EU EIP SA 4.1
Task 3: Validate and enhance quality proposals

Validation Report of quality proposals for Multi-Modal Travel Information Services (MMTIS)

Version: 1.0

Date: 25 July 2019

Document Information

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Distribution

Date	Version	Dissemination
20 May 2019	0.1	Internal MMTIS partners EU EIP SA 4.1
24 May 2019	0.2	Internal MMTIS partners EU EIP SA 4.1
03 June 2019	0.3	Internal EU EIP SA 4.1
28 June 2019	0.4	Internal EU EIP SA 4.1
18 July 2019	0.5	Internal EU EIP SA 4.1
25 July 2019	1.0	External

Preface

This report describes the activities of Task 3 of the sub-activity 4.1 of the EU EIP project covering "Validation of quality proposals for MMTIS".

This is an EU EIP SA 4.1 report describing the findings of stakeholder feedback and comments gathering on the July 2018 version of *Quality Definitions for Multimodal Travel Information Services (MMTIS)*. The findings of this report will feed into the updated version of *Quality Definitions for Multimodal Travel Information Services (MMTIS),* and help form the future direction of this work.

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1. Introduction

1.1. Background and purpose

In the framework of the EU ITS Directive and the corresponding EU Delegated Regulation (EU) No 2017/1926 concerning Multimodal Travel Information Services (MMTIS), quality of related data is of high importance to all involved service and data providers.

The EU EIP platform is developing a common framework to describe and assess MMTIS data quality. In this context, EU EIP has developed a proposal for MMTIS Quality Definitions, including quality criteria and (minimum) quality requirements for individual MMTIS data types.

The first version of the Quality Definitions for Multimodal Travel Information Services (MMTIS) document was published by EU EIP SA 4.1 in July 2018. Stakeholder surveys and information gathering were undertaken in the following months. This report documents the feedback and findings of this exercise, and suggests where revisions to the current version of the document could be made.

1.1.1. Document structure

The document has the following structure:

- Section 1, this section, introduces the Quality Definitions for Multimodal Travel Information Services (MMTIS) document and briefly describes the content.

- Section 2 describes the validation approach

- Section 3 summarises the stakeholder responses

- Section 4 provides responses to the stakeholder feedback received, and indicates how and when the feedback will be addressed by EU EIP SA 4.1

- Section 5 provides conclusions and notes additional related MMTIS fields of interest

- Annex 1 contains the detailed stakeholder responses that are summarised in Section 3

1.2. Quality Definitions for Multimodal Travel Information Services (MMTIS)

Throughout 2017 and 2018 EU EIP Sub-Activity 4.1 worked towards developing MMTIS quality definition recommendations. The development process reviewed existing literature and studies, undertook stakeholder workshops, gathered evidence (from a limited set of conditions and operating environments), and utilised the expert knowledge of the public and private stakeholders involved in the EU EIP SA 4.1 quality work.

The document describes the results of the efforts to define quality criteria, requirements and assessment methods, developed by the EU EIP. The intention was that the criteria, requirements and assessment methods for MMTIS would be validated with data suppliers such us public transport operators and/or their national access points (NAP), a Traffic Information Centre (TIC) or mobility providers (e.g. bike sharing and car sharing providers) in the different member states.

The framework covers a subset of 13 of the Delegated Regulation (EU) No 2017/1926 data types with a primary focus on Level of service 1. This selection was based mainly on the experts' assessments of relevance to road operators as well as expected user benefits of the related services and information types throughout Europe and the availability in practise of the related data.

The framework includes:

- quality criteria applicable to each data type;

- an interpretation for each quality criteria (specific to that data type) which explains how each quality criterion has been understood for a specific data type;

- proposed quality levels – *Basic*, *Enhanced* and *Advanced*;

- possible assessment methods.

The data types covered are:

1. Connection links where interchanges may be made & default transfer times between modes at interchanges

2. Network topology and routes / lines (topology)s

3. Timetables

4. Planned interchanges between guaranteed scheduled services

5. Road Network

6. Cycle Network (segregated cycle lanes, on-road shared with vehicles, on-path shared with pedestrians)

7. Park & Ride stops

8. Publicly accessible refuelling stations for petrol, diesel, CNG/LNG, hydrogen powered vehicles, charging stations for electric vehicles

9. Disruptions (all modes)

10. Real-time status information – delays, cancellations, guaranteed connections monitoring (all modes)

11. Future predicted road link travel times

12. Bike sharing stations

13. Car sharing stations

As the introduced quality criteria do not apply to all covered data types, a mapping table was created, showing which criteria are relevant to which data type, see Table 1.

