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Evaluation of the PoC ‘Data for Road Safety’

Final Report

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1. Summary

In various European Member States, the number of seriously injured victims of road crashes continues to increase whereas the decrease in the number of road deaths is stagnating. Governments are actively working together to structurally improve road safety. Traffic information can play an important role in this. Warning road users about dangerous situations such as temporary slippery road, reduced visibility, broken-down vehicles and accidents can prevent accidents and limit consequences. Vehicles are increasingly equipped with sensors that are able to detect and report unforeseen circumstances.

Since 2013, the sharing of (vehicle) data for road safety applications has been regulated in the European Regulation 886/2013. During the first High Level Meeting in the field of Connected and Automated Driving, the Ministers of Transport, the European Commission and the industry prepared a list of priorities on this topic. One of these was to set up the public-private Data Task Force (DTF). Its task is to take the first steps towards a harmonised exchange of (vehicle) data (ecosystem) with the aim of generating Safety Related Traffic Information (abbreviated SRTI).

The first step towards the ecosystem is the Proof of Concept (PoC): Data for Road Safety. The PoC is necessary to develop and test the exchange of SRTI messages between private and public parties. The PoC started at the ITS Europe conference in Eindhoven on 3 June 2019 and ended in October 2020.

The Dutch Ministry of Infrastructure and Water Management has asked Sweco to carry out a (mainly technical) monitoring and evaluation of the PoC. This report describes the final result of this evaluation.

1.1 Set-up of the PoC

The PoC started off by signing a Memorandum of Understanding (MoU) in which the various parties contractually worked out the collaboration. As from 3 June, participants are a number of European Member States (Netherlands, Spain, Finland, Germany, Luxemburg), service providers (HERE Europe and TomTom Traffic) and car manufacturers (BMW, Ford, Daimler and Volvo). During the PoC, the Ecosystem was expanded by the accession of ASFINAG Maut Service GmbH/Austria, Flemish Agency for Roads and Traffic/Belgium and Highways England/United Kingdom (public authorities) NIRA (supplier) and Audi, Scania and Honda (vehicle manufacturers).

The DTF focuses on sharing the following eight types of SRTI messages:

1. Temporary slippery road;
2. Animals/people/obstacles/debris on the road;
3. Unprotected accident area;
4. Short-term road works;
5. Reduced visibility;
6. Wrong-way driver;
7. Unmanaged blockage of a road;
8. Exceptional weather conditions.

1.2 Purpose of the evaluation

With this evaluation, the Ministry wants to gain insight into the following topics:

- The extent to which the parties contribute to the creation and/or improvement of the eight safety warnings;
- The quality, availability and timeliness of the data sources offered by the parties;
- Review of the Extended vehicle concept and the compliance and completeness of the agreed standards;
- Analysis of the NAP's structure and the purchase of the portal by private parties;
- Functioning of the ecosystem on based on the data offered;
- Comparison between the quality of this data on the one hand and that of the information in the current process of road authorities;

To investigate this, the project is divided into two phases: a monitoring phase from January to July 2020 and a subsequent evaluation phase from August to September 2020.

This evaluation focuses on the entire PoC of the DTF. However, SRTI messages from existing sources are required to compare the quality of vehicle data. The decision was made to cooperate with the Dutch NDW (National Road Traffic Data Portal) for this purpose, which also fulfils the role of National Access Point in the Netherlands with regard to the data in this PoC. NDW has however no data on accidents and broken-down vehicles on municipal roads available. As a result, conclusions in this report can only be made based on vehicle data from the Dutch main road and provincial road network.

1.3 Description of the chain

The PoC Data for Road Safety distinguishes between various levels of vehicle data. Level 2 (L2) (data from one or more sensors from one vehicle) and Level 2' (harmonised and validated data) is shared with the ecosystem to process it to Level 3 data (L3). This is the processed and aggregated vehicle data that is transmitted to end users as an SRTI message.

For the exchange of vehicle data with external parties, the car manufacturers developed the 'extended vehicle' (ExVe) concept. Via ExVe, all vehicles are connected via the cellular network to a back-end cloud system of the car manufacturer. Other parties have access to the data there (whether or not for a fee). The PoC offers the industry the opportunity to demonstrate the concept's operation. At the start of the pilot, not all partners involved were equally far in their development. Some were already collecting vehicle data on a large scale, whereas others were still in the process of putting back-end systems into operation.

