INCREASING ROAD SAFETY BY SHARING ROAD SAFETY RELATED DATA IN PUBLIC AND PRIVATE COOPERATION

Annex 1 belonging to ´Multi Party Agreement Deployment of the SRTI Ecosystem: Data for Road Safety d.d. November 1 2020´

SRTI Ecosystem Technical Documentation

Data Task Force

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Acronyms

Table 1: Acronyms

Acronym	Definition
API	Application Programming Interface
CEN	Comité Européen de Normalisation (European Committee for Standardization)
DTF	Data Task Force
EU	European Union
HTTPS	Hypertext Transfer Protocol Secure
JSON	JavaScript Object Notation
PoC	Proof of Concept
OEM	Original Equipment Manufacturer
MDM	Mobility Data Marketplace
RRP	Recommended Reference Profile
SENSORIS	Sensor Interface Specification
SRTI	Safety Related Traffic Information
L2	Level 2 Data
L2'	Level 2 Prime Data
L3	Level 3 Data
XML	Extensible Mark-up Language

1.0 Introduction

The purpose of the Data Task Force (DTF) is to take the first steps towards data sharing for Safety-Related Traffic Information in Europe.

The Data Task Force is the first project in the European Union (EU) and the largest project in the world, focusing on improving road safety by means of the large-scale use of vehicle data and aiming to improve safety on European roads, on a reciprocal basis. The project is unique because of the profound public-private cooperation. A proof of concept (PoC) has started in several European countries, in which vehicle data can be shared for the purpose of Safety-Related Traffic Information (SRTI). Industry leaders have agreed to cooperate and are willing to share relevant data.

In October 2020, partners of the PoC are planning to sign a Multi-Party Agreement (MPA) to continue the activities initiated by the PoC. This document lays out the technical foundation for the SRTI ecosystem first laid out in the PoC and planned to continue via the MPA.

1.1 Project Aim

The aim of the PoC was to create an SRTI Ecosystem where Original Equipment Manufacturers (OEMs), service providers and public authorities can share their safety critical data. The SRTI Ecosystem can be thought of as an area where all safety information from all participating parties can be found (something like an internet for vehicle safety messages). The Proof of Concept (PoC) tested the sending and receiving of Safety Related Traffic Information (SRTI) between vehicles and road authorities. The collaboration effort between consortium members means that all data shared by each member can be utilised by others in the consortium. There are no obligations for parties to use the data that is available in the SRTI Ecosystem.

The DTF supports the implementation of existing EU laws on access to safety data. By prioritising access to safety data and enabling collaboration between vehicle manufacturers and countries, the DTF aims to enhance traffic safety for all road users.

2.0 Data Categories

The data categories in Table 2 have been identified by the Delegated Regulation (EU) 886/2013 to be cases that are deemed safety related.

Table 2: Data Categories identified by Delegated Regulation (EU) 886/2013

Data Category No:	Title	Description
1	Temporary slippery road	Activation events of the electronic driving dynamic stabilisation program of the vehicle ("lamp on"), absolute friction values as detected by the vehicle ("µ")
2	Animal, people, obstacles, debris on the road	Object recognition from rich sensors for outside situations OR emergency call / breakdown call from ego-vehicle, where ego-vehicles are vehicles equipped with sensor technology.
3	Unprotected accident area	Object recognition from rich sensors for outside situations OR emergency call / breakdown call from ego-vehicle
4	Short term road works	Sign recognitions of road work signs
5	Reduced visibility	Activation events of the vehicle light (fog lights), rain sensor data, wiper activation
6	Wrong way driver	Object recognition from rich sensors for outside situations OR ego-vehicle detection by sign-recognition
7	Unmanaged blockage of a road	Object recognition from rich sensors for outside situations
8	Exceptional weather conditions.	Activation events of the vehicle light (fog lights), rain sensor data, wiper activation, activation events of the electronic driving dynamic stabilisation program of the vehicle ("lamp on"), absolute friction values as detected by the vehicle ("µ").

2.1 SRTI Ecosystem Stages

Each Party shall fulfil at least one of the following main roles within the SRTI Ecosystem:

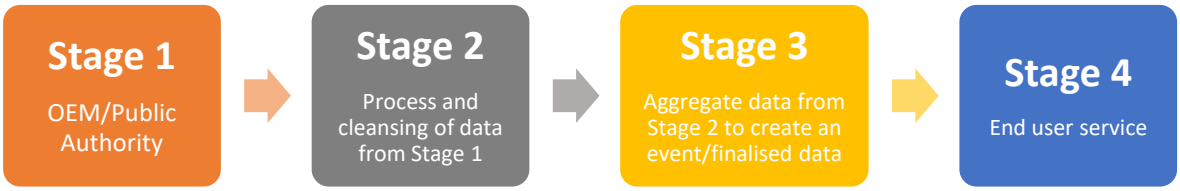

Figure 1: SRTI Ecosystem Stages

Stage 1: An OEM or public authority will be sharing raw data to all requesting parties.

Stage 2: An Aggregator will share the processed and cleansed data from Stage 1 that has been acquired through the SRTI Ecosystem to all requesting parties.

Stage 3: The Service Creator will ingest data from stage 1, 2, 3 and/or external data sources, it will then begin to aggregate to create a safety related event that can then be shared to all parties. It is important to note that once a service creator creates new set of data from previously aggregated data, this newly created data can be used by another Service Creator to further create additional safety related notifications. Therefore, once the service creator creates new data, they also must feed that data back into the system for other service creators to use.

Stage 4: The Service Provider will provide finalised data (output of the Service Creator) acquired through the SRTI Ecosystem directly to End Users, free of charge.

2.2 Data Types & Definitions

2.2.1 Level 2 Data / Data (L2)

Data (L2) is defined as the raw data made available to the SRTI Ecosystem that can be used for creating road safety related minimum universal traffic information. This data is collected via any private and/or public source, also referred to as ‘road safety related traffic data (as defined in article 2-m of Regulation 886), also referred to as “Level 2 Data”;

2.2.2 Level 2’ Data / Data (L2’)

Data (L2’) is an enriched version of Data (L2) made available to the SRTI Ecosystem and created by cross referencing the Data (L2) across multiple L2 data sources and/or through data harmonization and cleansing of the Data (L2), also referred to as “Level 2 Prime Data; Level 3 Data / Data (L3)

Any extracted, aggregated and processed road safety related traffic information made available to the SRTI Ecosystem, offered by public and/or private road operators and/or service providers to End Users through any delivery channels, also referred to as “L3 Information”” or “Road Safety Related Minimum Universal Traffic Information” or “SRTI” (as defined in article 2-n of Regulation 886;L3 data is generated by merging available data, including the fusion with L2/L2' data, to an event within the (a)-(h) categorization of the Regulation 886 and compliant with the Regulation 886. L3 data can extend L2’ substantially with information not contained in L2’.

2.3 Roles within the SRTI Ecosystem

At each stage of the data flow architecture, there are associated roles that are to be executed by specific parties.