The report compiling the Quality Definitions for Multimodal Travel Information Services (MMTIS) is downloadable at the EU EIP website[1].

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[1] https://eip.its-platform.eu/highlights/multimodal-travel-information-services-mmtis-quality-framework-published-stakeholders

Data type	Geographic coverage	Availability	Timeliness (start)	Reporting period	Timeliness (update)	Latency (content side)	Location accuracy	Error rate	Event coverage	Report coverage	Completeness of data
Quality Criteria											
Connection links where interchanges may be made	●	●					●	●			●
Network topology and routes / lines (topology)s	●	●					●	●			●
Timetables	●	●						●		●	●
Planned interchanges between guaranteed scheduled services	●	●					●	●			●
Road network	●	●					●	●		●	●
Cycle network	●	●					●	●			●
Park & Ride stops	●	●					●	●			●
Publicly accessible refueling stations	●	●		●	●		●	●			●
Disruptions (all modes)	●	●	●	●	●	●	●	●	●	●	●
Real-time status information	●	●	●	●	●			●	●	●	●
Future predicted road link travel times	●	●		●	●	●		●			●
Bike sharing stations	●	●					●	●		●	●
Car sharing stations	●	●					●	●		●	●

Table 1 - Mapping of proposed quality criterion for selected data types

2. Validation approach

2.1. Objectives

The objective was to collect feedback from MMTIS stakeholders on the interpretation for each quality criteria, the proposed quality levels and any assessment methods stakeholder used.

2.2. Method

Stakeholders were identified and requested to complete a document based survey. A table for each data type was included and stakeholders were requested to complete the survey for the data types related to their field of expertise. There was a series of text and check boxes to be filled and the survey asked the following questions:

- Is the interpretation of the quality criteria clear?

- Agreement of the proposed levels – Basic, Enhanced and Advanced

- Are there any existing quality assessment methods?

An extract of the survey table is shown in Figure 1:

EUEIP SA 4.1 DETERMINING QUALITY OF EUROPEAN ITS SERVICES
Multimodal Traveller Information Services - Data Quality Validation

Section 2: Data quality feedback tables

Data Type: Connection links where interchanges may be made, default transfer times between modes at interchanges

Data entity: Geographic position, Transfer time

Data category: Static travel data

Part A – Criteria and requirements		Check the boxes if you agree with the EUEIP proposed levels			Do you have a quality assessment method?
Quality Criterion	**Interpretation**	Basic Level	Enhanced Level	Advanced Level	Yes/No
Geographic coverage	*Percentage of all interchanges within a given network covered (% of all interchanges)* **Is the interpretation clear?** Choose an item.	90% Yes☐	95% Yes☐	99% Yes☐	Choose an item.
Add comments					If yes, describe in **Part B** below
Availability	*Server availability during hours of operation.* **Is the interpretation clear?** Choose an item.	95% Yes☐	99% Yes☐	99.5% Yes☐	Choose an item.
Add comments					If yes, describe in **Part B** below
Location Accuracy	*Accuracy of coordinates of entry positions for all provided links, compared to ground truth, described as: ē = "Mean value of positional uncertainties".* **Is the interpretation clear?** Choose an item.	$\bar{e} < 100$ Yes☐	$\bar{e} < 50$ Yes☐	$\bar{e} < 10$ Yes☐	Choose an item.

Figure 1 – Extract from EU EIP SA 4.1 MMTIS Validation Word Survey Template

3. Stakeholder response

There were seven responses to the questionnaire:

- Deutsche Bahn AG

- Helsinki Region Transport (specific real-time traffic   information traffic response)

- Helsinki Region Transport (specific GIS response)

- Finnish Transport Agency

- RET - public transport company of the Rotterdam city region

- Cykl, - bike share network in Wageningen, Netherlands

- National Transport Authority, journey planner / service provider, Ireland

Each of these organisations filled out responses to the questions in varying detail, according to their own business areas and expertise.