The SENSORIS (Sensor Interface Specification) protocol is used to exchange the L2 messages between vehicles and the various parties in the ecosystem. The standard has now been embraced by many OEMs and suppliers. DATEX-II, a European standard for the exchange of traffic information and traffic data, is used to distribute the SRTI messages.

1.4 Description of monitoring phase

In the PoC, six partners provided data to the National Access Point, which NDW is in the Netherlands. Three partners provided Level 2 data and three partners provided Level 3 data:

- L2: BMW, Daimler, Ford;
- L3: Nira, TomTom, Volvo.

The data flow has gradually become available. In part, this has to do with operational readiness of the various parties. When the PoC started, developments to collect and access the data were often still ongoing or in a testing phase. The Corona crisis and a statement by the European Data Protection Board, which drew up additional guidelines for asking the owner permission to collect vehicle data, also played a role.

The parties all provide a different set of types of notifications.

1.5 Results of the evaluation phase

1.5.1 Contributing to the creation and/or improvement of safety warnings

During the PoC, more and more parties joined the ecosystem. The vehicle data in de PoC currently mainly contribute to information about:

- Unprotected accident areas;
- Animals/people/obstacles/debris on the road (broken-down vehicles[1]).

At this moment, the reports on temporarily slippery roads and exceptional weather conditions cannot yet be immediately passed on as SRTI messages. Although the notifications can easily be correlated with the precipitation data, it is mainly the large number of notifications that require post-processing (clustering and filtering). In the case of post-processing, information is therefore also available about:

- Temporarily slippery roads;
- Exceptional weather conditions.
- Reduced visibility.

Vehicle data does not yet contribute to the following SRTI types:

- Short-term road works;
- Unmanaged blockage of a road;
- Wrong-way driver.

One of the reasons for this absence is that data come about based on object recognition by the vehicle (such as visually detecting traffic signs). Only a limited part of the fleet is currently equipped with this functionality. At the same time, these are notifications that are, in some cases, available within the public domain. The public and private parties therefore complement each other well in this respect.

1.5.2 Quality, availability and timeliness of data

In general, the supply of data is constant and stable. During the PoC, all data sources were unable to supply any data on one or more days, but in a number of cases this was also due to NDW or due to a change in the specifications.

Vehicle traces are also included in the L2 messages. These are coordinates from a few seconds before (and sometimes also after) the report. Traces can be used to generate the L3 data.

With regard to timeliness, the latency was examined (the time between the incident as registered by the vehicle and the time during which the message is available on the NDW server). In doing so, the time it takes for a notification to be produced in the vehicle until the message has been received by NDW was examined. The analysis shows that 52% of the messages are received within 5 seconds, 85% within 1 minutes and 96% within 5 minutes. For road safety-related messages, in general the faster the notification is known, the faster

[1] According to Safety related message sets – Selection of DATEX II Codes, DENM Event Types, TPEG2-TEC Causes and TMC Events for EC high level Categories

road users can be warned and the smaller the risk of the occurrence of an unsafe situation or an accident. This certainly applies to the 85% of all messages that arrive within 1 minute.

1.5.3 Assessment of the Extended vehicle concept and use of the standards
During the PoC, NDW performed a check on the validity of the messages. Only temporary incidental deviations were observed in this respect.

The SENSORIS data standard is used by two of the Level 2 parties. The third party uses SDII, but this party is also expected to transfer to SENSORIS. The L3 messages comply with DATEX-II.

The final conclusion is that the Extended vehicle concept and the standards applied function properly. This makes it possible to access the vehicle data and share it with other parties within the ecosystem.

1.5.4 Organisation of the NAP and purchase of the portal by private parties
During the PoC, all parties were able to supply data to NDW, implementing the NAP on behalf of the Netherlands. For this purpose, NDW has developed its own specific connection for each individual party, partly due to the difference in standards that are applied. This means that development work is needed to connect new parties.

During the PoC, two parties purchased L2 data from NDW. Neither party experienced any problems in this respect. NDW is therefore ready for data delivery and purchase by private parties.