These roles are as follows:

2.3.1 Data Source

- A Party that generates Data (L2), Data (L2') and/or Data (L3)
- The Data Source is responsible for contributing original, new Content into the ecosystem
- A typical L2 Data Source would be a vehicle OEM contributing L2 Data to the ecosystem

2.3.2 Data Access Interface Provider (L2)

- Provides access to L2 data
- For vehicle L2 data usually executed by an OEM or a delegated entity
- For public authority L2 data usually executed by road operator

2.3.3 Aggregator (L2 to L2')

- A Party that uses Data (L2) to create Data (L2') e.g. by harmonizing and cleansing L2 data from L2 data sources.

2.3.4 Data Access Interface Provider (L2 Prime)

- Provides access to L2 prime data (Refer to *Appendix 1 - L2' Data*)

2.3.5 Creator (L3)

- A Party that creates Data (L3) from varying sources including Data (L2) and/or Data (L2') and/or Data (L3) acquired through the SRTI Ecosystem and/or external data sources.

2.3.6 Data Access Interface Provider (L3)

- Provides Access to L3 data

2.3.7 Service Provider

- A Party that renders and distributes Data (L3) acquired through the SRTI Ecosystem directly to an end user (i.e. driver in vehicles).

For further technical details regarding the data flow architecture, please refer to *Appendix 1 – Stages for Data Flow*.

3.0 SRTI Ecosystem Architecture

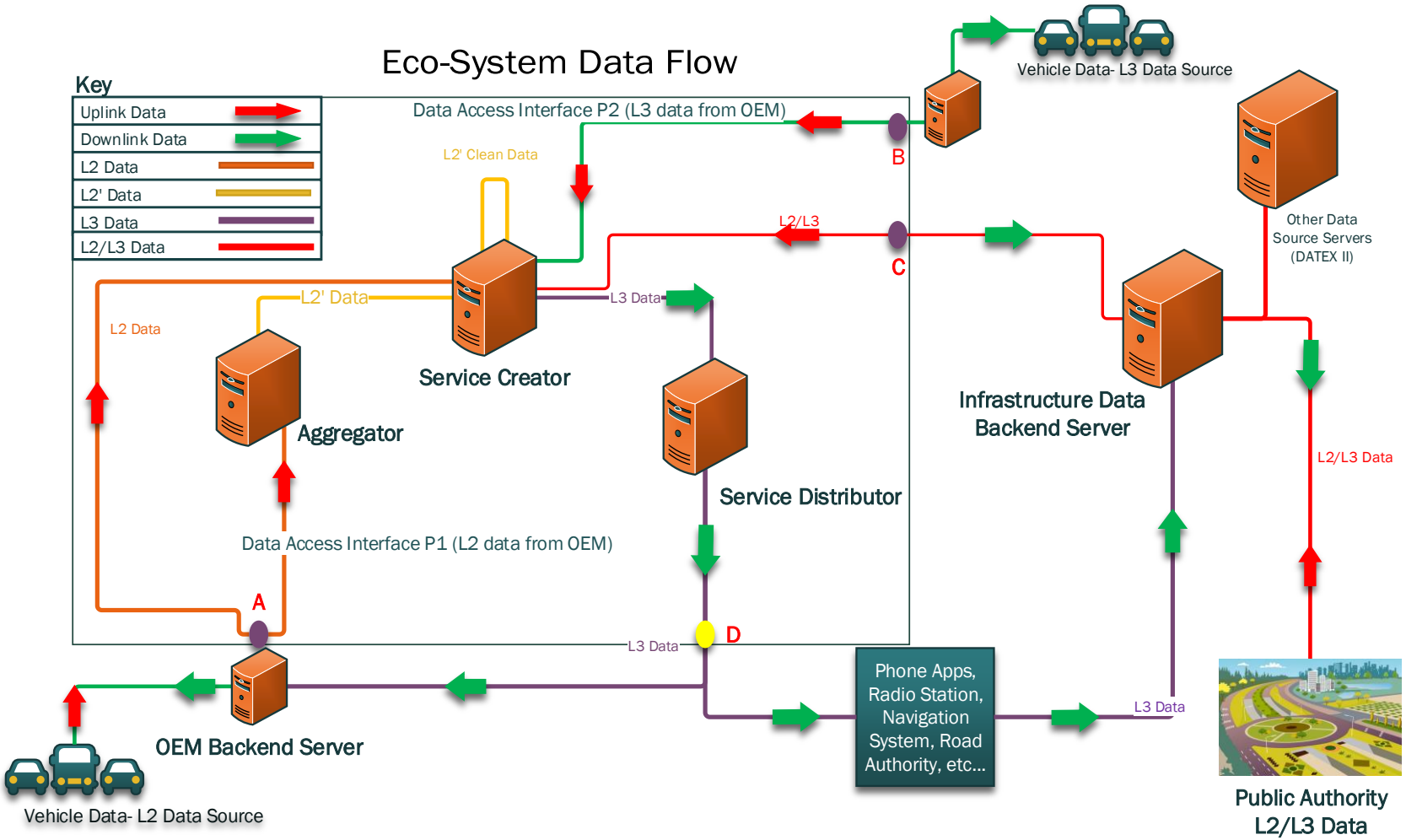

Figure 2: SRTI Ecosystem Overview Architecture

4.0 Members within the SRTI Ecosystem

4.1 OEM Member

An OEM (car manufacturer) main task within the SRTI Ecosystem is to share SRTI data to all requesting parties, these data types are either L2 or L3 data types. Thus, they are a Data Source (L2 or L3).

Examples of OEM members within the SRTI Ecosystem are:

- Ford
- BMW
- Daimler

4.2 State Member

A State member has the commitment within the SRTI Ecosystem to share public authority L2 and L3 data to all requesting parties and provide a NAP.

Example of States within the SRTI Ecosystem are:s

- Luxembourg
- Highways England
- Austria/ASFINAG

4.3 Examples of Existing Role Holders

The following is a list of examples of the existing role holders within the SRTI Ecosystem.

L2 Data Source

- Ford
- Audi

L2 Data Access Interface Providers:

- HERE on behalf of BMW
- Daimler
- HERE on behalf of Ford

L2/L2' Aggregator:

- HERE
- NDW
- Post Luxembourg

Service Creators:

- Tom Tom
- NDW
- Post Luxembourg

L3 Data Interface Providers:

- Volvo
- HERE on behalf of NIRA
- Public Authority (Highways England, MDM, Rijkwaterstaat)

Service Providers:

- HERE
- Volvo
- Asfinag Austria

5.0 Data

In the context of incoming sensor data to the SRTI Ecosystem, within the previously mentioned 8 use cases various sensor signals can potentially be used. However, it must be accounted for the fact, that the sensor signals in the vehicle/infrastructure can be aggregated and processed in the data supplier backend before entering the SRTI Ecosystem.

Vehicle and Infrastructure data sets are classified into the following categories:

- L2 Data
- L2' Data
- L3 Data - *For further technical details the L2/L3 mapping profile can be found in appendix 1*

5.1 Data Standards

5.1.1 DATEX II

DATEX II is a standard for modelling and encoding data regarding road traffic and travel information. It focuses on data that is relevant to traffic management and for planning and performing a journey, pre- and on-trip. This standard is formally covered by the multi-part CEN 16157 series. The current standard model that covers safety related information for drivers is CEN EN 16157-3:2018. The technical documentation for implementing the standard as well as further guidance can be obtained from the DATEX II website at datex2.eu.