A short summary is provided below with more detail on areas of commonality; differences; and issues noted in Annex A. A response from Danish stakeholders was provided by email and is summarised in section A2.

3.1. Feedback summary

The following bullet points provide a high level summary of the survey feedback:

- Overall there was a limited number of responses received, and different levels of detail from stakeholders, although some feedback on all data types was provided.

- For some data types and criteria, the interpretations were clear and understood, and where there was disagreement constructive comments were provided.

- For some data types although the responder indicated that the interpretation was clear, there is some doubt over whether this is actually the case. For example; no definition of an "interchange" is provided by the Delegated Regulation, EU EIP SA 4.1, or by the survey responders, therefore there is no guarantee there is a common understanding of the terms used; and therefore also the interpretation.

- The concept of quality levels was generally understood, with some additional proposals also provided.

- Proposals to alter the quality levels and changes to the definitions were made by single stakeholders, therefore without additional validation it is impossible to conclude if their suggestions would be acceptable to other stakeholders.

- One stakeholder questioned the useful-ness of some criteria and requirement levels in relation to the end user experience.

- On the whole, assessment methodologies, as reported by the stakeholders, do not seem to fit in the assessment concept of the EU EIP SA4.1 quality work. The majority of the reported methodologies focussed primarily on internal processes (such as monitoring of organisation-related KPIs for data provision), rather than on describing and documenting data qualities with the goal to be provided to external parties via the content access point.

- Dialogue with potential stakeholders highlighted the complex nature of MMTIS data quality, and the level of detail contained in the survey and Quality Definitions for MMTIS may have been a barrier to more stakeholders participating

- General comments were made on the complexity and data requirements to undertake the proposed MMTIS quality testing and reporting

4. EU EIP SA 4.1 responses and potential updates

This section provides responses to the stakeholder feedback received, and indicates how and when the feedback will be addressed by EU EIP SA 4.1.

4.1. Interpretation of the proposed Quality Criteria

One responder did not think the interpretation of "Completeness of data" was clear for all data types, no details or additional explanation was provided.

There are two different versions of the definition in the Quality Definitions for MMTIS document, in table 4:

> *"Percentage of data elements available in the service provision with respect to the total data elements of that service or data type for which quality criteria have been defined. More precisely, for a given service or data type, are all the data elements foreseen in the Regulation provided?"*

And, in table 14:

> *"The percentage of data entities within instances / for stops / for stations in the service provision for which values are provided out of the total data entities for which quality criteria have been defined"*

The comment may also have arisen due the use of different terms used in the definition; the terms are defined in §1.3.4, Table 2 of the Quality definitions for MMTIS document. An extract is shown in Table 2 below:

Term	Definition	Example
Instance	One logical unit within the Data set	"Refuelling station X"
Data entity	Sub-set of data related to one Instance	Opening hours
Data element	Specific data element within Data entity	"Week_days_from"

Table 2 - Extract from Table: Definition of data structures in the field of MMTIS

To avoid future misunderstandings a single interpretation will be included in the next update.

For the data type "Real-time status information" the interpretation of "Latency (content side)" was not clear for one responder, no further details were provided. The EU EIP SA 4.1 interpretation is:

> *"The delay between the acceptance of the disruption and the moment the information is provided at the CAP"*

One possible explanation for this not being clear is use of the abbreviation "CAP". It is proposed to add the full context of the abbreviation to avoid this issue in the future.

For Bike sharing stations, comments on all interpretations were made:

For Geographical coverage one responder felt that the definition failed to include free floating bike share (e.g. % area covered). The EU EIP SA 4.1 interpretation is:

> *"Percentage of bike sharing stations within a given network covered (% of all stations)".*

The Delegated Regulation and the EU EIP SA 4.1 work did not intend to include free-floating bike stations, although this may be taken up in future phases of the project. No changes to be made.

For "Availability", the comment was that for journey planning using multiple modalities multiple data sources (servers, APIs etc.) need to be accessed. E.g. a calculation using 10 API's with a server availability of 95% each has an availability of fewer than 60% (0.95^10) therefore the proposed level is useless for the end user. The EU EIP SA 4.1 interpretation is:

> *"Server availability during hours of operation for a relevant measurement period".*

The levels proposed only cover the data processes up to the CAP, rather than to the end user. It is agreed that availability targets should be high but without additional feedback or availability statistics from stakeholders EU EIP SA 4.1 cannot assess if the proposed levels are ill-chosen.

