIL-TRANSPORT CHAINS

TAP TSI Technical document B.9 - STANDARD NUMERICAL CODING OF LOCATIONS

Warning

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11. Appendix A

JSON schema files version 1.2

The json schema files are available separately:

12. JSON Definitions

- 90918_4_V_1.2_definitions.json

13. JSON messages

- msg_schema_addannotationrequest.json
- msg_schema_retrieveticketrequest.json
- msg_schema_retrieveticketreply.json
- msg_schema_retrievetrainticketsrequest.json
- msg_schema_retrievetrainticketsreply.json
- msg_schema_ticketdelivery.json

14. JSON data objects

- schema_anonymousticket.json
- schema_personalticketdata.json
- schema_annotation.json