The DATEX II approach supports multiple different implementation platforms, where XML – with transfer syntax being validated by an XML Schema Definition – is the reference platform and is explicitly covered by the CEN standard document. New developments include alternative encoding platforms like JSON Schema and ASN.1 Encoding Rules, but these are not yet part of the standard.

The application of DATEX II is based on generating individual data profiles from the standardised models for publications. These profiles can be chosen to be compliant to Recommended Reference Profiles (RRP) that cover compliance with Delegated Regulations from the European Commission. The Data Task Force Technical Group has produced such a profile for SRTI information created from vehicle L2/L2' data, based on the RRP for Delegated Regulation (EU) 886/2013 regarding safety related traffic information. The profile uses a mechanism in DATEX II called "Level B extensions" that can extend data models in a backward compatible way to add some small features that were seen as useful by group members but not available in this form in the model from CEN EN 16157-3.

5.1.2 SENSORIS

The Sensor Interface Specification (SENSORIS) defines an interface for requesting and sending vehicle sensor data from vehicles to clouds and across clouds. The specification and its standardisation focus on the content and encoding of the interface.

SENSORIS differentiates between the following three actor roles:

- Service Cloud
- Vehicle Cloud
- Vehicle Fleet

A vehicle is part of a vehicle fleet. The vehicles of a vehicle fleet communicate with a vehicle cloud. A vehicle cloud can also communicate with a service cloud. A cloud instance can have both the role of a vehicle cloud and a service cloud. However, if a cloud instance has only the role of a service cloud, then it cannot communicate with a vehicle fleet. An example setup could be that vehicles of an OEM vehicle fleet communicate with their OEM vehicle cloud. The OEM vehicle cloud in turn communicates also to the service cloud of a map maker.

The interface of SENSORIS defines content and encoding of the messages that are communicated between the actor roles. Data messages contain vehicle sensor data. Data messages communicated from one vehicle of a vehicle fleet to its vehicle cloud contain sensor data from the one vehicle. Data messages communicated from a vehicle cloud to a service cloud contain data from individual vehicles or aggregated data from several vehicles of a vehicle fleet. Job request messages contain jobs defining which vehicle sensor data is requested under which conditions and when the data shall be communicated to the requesting cloud. Job status messages contain information about termination of jobs. Job status messages communicated from a vehicle of a vehicle fleet to its vehicle cloud or from a vehicle cloud to a service cloud contain the reason of the termination of the job in the vehicle or vehicle cloud. Job status messages communicated from a service cloud to a vehicle cloud or from a vehicle cloud to a vehicle of a vehicle fleet request the termination of the job. Detailed description of SENSORIS and further technical information can be found in *Appendix 2 - SENSORIS Data Format*

NB: At time of writing this document SENSORIS version 1.2 is the encouraged standard to be used.

5.2 Data Harmonisation

5.2.1 Level 2

For L2/L2' data, it has been decided that the basic elements possible to structure such data would be agreed by all signatories. In addition, a simple set of additional attributes to describe these elements (e.g. location) were also agreed.

No specific standard of format has been prescribed, however it has been identified that the requirements for SRTI Ecosystem data are similar to that of SENSORIS standards, therefore Data Task Force has worked closely with SESNORIS to influence their latest release to include the requirements for data flow within the SRTI Ecosystem. SENSORIS is used by all OEM L2 providers and is strongly recommended for new OEM L2 data sources. was recommended.

There is no common specification of the actual access technology used, but all data feeds are requested to use open standards only for this purpose, and to accompany their data feed with clear guidance and documentation that is sufficiently detailed to allow system developers to implement a client against this data feed.

Further details can be found in Appendix .

5.2.2 Level 3

For Level 3 data it has been agreed to follow the recommendation of Delegated Regulation 886/2013 to provide the data encoded in DATEX II according to the CEN 161517 series of standards. The Technical group identified that the DATEX II organisation had published a Recommended Reference Profile (RRP) on the datex2.eu website. This mechanism allows for the creation of data profiles that have a proven compatibility with the requirements of the Delegated Regulations. Since such RRPs are not complete data profiles, the group agreed to develop a dedicated DATEX II profile – compliant with the RRP – that would be suited for L3 data feeds created out of vehicle based L2/L2' data.

This profile has been published for direct references on the DATEX II website at: https://datex2.eu/profiles/srti/fromvehicledata/v1.

Further details can be found in Appendix 3 3 – DATEX II Data Format.

5.3 Metadata Repository - Mobility Data Marketplace (MDM)

For partners to know which data is available where and in what format, metadata for the data access interfaces needs to be made available to all partners. Since not all data access interfaces are public, a protected, SRTI Ecosystem partner internal metadata repository is required.

For now, all metadata is to be made available at the MDM (Mobility Data Marketplace) repository at https://service.mdm-portal.de . This is the German NAP and currently acts as an intermediate solution.

The following is the step-by-step instruction for creating so-called "data publications" (metadata for one data access interface) within the MDM.

5.3.1 User certificates

In order to be able to enter and edit metadata in the MDM, a user certificate is required. The MDM operates with authentication via X.509 certificates (as opposed to username, password).

Follow the following steps to set this up:

1. Send an email to Timo Hoffmann at hoffmannt@bast.de,CC to mdm@bast.de with your affiliation/organization name, email address and mobile phone number (the mobile phone number is used to send the password for the certificate).
2. You will receive (usually the next working day at the latest) an email with a verification link. Click on the link to activate your account.

3. You will receive (usually the next working day at the latest) a X.509 certificate to your email address and the password to the mobile number you provided via text message.
4. Install the certificate to your operating system and/or browser.
5. In case you need any help with the certificate, send an email to orga@mdm-portal.de for further help.

5.3.2 Create contact person

For each data publication, there needs to be a contact person. In order to be able to select yourself (or your organisation's) contact person for the data access interface to the Data Task Force, it is required that you create a contact person, if you have not done so already.

1. Go to https://service.mdm-portal.de,
2. Switch to English language
3. "Log-in" (only works with installed certificate)
4. Go to "My organization"
5. "Add new contact" and add your contact details (deselect system notifications)
6. Save

5.3.3 Create data publication

For every data access interface that your organization is making available to the DTF ecosystem, you must do the following:

1. Go to https://service.mdm-portal.de
2. Switch to English language
3. "Log-in" (only works with installed certificate)
4. Go to "Publications", "Create publication"
5. "Yes" if your publication is in DATEX II format and you want to use MDM brokering. In all other cases choose "No".In Step 2 in all relevant fields as detailed as possible
    - Choose the right contact person (you)
    - Make it non searchable to keep the info amongst our group (for now)
    - Leave "Valid from" and "Valid to" empty
    - Data category "Unexpected road events and conditions" (category detail empty)
    - Transport modes "Car" and "Truck" (leave at this even though data might apply for more)
    - Conditions of use "License and free of charge"
6. In Step 3 fill in all relevant fields as detailed as possible
    - Geographical coverage: "NUTS 0: Deutschland" (this is a known limitation of the system)
    - Road network coverage choose all "Motorways", "Federal and state roads" and "Urban roads"
    - Reference file could be further documentation of the data
7. In Step 4 fill in all relevant fields for access information as detailed as possible
    - Data format e.g. "Protocol buffers", "other", "SENSORIS"
8. In Step 5 (Confirmation) choose "no" to not submit your self-declaration to the German national body and verify your submitted information.
9. Save publication

6.0 Development Work Required for Sharing & Receiving Data

The following are examples of the development work and methodologies that are required for sharing and receiving data. The examples are indicative and therefore members are under no obligations to adopt any of the approaches that have been listed below.