Lastly, "Availability" is a criterion included for all data types, this is generally well understood and is a commonly used metric. Given that the EU EIP SA 4.1 criteria is to be applied at the Content Access Point it could be possible to include "Availability" as a higher-level criterion.

For "Location accuracy" the comment was that the interpretation was not suitable for bike share systems with virtual stations since there is no infrastructure in the real world. The EU EIP SA 4.1 interpretation is:

> *"Accuracy of coordinates of entry positions for all provided stations, compared to ground truth, described as: $\bar{e}$ = "Mean value of positional uncertainties".*

Virtual bike stations were not included in the Delegated Regulation or the Quality Definitions for MMTIS. It is recommended that the current interpretation stands but the issue is noted and may be progressed in future work.

For "Report coverage" the responded commented that Basic level (Best effort) was ineffective since, if a user is not able to locate the bike share station it is likely they will

not use the service in the future, therefore a higher level should be reached. This is a valid comment, but the only comment on this aspect. The current Enhanced level is 90% and Advanced is 97%. The EU EIP SA 4.1 interpretation is:

"Percentage of the bike sharing stations for which either data entities "Opening hours" or "Conditions for use" were updated out of the total bike sharing stations for which changes occurred in these data entities since the previous update period"

The comment appears to be a misunderstanding on the criteria and interpretation, no EU EIP SA 4.1 change is recommended.

4.2. Quality Levels

The comments and proposals on quality levels are summarised below, Table 3:

Data type & quality criteria	Basic Level	Enhanced Level	Advanced Level
Connection links where interchanges may be made, default transfer times between modes at interchanges			
- Geographic Coverage	Inc. 90% to 95%	Inc. 95% to 98%	
Network topology and routes / lines (topology)s			
- Geographic Coverage	Inc. 90% to 95%	Inc. 95% to 98%	
Timetables			
- Geographic Coverage	Inc. 90% to 95%	Inc. 95% to 98%	
Planned interchanges between guaranteed scheduled services			
- Geographic Coverage	Inc. 90% to 95%	Inc. 95% to 98%	
- Availability	Inc. 95% to 98%		
- Error rate	Dec. 10% to <5%	Dec. <5% to <3%	
Cycle Network (segregated cycle lanes, on-road shared with vehicles, on-path shared with pedestrians)			
- Geographic Coverage	levels proposed were not appropriate as a single wrong link makes it impossible to calculate the route. *The EU EIP SA 4.1 criteria and interpretation is concerned with the % of the network covered by a data type, not missing / incorrect links. There is another similar definition of the criteria in the document: "Percentage of the transport system infrastructure covered by the (content provision) service." In future versions a single agreed definition will be used.*		
- Availability	for journey planning using multiple modalities multiple servers/api's need to be accessed. Therefore a calculation using		

	10 api's with a server availability of 95% each has an availability of fewer than 60% (0.95^10) therefore the proposed level is of low value to the end user. *Comments on this are provided above in Bike sharing stations.*		
- Location Accuracy	these levels use the same confidence level as the road network. Since the travel speed of cyclists is usually much lower than motorised vehicles, the error expressed in time is relatively high. *This is a misunderstanding of location accuracy. For location accuracy the data entity is: GIS attributes including type of path, direction, possibly also safety coefficient (as present in e.g. OpenStreetMap), presence of ferries in network (non-toll/toll including tariffs), and interpretation is Accuracy of coordinates of link nodes for all provided links, compared to ground truth, described as: $\bar{e}$*		
- Error Rate	levels proposed were not appropriate as a single wrong link makes it impossible to calculate the route. *This is a misunderstanding of the interpretation of the EU EIP SA 4.1 error rate, the listed data entities are GIS attributes.*		
Disruptions (all modes)			
- Geographic Coverage	Inc. 90% to 95%	Inc. 95% 98%	Inc. 99% to 100%
- Availability	Inc. 95% to 98%		
- Error rate	Dec. 20% to 10%	Dec. <10% to <5%	Dec. <5% to <2%
Real-time status information – delays, cancellations, guaranteed connections monitoring (all modes)			
- Geographic Coverage	Inc. 90% to 95%	Inc. 95% to 98%	
- Availability	Inc. 95% to 98%		
Future predicted road link travel times			
- Geographic Coverage	Inc. 90% to 95%	Inc. 95% to 97%	
Bike sharing stations			
- Geographic Coverage	Inc. from 90%	Inc. from 95%	
- Location Accuracy	Basic ($\bar{e}$ < 100): 100 m makes it difficult to locate the station in dense city environments (e.g. railway stations). *This is a misunderstanding of the criteria*		
- Report coverage	Basic (Best effort): if a user is not able to locate the bike share station it is likely they will not use the service in the future, therefore a higher level should be reached *This is a misunderstanding of the interpretation, which does not include the location of the bike station. The EU EIP SA 4.1 interpretation is:*		