6.1 L2 Data Provider

L2 Data is collected via vehicles or infrastructure is provided to the ecosystem. Vehicle data comes usually from the OEMs and infrastructure data from the member states. When the data is aggregated from different sources it is called L2' prime data. One example of L2 Data is broken down vehicle provided by Daimler or road weather sensor data provided by member states.

6.2 Data Aggregator

As a Data Aggregator, NDW role is to collect and aggregate the L2-feeds of different data providers including BMW, Daimler and Ford. NDW have successfully aggregated both BMW and Daimler data into a single feed, however Ford have yet to migrate from SDII-format to Sensoris.

Once Ford has migrated to Sensoris, NDW can begin to ingest their data and combine it into a single feed. The combined feed is available in JSON format, as this is an easier format for data scientists to process.

6.3 Creator

As a Service Creator, Post Luxembourg role is to create L3 Data from varying sources including L2 Data, L2' Data and/or L3 Data. This data is acquired through the SRTI Ecosystem and/or external data sources.

The following demonstrates the step process required to implement for the receiving, computing and sharing of Data:

1. Set up a technical architecture to get real time L2, L2' and L3 data to be combined with cold data;
    - Message queue mechanism e.g. Kafka and MQTT.
    - Specific Data Storage for high velocity data retrieval (key-value system like HBase)
    - API implementation and exposition for data sharing
2. Subscribe to the dedicated provider to get OEM/non-OEM L2, L2' and L3 data, implement the interfaces and data parsers.
3. Implement a L3 creation process;
    - Filter, cleanse and aggregate input data
    - Data quality rules
4. Implement an API to share generated L3 data in real time in DATEX II.
5. Expose the API through your internal API Manager and/or through the German MDM.

6.4 L3 Data Provider

6.4.1 OEM

As an OEM and L3 Data Provider, Volvo holds the responsibility of providing access to L3 Data. The list below demonstrates the requirements of a Data Provider from the perspective of an OEM. The Integration to NDW (see 6.2) interchange node work items as follows:

1. Obtaining security credentials for all environments (test + production)
2. Implementation of transformation from internal data representation format to the SRTI DATEX profile
3. Implementation of integration adaptor to interchange node
4. Deployment and verification in test environment
5. Deployment to production environment

Table 3 summarises the different difficulty levels for each of the above steps.

Table 3 Difficulty levels of steps required for integration to NDW interchange node

Difficulty	Step
Low	1, 4, 5
Medium	3
High	2

6.4.2 Road Authority

6.4.2.1 Implementation requirements

ASFINAG provides data interface for the streaming of all its traffic data based on the DATEX II traffic data model. The setup of a system with registration and key-based data access did require a central data distribution server as a pre-requisite as well as the implementation of a registration portal and a data streaming frontend. The frontend is a two-tier system comprising of an xml-creator to translate database data into xml format and a REST-interface module to pack the xml data into the transmission packet for the subscriber interface.

The complete list of implemented items indicates a considerable overall effort:

- Pre-requisite: Central Data Distribution Server
- Gateway to the Central Data Distribution Server
- Connector Manager module to create DATEX II packets according to profiling
- Frontend to handle subscriber polling and push transactions
- Web portal for registration and acquisition of Resource Keys for data access

However, a central Data Distribution Server, which converts data from all the legacy interfaces in the field into a normalized database structure, would in many cases already exist independent of L3 services. Likewise, a web portal is usually already available, so the registration and provision of Resource Keys only have to be added on.

6.4.2.2 Implementation aspects

Modular approach

As a principle, monolithic components should be avoided. Providing an L3 data stream from various sources for various output formats in multiple versions is a rather complex endeavour, so it is advisable to stick to a highly modularized architecture. We did not build a single data transformer from database to interface, but instead ended up with a Serializer to transform data from the central database into a specific data model i.e. DATEX II & SENSORIS, or DENM Converter to convert the data into a specific format, i.e. XML, PROTOBUF, or ASN.1an Uploader, to transmit the data to the interface

Asynchronous approach

In addition to providing the correct format to the interface, there is also the matter of data volume to be considered. Data passes through various gateways before arriving at the interface, which are all prone to data clogging at some point or other. Designing an asynchronous hand-over at these critical points – no “waiting” for anything at the receiving end – ensures that the clogging of one gateway does not lead to a domino effect which will eventually kill the system. Instead the fault can then be pin pointed by a monitoring system and quickly resolved.

Elementarization and versioning

As mentioned above, a key factor in being able to maintain the servicing of a number of subscribers with contrasting use cases, is to elementarize the data content, so that the subscriber picks needed elements and aggregates on his end. This also enables a high system availability, as the failure of one element or channel does not affect the others. The same goes for a strict versioning of the elements. There may be subscribers who need additional data fields in a new version. This has to be implemented while leaving the other versions untouched, as they may have had to pass a rigid test regime by other subscribers.

Tool Specification

All software was built in C# and Java environments.

The subscriber interface is realized as a REST-interface in HTTPS for polling of DATEX II, as well as PUSH variant for specific subscribers requiring this.

For authentication we use unique Resource Keys which are provided to customers via the official ASFINAG website asfinag.at. A resource key is unique for a resource and a customer. If another customer requests the same resource, a new Resource Key is generated.

The following is an example API call to request SRTI data:

https://content.asfinag.at/services/resource/<customer resource key>

6.5 Technical Support

Current members of the consortium should commit to providing advice and technical support to any new members joining the consortium. Should any new members require support or have any questions, they should contact the appropriate consortium member.

Appendix 1

Detailed Data Definitions

L2 Data

In the context of vehicle sensor data, various sensor signals can potentially be used to create one of the 8 categories of the SRTI. However, it must be accounted for the fact that the sensor signals in the vehicle can (and must be) aggregated and processed in the vehicle and/or in the OEM backend before being delivered to the outside world.

Example: A signal that is broadcasted once every 100ms on a vehicle bus might be aggregated to provide a mean value (or maximum value, or minimum value etc.) for a defined period of time before being sent by the vehicle. All data falling in that category are so-called "Level 1" data and are not further specified in the context of the EU Data Task Force.

The following shall list some examples of Level 1 data in the categories. Note, this data is not necessarily available within certain OEMs vehicles or might not be possible at all (especially in the case of object recognition capabilities based on visual sensors such as cameras, radars, LIDARs, etc) in the current state of the art:

The following data categories have been identified by the Delegated Regulation (EU) 886/2013 to be cases that are deemed safety related:

1. **Temporary slippery road**: Activation events of the electronic driving dynamic stabilization program of the vehicle ("lamp on"), absolute friction values as detected by the vehicle ("µ"), etc.
2. **Animal, people, obstacles, debris on the road**: object recognition from rich sensors for outside situations OR emergency call / breakdown call from vehicles
3. **Unprotected accident area**: object recognition from rich sensors for outside situations OR emergency call / breakdown call from ego-vehicle
4. **Short-term road works**: recognitions of road work signs
5. **Reduced visibility**: activation events of the vehicle light (fog lights), rain sensor data, wiper activation, etc.
6. **Wrong-way driver**: object recognition from rich sensors for outside situations OR ego-vehicle detection by sign-recognition
7. **Unmanaged blockage of road**: object recognition from rich sensors for outside situations
8. **Exceptional weather conditions**: activation events of the vehicle light (fog lights), rain sensor data, wiper activation, activation events of the electronic driving dynamic stabilization program of the vehicle ("lamp on"), absolute friction values as detected by the vehicle ("µ"), etc.