	Percentage of the bike sharing stations for which either data entities "Opening hours" or "Conditions for use" were updated out of the total bike sharing stations or which changes occurred in these data entities since the previous update period.

Table 3 – Stakeholder comments and proposals on MMTIS quality levels

Within SA 4.1 it was discussed whether any levels should be changed following stakeholder feedback given in the table above. The survey only gathered stakeholders' opinions on the interpretation and levels. This exercise was not concerned with gathering evidence or testing any methods.

Consequently, EU EIP SA 4.1 does not yet know what is achievable or realistic with respect to MMTIS data quality. It is important that high quality MMTIS data is the aim, but there has to be a balance – especially when there has been quite opposing feedback from stakeholders who feel more high-level and simplified criteria would be better. The proposal is to leave the current levels in the document and revisit when testing results are available. EU EIP SA 4.1 could then compare the results to the 2018 stakeholder feedback and potentially revise in a future version of the Quality Definitions for MMTIS.

4.3. Assessment methods

Details of the comments provided by stakeholders are given in Annex 1, Table A1. Survey feedback. Given the limited additional information provided on assessment methods, no changes are proposed. This is an area where future work could be carried out.

4.4. Short term updates for the EU EIP MMTIS Quality Definitions

The following changes are proposed to be made within the period of EU EIP SA 4.1:

- Single, consistent interpretation of the criterion "Completeness of data" to be included; all other criteria definitions and interpretations will be checked for consistency.

- Add a list of MMTIS definitions from the INSPIRE Directory; such as link and node.

- Add a statement to explain that the Quality Definitions for Multimodal Travel Information Services document, could be used as an stakeholder aid; rather than a formal guideline or Member State endorsed document.

- Add additional explanation, and possibly a concrete example, on the use of the Location Accuracy $\bar{e}$ measurement, and look for an alternative measure; possibly something simple linked to location address.

As noted above in 4.2, no changes to the levels are recommended at this time.

4.5. Longer term updates for the EU EIP MMTIS Quality Definitions

The following will be considered and addressed in future phases of the project:

- Investigate potential ways that the Quality Definitions for MMTIS could be simplified and could provide a general approach to quality assessment, and also address the comments on quantity and scale of data required to carry out assessment. Most MMTIS stakeholders are not familiar with the work, approach and proposals of EU EIP SA 4.1, so the approach of the quality definitions has to be clearly communicated to MMTIS stakeholders.

- Review the practical relevance of the quality criteria to individual data types and their data entities (e.g. the criterion "geographic coverage" is maybe less useful for the data types "connection links" and "timetables").

- Review the quality requirements with respect to floating and virtual bike sharing stations, and decide if the EU EIP SA 4.1 work should be extended to cover non-fixed infrastructure.

- Investigate prioritising the data types. Limiting and prioritising the data types would allow more focussed and concentrated effort on developing and testing criteria and proposing appropriate assessment methodologies. The data types "Disruptions" and "Real-time status information" are possibilities for prioritisation. This could be followed by real-life stakeholder testing.

- Review if restructuring the tables showing the criterion by data type would be useful to the Quality Definitions for MMTIS document.

- Carry out further review and stakeholder information gathering on assessment methods to better reflect MMTIS.

5. Conclusions and related MMTIS fields of interest

From this exercise it is clear that providing harmonised Quality Definitions for MMTIS is complex, and it will take time to progress. All feedback received has been valuable, and can input to SA 4.1 tasks and future work. There is general agreement that MMTIS data quality is important but currently there is no clear consensus across all stakeholders on the approach to take.

MMTIS is evolving and dynamic. Within MMTIS there is a multipart network of public and private stakeholders, many more data types, and moving away from the traditional models of information processes, with separated content and service sides of the value chain. Capturing this in a quality package is a challenge.

During the development of the Quality Definitions for MMTIS and this feedback exercise, a wide range of related issues has been raised. These are outwit the current scope of this task but should be noted and, in the future could be explored:

- The growing influence of the end user (i.e. the traveller), where they can be the data provider, and the use of crowd sourced data.

- The current Quality Definitions for MMTIS document focusses only on the content part of the value chain, up to the Content Access Point. However, quality on the service side is also important for many stakeholders

- The development of Mobility as a Service – MaaS – with new modes and new services will most likely come along with higher expectations regarding information quality.

- The quality trade-off is more acute when you consider a multimodal trip – in a trip plan using different modes any quality issues / errors will be multiplied down the chain – end user expectations are high and any errors are likely to reduce user confidence in the entire service.

- Currently not all public transport data is open and available, this is a major barrier to MMTIS and MaaS. Consequently, assessment of data qualities is often kept inside the organisations and is rarely documented to external parties.

- Within MMTIS there are different data and service drivers. Thus, complex legislation and obligations as well as commercial interests play a much greater role compared to information in the road-traffic domain.

- Linking to quality work being carried out in other projects and related to public transport standards, such as TN-ITS GO Map Update Exchange, INSPIRE, and other ongoing EC-supported activities. Among others, there is the CEF Transport Programme Support Action (PSA) to support Member States in the development and deployment of European public transport data standards Transmodel,

NeTEx and SIRI for the provision of Union-wide multimodal travel information services which apply to the TEN-T network including urban nodes. Further, there are ongoing data standardization activities to enable interoperable data exchange in the area of "new" (e.g. demand-responsive) traffic modes, see CEN/TC 278, Working Group 17.

Annex 1 - Stakeholder Response Details

A1. Survey feedback

This section provides an overview of the stakeholder responses by data type. Feedback was received on all data types.

Connection links where interchanges may be made, default transfer times between modes at interchanges

Interpretation	- Although some stakeholders indicated the interpretation for all quality criteria was clear, it cannot be assumed there is agreement due to a lack of common definitions, e.g. *connection links* and *interchanges* - For one responder the interpretation of "Completeness of data" was not clear, no additional explanation was provided
Quality levels	- Where stakeholders appeared to understand the criterion and interpretation, they accepted the EU EIP levels - One stakeholder proposed increasing geographic coverage for Basic from 90% to 95% and Enhanced from 95% to 98%
Assessment	- For "Availability" only: this was measured through server up-time via an SLA with a hosting party - One stakeholder commented they consider connections for an intermodal perspective, in particular scheduled trips, therefore they do not carry out any assessment

Network topology and routes / lines (topology)s

Interpretation	- Although some stakeholders indicated the interpretation for all quality criteria was clear, it cannot be assumed there is agreement due to a lack of common definitions and additional information from the stakeholder - For one responder the interpretation of "Completeness of data" was not clear, no additional explanation was provided
Quality levels	- Overall stakeholders accepted the EU EIP levels - One stakeholder proposed increasing geographic coverage for Basic from 90% to 95% and Enhanced from 95% to 98%
Assessment	- No assessment methods provided - Stakeholder commented that they focus on parts of the network (transportation hubs of a certain size). For our purposes of traveller information, the geo-position is less relevant than the logical position within the network. - Another commented that they do not have quality assessment methods for this kind of data, but would methodologies would be beneficial. They have an older system where data structure is not optimally consistent and has caused problems previously.

Timetables

Interpretation	- No comments on the interpretation
Quality levels	- Overall stakeholders accepted the EU EIP levels

	- One stakeholder proposed increasing geographic coverage for Basic from 90% to 95% and Enhanced from 95% to 98%
Assessment	- For "Geographic coverage" and "Availability": this was measured using consistency checks for railway timetables and the related interchange information - One stakeholder commented they consider connections for an intermodal perspective, in particular scheduled trips, therefore they do not carry out any assessment

Planned interchanges between guaranteed scheduled services

Interpretation	- For Geographic Coverage, DB commented that Static interchange information for railways is provided - For Location Accuracy, DB commented that this only relates to transportation hubs, not to specific geo-positions - Although they stated the interpretations were clear and agreed with the proposed levels without further clarification it cannot be assumed there is a common understanding
Quality levels	- Generally stakeholders accepted the EU EIP levels - One stakeholder proposed increasing Geographic Coverage for Basic from 90% to 95% and Enhanced from 95% to 98%; increasing Basic Availability from 95% to 98%; Basic Error Rate from 10% to <5% and Enhanced Error Rate from <5% to < 3%.
Assessment	- For all Timetable criterion - one stakeholder uses a set of detailed KPIs, to automatically monitoring technical availability and logical consistency of data.