The main characteristics of L2 data are as follows:

- The data can originate from varying sources (rich sensors, classical sensors, driver behaviors, etc.)
- L2 data is pre-processed
- It can be discrete events or analogue values

It is suggested, that each value two data object is categorized along the following categorization scheme, which should allow the data users to qualify the data concerning the confidence level that the data point should be treated with along the processing chain.

The following are examples of a datatype set regarding the L2 signal:

- In-Vehicle User Interface Element triggered by customer - Example: wiper, manual breakdown call)

- In-Vehicle User Interface Element triggered by vehicle regularly - Example: ABS Lamp, Stability Program Lamp)
- In-Vehicle User Interface Element triggered by vehicle rarely - Example: automatic e-call, automatic breakdown-call
- Simple Sensor Reading, minimally processed - Example: temperature, friction value representing a known physical value
- Locally simple combined sensor data - Example: sending ABS only if brake force <x
- Locally complex fused sensor data - Example: rain density by locally fusing wiper frequency and rain sensor data with speed and windshield angle
- Complex object detection - Example: object detection by camera

It is important to note that the provision of L2 data is the responsibility of the OEM.

L2' Data

Level 2' Data is an enriched version of Level 2 (L2) Data created by cross referencing the Data (L2) across multiple L2 data sources and/or through data harmonization and cleansing of the Data (L2), also referred to as "Level 2 Prime Data".

With the characteristics of L2 data outlined in the preceding section, the Level 2' data is characterized by processing L2 data from various sources to make the further processing more efficient.

Tasks performed in providing Level 2' data from Level 2 data can be a one or more of the following:

- Creating L2 data from various sources accessible in a consistent manner
- Harmonizing L2 data (e.g. normalizing sensor readings from absolute values in percentage values)
- Cleansing of L2 data for obvious errors (e.g. invalid values or locations)

The source of the original L2 data shall remain referenceable across the L2 to L2' processing to allow for the accountability of source specific characteristics. For the sake of clarity: all L2 data is by definition anonymous but may still be located by OEM. The mentioned reference ability shall only provide for the handling of source specific characteristics in the processing chain towards L2' and L3 (see below) and does not necessarily provide an OEM identification.

L3 Data Provider

How data is made available

ASFINAG provides a data interface for the streaming of all of its traffic data based on the DATEX II traffic data model. The data is secured by means of Resource Keys, which hold subscriber id, data stream and version thereof in an encrypted alphanumeric string, and which have to be included in every data poll request to the interface. In case the data is pushed to the subscriber, data is secured by means of certificates.

The Austrian National Access Point www.mobilitydata.gv.at directs potential subscribers to the ASFINAG web site www.asfinag.at. After registering and being cleared by ASFINAG staff, access is granted, and the subscriber can acquire Resource Keys for the desired DATEX II services.

Organization of the data

Data is organized into elementary parts in order to make it possible to service a multitude of subscribers from a variety of engineering interests. It is the data recipient who aggregates the required end product from these elements. DATEX II's profiling feature made this possible, where parts of the overall structure can be isolated. The data repository is advertised on www.datex2.eu, complete with all necessary documentation.

European harmonization

European initiatives, like the European Data Task Force, are gradually standardizing the elementary parts of DATEX II. The DTF has standardized the SRTI profile, which holds all unplanned, safety relevant events. This will be followed by the Traffic Regulations profile which will hold all road regulatory.

L2 Data Field Classification

L2 Data consists of multiple attributes that are categorised as the following:

- Mandatory attributes for all messages (M) – Fields that are required for the proper function of the use case temporal and geo localization, message identification, … (e.g. longitude, latitude and timestamp)
- Message Triggered content (T)
- Event type optional information (O) - Actual sensor readings that alone cannot derive SRTI content but may be used to identify false positives or negatives of an information (e.g. outside air temperature, actual acceleration

Table 4 below describes L2 data and how it can be used to create L3 events.

Table 4: DTF SRTI L3-L2 Mapping

				Possible relevance to SRTI Data Types (M – Mandatory, T – Triggered, O – Optional)							
Content	sortingID	L2 Signals	Example of a DataType set regarding the L2 Signal	Use Case A: Temporary slippery road	Use Case B: Animal/people/... on the road	Use Case C Unprotected accident area	Use Case D: short term roadworks	Use Case E: Reduced visibility	Use Case F: Wrong way driver	Use Case G: Unmanaged blockage of a road	Use Case H: Exceptional weather conditions
Mandatory	1	Unique Identifier		M	M	M	M	M	M	M	M
Mandatory	2	Position WGS84	long, lat in WGS84 coordinate system	M	M	M	M	M	M	M	M
Mandatory	3	Timestamp	time of event observation	M	M	M	M	M	M	M	M
Mandatory	4	Heading or Trace	0..360 - or list of positions	M	M	M	M	M	M	M	M
Mandatory	5	Confidence Level	A-G as per Glossary	M	M	M	M	M	M	M	M
Trigger	10	Event: Slippery Road	Boolean, Subcategory, SourceClassification	T							
Trigger	10	Event: Obstacle	Boolean, Subcategory, SourceClassification		T						
Trigger	10	Event: Accident	Boolean, Subcategory, SourceClassification			T					
Trigger	10	Event: Road Work	Boolean, Subcategory, SourceClassification				T				
Trigger	10	Event: Reduced Visibility	Boolean, Subcategory, SourceClassification					T			
Trigger	10	Event: Wrong Way Driver	Boolean, Subcategory, SourceClassification						T		
Trigger	10	Event: Road Block	Boolean, Subcategory, SourceClassification							T	
Trigger	10	Event: "Exceptional Weather Condition"	Boolean, Subcategory, SourceClassification								T
Trigger	20	System ESP	Boolean, SourceClassification	T							
Trigger	20	System Traction Control	Boolean, SourceClassification	T							
Trigger	20	Sensor meta: Visibility Distance	Value, Accuracy, SourceClassification					T			
Trigger	20	Road Surface: Friction Value	Value, Accuracy, SourceClassification	T							
Trigger	20	Traffic Sign: Road Work Signs	Compex Type, SourceClassification				T				
Trigger	20	Crash	Boolean, SourceClassification			T					
Trigger	20	Crash: battery cut-off	Boolean, SourceClassification			T					
Trigger	20	Crash: airbag deployment	Boolean, SourceClassification			T					
Trigger	20	System Automated Braking	Boolean, SourceClassification		T	T					
Trigger	20	Detected Object Data	Complex Type, SourceClassification		T				T		
Trigger	20	Connectivity: Ecall	Boolean, SourceClassification		T	T					
TriggerOptional	30	System ABS	Boolean, SourceClassification	T						O	