Road Network

Interpretation	- For one responder the interpretation of "Completeness of data" was not clear, no additional explanation was provided
Quality levels	- Overall stakeholders accepted the EU EIP levels
Assessment	- No assessment methodologies provided - One stakeholder commented they don't have any quality assessment methods for this data type. They use crowdsourced GIS data (OpenStreetMap) so they expect quality could differ greatly between different areas. They are in the process of building different validation tools to try and monitor/compare OpenStreetMap data with government reference data.

Cycle Network (segregated cycle lanes, on-road shared with vehicles, on-path shared with pedestrians)

Interpretation	- For one responder the interpretation of "Completeness of data" was not clear, no additional explanation was provided
Quality levels	- For Geographic Coverage - stakeholder commented that the levels proposed were not appropriate as a single wrong link makes it impossible to calculate the route. - For Availability – stakeholder commented that for journey planning using multiple modalities multiple servers/api's need to be accessed. Therefore a calculation using 10 api's with a server availability of 95% each has an availability of fewer than 60% (0.95^10) therefore the proposed level is of low value to the end user. - For Location Accuracy – stakeholder commented that the levels use the same

	confidence level as the road network. Since the travel speed of cyclists is usually much lower than motorised vehicles, the error expressed in time is relatively high. - For Error Rate – stakeholder commented that the levels proposed were not appropriate as a single wrong link makes it impossible to calculate the route.
Assessment	- No assessment methodologies provided - One stakeholder commented that since data about cycle infrastructure (especially parking) is often lacking, they commit changes to OSM. They use satellite images (PDOK) and their own on-site 360-degree images and process these using image recognition software. Since these commits are only a small percentage of the OSM database, we cannot access the quality of the OSM api as a whole.

Park & Ride stops

Interpretation	- For one responder the interpretation of "Completeness of data" was not clear, no additional explanation was provided
Quality levels	- Overall stakeholders accepted the EU EIP levels
Assessment	- No assessment methodologies provided

Publicly accessible refuelling stations for petrol, diesel, CNG/LNG, hydrogen powered vehicles, charging stations for electric vehicles

Interpretation	- For one responder the interpretation of "Completeness of data" was not clear, no additional explanation was provided
Quality levels	- Overall stakeholders accepted the EU EIP levels
Assessment	- No assessment methodologies provided

Disruptions (all modes)

Interpretation	- For one stakeholder the interpretation of all the Disruption criteria was not clear
Quality levels	- Overall stakeholders accepted the EU EIP levels - One stakeholder proposed increasing geographic coverage for Basic from 90% to 95% and Enhanced from 95% to 98%, and Advanced from 99% to 100%; increasing Basic Availability from 95% to 98%; decreasing the Error Rate levels from 20% to 10% for Basic, <10% to <5% for Advanced; and <5% to <2% for Enhanced
Assessment	- Assessment methods were given for Geographic coverage, Availability and Latency (content side) there are measured by technical monitoring of components

Real-time status information – delays, cancellations, guaranteed connections monitoring (all modes)

Interpretation	- "Latency (content side)" and "Completeness of data" was not clear for two stakeholders, no additional explanation was provided
Quality levels	- Overall stakeholders accepted the EU EIP levels - One stakeholder proposed increasing geographic coverage for Basic from 90% to 95% and Enhanced from 95% to 98%; and Basic Availability increased from 95% to 98%
Assessment	- Geographic coverage, Availability, Timeliness (start) Reporting period, Timeliness (update), Error rate, Report coverage and Completeness of data – is measured by one stakeholder by cross-checking of static timetable data with real time information from

	various sources, and detailed KPI - monitoring at relevant points.

Future predicted road link travel times

Interpretation	- No comments on the interpretation
Quality levels	- Overall stakeholders accepted the EU EIP levels - One stakeholder proposed increasing geographic coverage for Basic from 90% to 95% and Enhanced from 95% to 97%;
Assessment	- Availability only via automatic monitoring

Bike sharing stations

Interpretation	- Geographic coverage - This definition fails to include free floating bike share (e.g. % area covered). - Availability - For journey planning using multiple modalities multiple servers/API need to be accessed. E.g. a calculation using 10 API's with a server availability of 95% each has an availability of fewer than 60% (0.95^{10}) therefore the proposed level is useless for the end user. - Location accuracy - This definition is not suitable for bike share systems with virtual stations since there is no infrastructure in the real world. - Completeness of data – the definition was not clear for one responder
Quality levels	- Geographic coverage – Basic (90%) and Enhanced (95%) should be higher, since the number of possible journeys increases quadratic ally with the number of stations. - Location accuracy – Basic (ē < 100) comment – 100 m makes it difficult to locate the station in dense city environments (e.g. railway stations). - Report coverage – Basic (Best effort): if an user is not able to locate the bike share station it is likely they will not use the service in the future, therefore a higher level should be reached
Assessment	- Yes for Geographic coverage, Availability and Error rate: Server Availability: A third-party server sends a call to the bike share back end each 5 minutes, which is used to calculate uptime. Geographic Coverage / Error rate / Location Accuracy: since bike share stations are software defined and the API uses the same database as the bike share application the coverage for such a type of bike share is always 100%.

Car sharing stations

Interpretation	- For one responder the interpretation of "Completeness of data" was not clear, no additional explanation was provided
Quality levels	- Overall stakeholders accepted the EU EIP levels
Assessment	- No assessment methodologies provided

A2. Additional feedback

Danish stakeholders did not provide a response via the survey template but provided comments and remarks in the MMTIS data quality proposals via email, these are summarised as:

- Danish Transport, Construction and Housing Authority

    o EU EIP should consider the total amount of information/data to be collected for the proposed matrix of data entities/services and quality requirements and also the complexity of the complete proposed framework

    o The complete quality package will be very complex to prepare and even more so to implement, and it will require huge amounts of data. It is very important to consider whether the effort for measuring and reporting quality will be proportionate with the benefits.

- Vejdirektoratet - Danish Road Directorate

    o Comments on the general understand-ability of MMTIS terms. In the distributed MMTIS Quality Validation survey the Quality Criteria for the 13 selected Data Types are listed and their interpretations/definitions are given. And for each interpretation there is a question if the interpretation is clear. For a large part of the Quality Criteria the interpretations are unclear even though they seem clear. This is to a large extend due to the fact that the Data Types listed in the Delegated Regulation are not well defined. One out of many examples is "Error Rate" for "Connection links where interchanges may be made". The interpretation of Error Rate: "Percentage of links for which at least one data entity has a wrong value out of the total links" seems clear enough. But when it is considered that "Connection links where interchanges may be made" is not at all clear, is it e.g. a bus stop with at least two bus lines or a big station, then the total number of links are not known, and the Error Rate cannot be calculated. Furthermore, it is not clear what a data entity for a link is.

    o In order to explain that Quality Definitions for Multimodal Travel Information Services (MMTIS), could be used as an "aid" (rather than a formal guideline / endorsed document), for stakeholders looking for information on potential MMTIS quality criteria, a statement about this could be added to the document.

- Rejseplanen - Danish Journey Planner

    o They foresee a huge operational task to deliver all the documentation needed for the proposed quality assessment and reporting.

o They believe requirements for data quality assessment should be on a more general level – for instance yearly documentation on data quality on some overall themes and not specific as in the questionnaire/quality package.

o Their view is that there are significant challenges in creating a common framework with the proposed level of detail that will be easy to implement across different companies in the public transport sector.

The National Transport Authority (Ireland) also provided additional information on the topic of data quality in the MMTIS domain:

• They currently have some minimum performance criteria

• Completeness of timetables / schedule data

• Programme for improvement of data quality, including bus stop location accuracy, inter-stop journey times, using historic data distance / time, to create a threshold

• Some information on the location accuracy of stop locations (i.e. know which stops are accurate to within 2 m / which are not) from previous national data collection exercises

Future planned activities include:

• The development of National profiles for NeTEx

• Some method to assess / collect data on how accessible bus stops are planned.