TriggerOptional	30	Windshield wiper	Value, SourceClassification	O				O			T
TriggerOptional	30	Detected Lane Geometry	Complex Type, SourceClassification		O		T				
TriggerOptional	30	Light Status: Rear Fog Light	Boolean, SourceClassification					T			O
TriggerOptional	30	Traffic Sign: Road Block Signs	Compex Type, SourceClassification				T			O	
TriggerOptional	30	ego-broken down vehicle	Boolean, SourceClassification			O				T	
Optional	40	Speed	Value, Accuracy, SourceClassification	O			O	O	O	O	O
Optional	40	System Emergency Braking	Boolean, SourceClassification		O	O			O	O	
Optional	40	Environment: Outside Air Temp	Value, Accuracy, SourceClassification	O				O			O
Optional	40	Sensor: Brake Pedal Pressure	Value, Accuracy, SourceClassification	O							
Optional	40	Dynamics: G-Forces	Value, Accuracy, SourceClassification	O							
Optional	40	Chassis: Suspension	Value, Accuracy, SourceClassification	O	O						
Optional	40	Environment: Humidity	Value, Accuracy, SourceClassification	O				O			O
Optional	40	Environment: Luminocity	Value, Accuracy, Type, SourceClassification					O			
Optional	40	Air Quality Information	Value, Accuracy, SourceClassification					O			O
Optional	40	Cross Wind Detection	Value, Accuracy, SourceClassification								O
Optional	40	Light status: Front Fog	Boolean, SourceClassification					O			O
Optional	40	Dynamics: Dangerours slow down	Boolean, SourceClassification		O	O				O	

Examples of the implementation of this interface will be showcased in a technical implementation guideline (Addendum to this document).

Stages for Data Flow

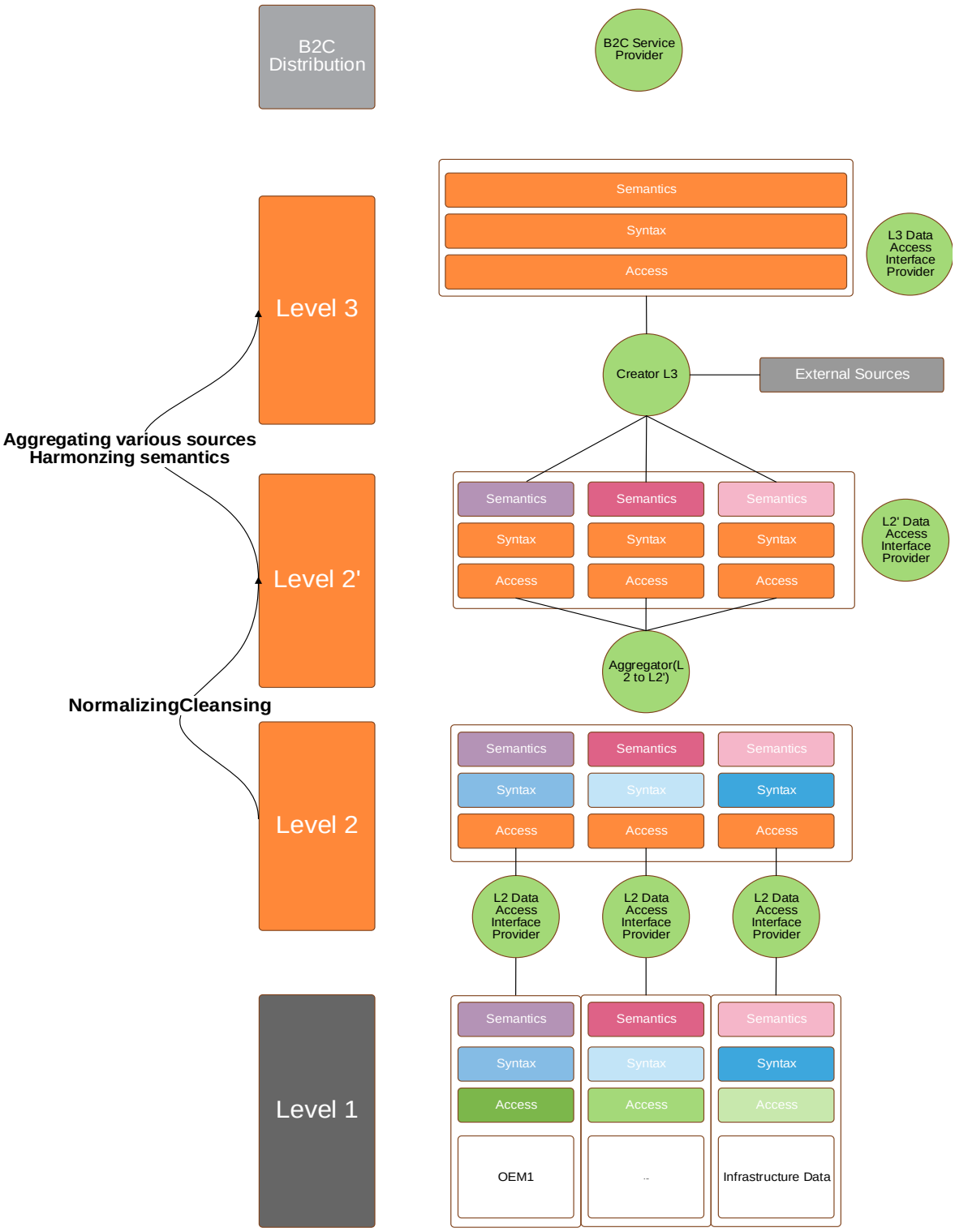

Figure 3 Stages for Data Flow

Appendix 2

SENSORIS Data Format

SENSORIS is not limited to just one instance of each actor role as shown in Figure 4, but is designed for cross collaboration in a setup with multiple actor roles as shown in Figure 5. A vehicle cloud can communicate with an arbitrary number of vehicle fleets. A service cloud can communicate with other service and vehicle clouds. For all communication channels the interface contains job request, job status, and data message types.

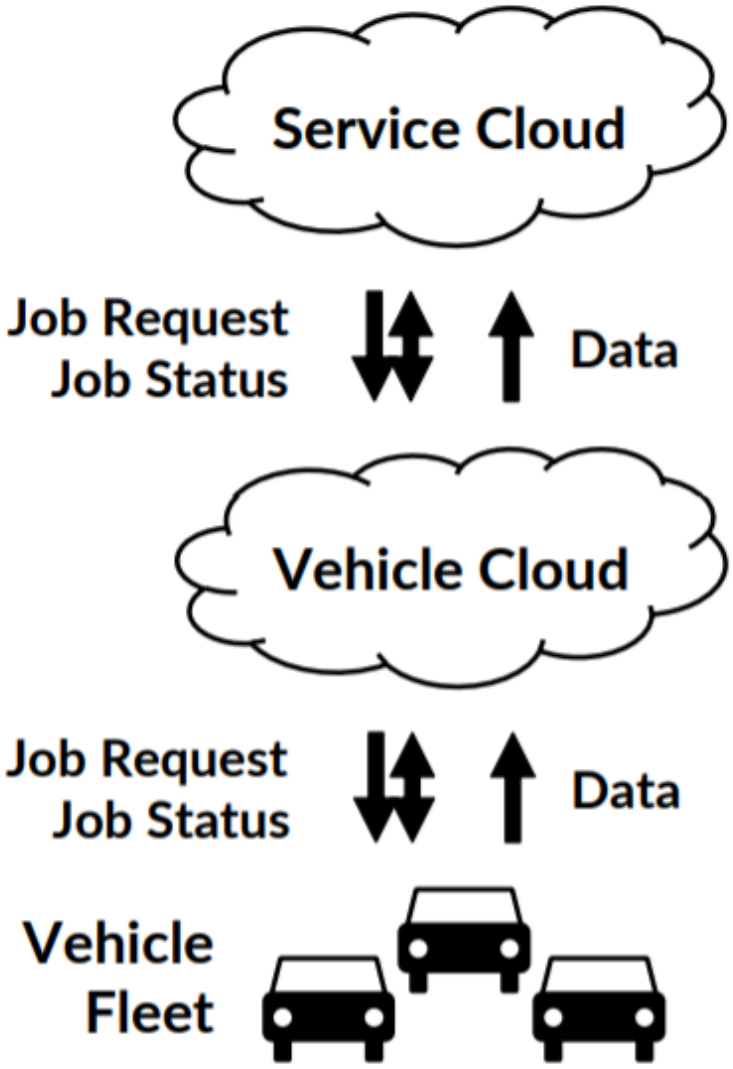

Figure 4 Actor roles and interfaces

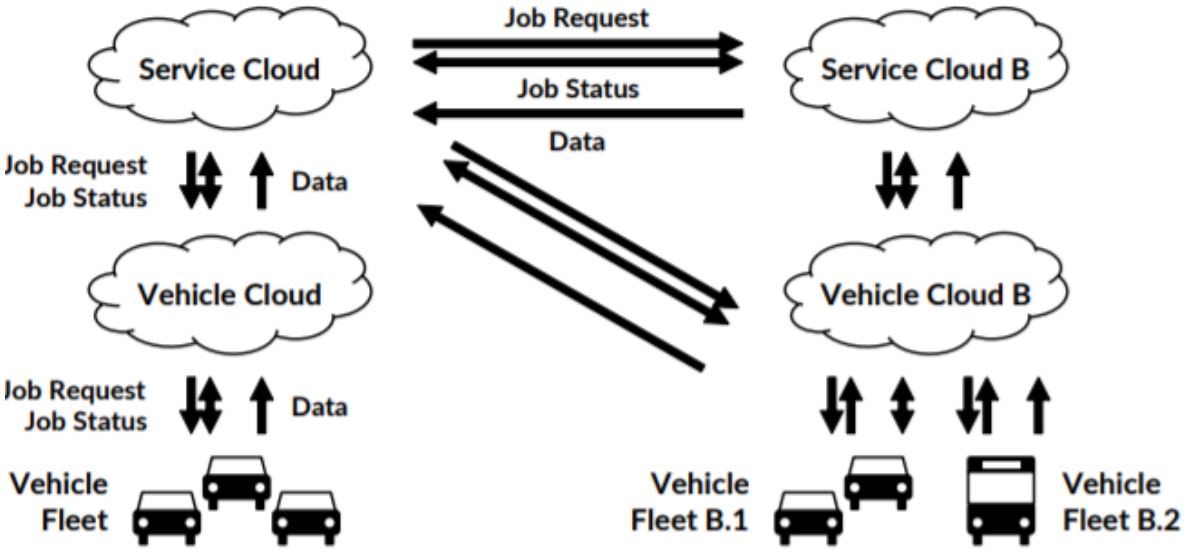

Figure 5 Multiple actor roles and interface

Interface Architecture

The interface architecture is purely limited to content and encoding of the SENSORIS interface. This limitation serves two purposes. The first purpose is to allow for a large variety of implementations. The SENSORIS interface shall be e.g. irrespective of the communication channel used, may it be already available technology to retrofit vehicle fleets being already in the field, state-of-the-art technology to roll out on vehicle fleets in production, or next generation technology for research. The second purpose of the limitation is to reduce time to standardization, as requirements for implementation sometimes differ significantly.

Message Encoding

SENSORIS job request, job status, and data messages are communicated between the three actor roles vehicle fleet, vehicle cloud, and service cloud. The SENSORIS messages have to be encoded for over-the-air and over-the-wire communication channels, i.e. they have to be serialized by the sender prior to communication and then have to be deserialized by the receiver.

Appendix 3

DATEX II Data format

Rationale

The signatories of the Proof-of-Concept MoU have agreed to use DATEX II to encode SRTI Level 3 data. They further agreed to use a common DATEX II profile, based on the SRTI *Recommended Reference Profile* which ensures compliance with the Commission Delegated Regulation (EU) 886/2013. This RRP is based on the common mapping table from DR886 to ITS standards, jointly developed by the DATEX II Program Support Action, TISA and the Amsterdam Group.

DATEX II model used

The profile is based on the DATEX II Situation package, which was downloaded from the http://www.datex2.eu website as a DATEX II pre-assembled package[1], containing the packages Common, LocationReferencing and Situation. The package contains also an empty Extension package, which has been filled by two DATEX II Level B extensions to extend the classes Linear and Point. The extensions provide one attribute respectively that takes up the corresponding location references – i.e. either a point or a linear – in OpenLR binary format. This format was preferred to the structured OpenLR encoding capabilities that exist in the LocationReferencing package.

Selection agreements

Based on this model, a selection was performed to define the common L3 profile. The selection was based on the SRTI RRP and no RRP-governed elements were de-selected.
The profile was created on the following principles, which had been agreed amongst the signatories:

1. *Additional values that allow adding further detailed information to the classes used in the SRTI mapping table:* It was agreed to keep these out of the PoC profile initially, unless we get concrete requirements for certain attributes to be included from PoC partners that want to provide the respective information details.
2. *Data elements to specify time validity aspects beyond overalStartTime and overallEndTime:* It was agreed that no further timing details are required/available for SRTI information.
3. *Optional classes to further detail the SiutationRecord base class of all SRTI events:* It was agreed that these classes are not suitable/relevant for SRTI information, if the L3 information is created out of L2 vehicle data. In case that partners fuse non-vehicle L2 or L3 data feeds into the L3 generation process, they should state concrete requirements if they need any of these data elements.
4. 4. *Location referencing:* The following agreements were made to tailor the location referencing options in the profile:
    a. Only point and linear locations are used (i.e. no area locations)
    b. Options based on EN ISO 19148 and TPEG location referencing are not selected
    c. ALERT-C location referencing is supported as an option for points and linears – in both cases only ALERT-C Method 4 (including offset distance from pre-defined location points) is used for SRTI; ALERT-C linears by AlertCLinearByCode is not selected
    d. OpenLR location referencing is supported as an option for points and linears, but not the structured model available in DATEX II, but the binary encoding provided by OpenLR – this encoding is introduced as a string via a Level B extension
    e. Co-ordinate based location references for points and linears (PointByCoordinates, GmlLineString) are used and made mandatory, to achieve interoperability with all clients. Note that the GmlLinearRing specialisation for GmlLineString is excluded, since it is used for area locations

Application

The profile is provided in a package with the following documents:

- SRTI L3 Profile Briefing Note 00-02-00.pdf: this document
- DATEX II PIM v3.0 with OpenLR binary 00-01-00.eap: the DATEX II pre-packaged Situation UML model including the OpenLR binary extensions

[1] https://docs.datex2.eu/

- DATEX II PIM v3.0 with OpenLR binary 00-01-00.xml: the XMI export from the UML model above needed for the profile generation
- L3Profile 00-03-00.sel: the selection file that represents the data profile in the schema generation process (note that the version number may increase if additional requirements are added to the profile selection)
- safety_related_mapping_datex_denm_00-06-03.xlsx: the current working draft of the DR886 mapping table which is the basis for the current RRP as well as this profile

A folder named DATEXII_v3.0_L3_Profile with the following content: DATEXII_3_Common.xsd
DATEXII_3_D2Payload.xsd
DATEXII_3_Extension.xsd
DATEXII_3_LocationReferencing.xsd
DATEXII_3_Situation.xsd
-- all these are the schema files created for the different namespaces by the DATEX II schema generation tool[2] based on the profile data above
instance1 00-01-00.xml
-- an example file with a valid message instance for testing purposes

The following options of using the package are possible:

Implementation of the whole profile

If you want to implement the profile "as-is", you simply use the provided XML schemas (*.xsd files in the subfolder) for creating the serialisation functions of your interface, e.g. for data binding.

Creating a sub-schema

If your system does not handle all the data elements in this profile, you can create a tailored sub-schema for your system. This will reduce the implementation costs for clients that only want to connect to your data feed. Note that the DATEX II methodology and toolkit ensure that all valid SRTI instances against such a sub-schema are by definition also valid against the full profile schema, i.e. this step does not create interoperability problems.
In order to create a sub-schema, follow the following steps:

1. Put the package in a folder on your hard disk
2. Open the DATEX II schema creation wizard at https://webtool.datex2.eu/wizard
3. In Step 1 – Source: Go to the "Your own model" tab; then click on the Browse… button and select your XMI file ("DATEX II PIM v3.0 with OpenLR binary 00-01-00.xml") from your local folder; click on "Next"
4. In Step 2 – Selection file: Go to the "Your own selection" tab; then click on the Browse… button and select your .sel file ("L3Profile 00-02-00.sel") from your local folder; click on "Next"
5. In Step 3 – RRP Selection: Select the "SRTI RRP 2019 SRTI RRP" option
6. In Step 4 – Selection: Now go through the selection tree and de-select the elements that your system does not support; Note that the tool will warn you if you de-select elements governed by the DR, but that is OK if your system doesn't hold the content; Do not change the multiplicity of pointByCoordinates and gmlLineString, since we have agreed to make these mandatory IMPORTANT: do not add elements, a sub-schema can only remove (optional) elements in order to stay interoperable
7. In Step 5 – Options: select the "Save selection to file selection.sel" to make sure you have your modified selection available for future iterations; use this file in Step 2 instead of the selection file provided initially with the package
8. In Step 6 – Finish: save the ZIP with the schema files you have created and the corresponding selection file (see Step 5) on your hard disk and proceed with them towards interface implementation as described in the previous section.

Extending the schema, extending the model

If the model or the selection in the schema are not sufficient for your data feed, do not extend the model/selection yourself. Contact the Tech Group to discuss modifications, which would then be made available for all users of the package.

[2] https://webtool.datex2.eu/wizard

Appendix 4

SRTI Ecosystem – Entrant information and self-declaration form

New entrants need to hand in a document containing information related to their (planned) role in the SRTI Ecosystem and available (or planned) data access interfaces. The SRTI ecosystem works best if the following technical requirements are met:

1. The data and the data access interface are thoroughly documented
2. The data access interface uses open standards exclusively
3. Metadata for the data access point is made available in the SRTI ecosystem's metadata repository (see chapter 5.3)

.

The following information needs to be provided by all new entrants:

- Organizational profile
- Declaration of what technical role(s) the applicant wishes to fulfill in the SRTI ecosystem together with a short description of planned activities in this context
  Some metadata of provided data or data access interfaces

The MPA mandates the use of a form to provide information and a self-declaration regarding the new entrants' role(s). The next two pages are a template to be used for this.

SRTI Ecosystem - Entrant information and self-declaration form

Form Version 05.10.2020

Organisational Profile

Party (organisation name)	*Name of legal entity*
Authorised signatory representing the Partner	*Name, position, e-mail address, postal address, phone number (optional)*
Contact person (project management, General Assembly representative)	*Name, position, e-mail address, postal address, phone number (optional)*
Contact person (technical working group representative)	*Name, position, e-mail address, postal address, phone number (optional)*
Motivation	*Rationale behind joining the SRTI Ecosystem*

Declaration of what technical role(s) the entrant wishes to fulfil	☐ Data Source of
	  ☐ L2 vehicle-generated data
	  ☐ L2 non-vehicle data
	  ☐ L3 data - vehicle-based
	  ☐ L3 data - non-vehicle-based
	☐ L2 Data Access Interface Provider *
	☐ Aggregator (L2 to L2')
	☐ L2' Data Access Interface Provider *
	☐ Creator (L3)
	☐ L3 Data Access Interface Provider *
	☐ Service Provider
	☐ National Access Point
	* Note: A 'Data Access Interface Provider' is no Party to the Multi-Party Agreement and thus has no voting rights in the General Assembly.

Data interest	*What type(s) of data are you interested in receiving from the SRTI Ecosystem and for what reason?*
Timeline	*What is the rough timeline for data provision and system development related to SRTI data exchange?*

Data Provided

Name of dataset	*e.g. XYZ fleet L2 data*
Description of dataset	*e.g. This dataset contains vehicle/infrastructure generated L2 data using the following data fields / the following types: …*
Who collected or created the data?	☐ Our organization ☐ Another organization: *Organisation collecting/generating the data* *Company name, postal address, website, contact person*
Who is managing the data access interface for the data?	☐ Our organization ☐ Another organization: *Organisation collecting/generating the data* *Company name, postal address, website, contact person*
Data Level	*L2 data / L2' data / L3 data* *Further clarification if needed*
Description of measures taken to ensure that the data provided is not person identifiable	*e.g. no VIN included, no traces longer than x waypoints / y meters, non-retraceable Event-ID,……*
Start date of publication	*From what time was/will the data be available at the interface*
Area covered by publication	*The whole of Europe, World-wide, individual country, …*
Transportation mode(s)	*What type(s) of vehicles are the source of the data? Passenger vehicle, motorcycle, truck, …*
Data format - Encoding	*e.g. Binary*
Data format - Syntax	*e.g. Protocol buffers*
Data format - Data Model	*e.g. Sensoris*
Data format description	*e.g. The available data uses the Sensoris v1.2 profile for OEM L2 data / DATEX II L3 data. More information on this format can be found at http://...*
Access interface	*e.g. The data feed is accessed via a REST API at the endpoint https://...* *To be able to access the interface, authorization is needed. Contact XYZ for access.*
API documentation	*e.g. The API documentation can be found at https://...*
Additional information	*e.g. Latency expectation*

(add additional tables if more than one dataset / data access interface is provided)

If interested in applying to join the SRTI ecosystem, please extract the last 2 pages of the document for submission or use the separately provided entrants word document.