1.5.5 Functioning of the ecosystem
The purpose of the DTF is to build a sustainable and scalable ecosystem for the creation and exchange of road safety data and road safety information.

In order to gain insight into how the parties experienced the PoC and the ecosystem, two interviews were held, with the branch organisation of OEMs (ACEA) as a data supplier and a service provider (TomTom) as user of data and supplier of L3 data. Both partners have a positive opinion on the DTF, the PoC and the ecosystem that was developed. They are satisfied with the role of NDW as a neutral NAP and the stability and reliability provided by NDW in the data value chain.

Both partners believe that the supply and exchange of data should continue in terms of functionality after the PoC has ended. It is important to maintain the focus on the eight SRTI messages without extending to other types of notifications or use cases. Both see great added value in the joining of new partners, such as additional OEMs and service providers. The more data the better. Both interviewed partners consider the principle of reciprocity to be of added value.

However, additional action is still necessary to make extensive upscaling possible within the Member States and at the European level. Not all parts of the chain have been sufficiently developed and are ready yet to deal with large amounts of data. This is necessary for a stable provision of services to end users.

1.5.6 Comparison with the current information available from road authorities
In view of this research question, the vehicle notifications were compared with other data sources from the Ministry of Infrastructure and Water Management and Waze. The analysis applied to the period from June to July 2020. This matching of notifications to existing sources was based on broken-down vehicles and accidents.

Only 1 party delivered reports of **accidents** during the PoC. In the period analysed, there were 17 vehicle notifications of accidents on motorways and provincial roads. 12 out of 17 notifications provided new information. Especially on the provincial and urban road network, a limited number of accident reports are now available. Vehicle data provide a major new source of information and are therefore of added value.

The accident reports from vehicle data are received earlier than SRTI reports from the existing sources, ranging from 7m 42s to 21m 48s as far as time saving is concerned. The average time savings are 11m 43s. The difference in location varies from 0m to 495m, with an average distance of 195m between vehicle notifications and the SRTI message based on other data sources.

In addition to accidents, there are also **broken-down vehicle** notifications. The number of broken-down vehicle notifications is much higher than the number of accident notifications. A significant part of these notifications do not involve an actual blockade. This involves, for example, reporting to a care centre along the motorway. In a strict selection of the broken-down vehicles that could be matched, the time saving amounted to 7.5 minutes compared to existing sources. In order to be used as an SRTI notification, a subsequent processing must be performed on the data (such as on-site check and filtering).

1.5.7 Recommendations

More insight into the set up of notifications increases its usability
Up to this moment, it is still unclear as to the basis of which sensors and triggers the L2 messages (events) are generated. There will also be differences between car manufacturers. It is recommended to gain more insight into the coming about (and perhaps some degree of uniformity in this). For example, filtering (at geographical locations, such as care facilities) or cross checks (with notifications from other vehicles) can be made possible. This may contribute to a further increase in the reliability of reports. The reports can therefore be better used as a supplement to the current accident registration.

L2 data for accidents and broken-down vehicles are already easily usable
The notifications regarding accidents are already useful for generating SRTI messages. For broken-down vehicles, this can be done by means of relatively simple filtering and checks for areas of interest, such as for thoroughfares. It is recommended to continue to use these data for SRTI messages, both by service providers and road authorities.

Ready for new partners joining the ecosystem
All partners are positive about the ecosystem and indicate that it is desirable for more partners to join. The advice is to actively invite new partners to do so. With more OEMs and service providers, more data becomes available, resulting in greater coverage of the notifications and reliable information. Member States can support this by actively recruiting new partners.

Extension of types of SRTI messages
At present, only a limited number of SRTI messages are shared per party. It is recommended that further discussions be held with these parties regarding an expansion.

Continued development of the chain and standards
All vehicle manufacturers are currently developing the data infrastructure required for the large-scale rollout of data sharing. During the PoC, the data chain was demonstrated to function properly and the standards applied are effective. Some parties have however made

more progress on the rollout than others. Further development of the chain is recommended in order to facilitate a large-scale rollout with 24/7 services.

Development of NAPs in the Member States
There is a difference in the way Member States have set up their National Access Point. In the long term, a European Access Point might be a good alternative. The parties are still unclear about this. It is recommended to further develop the NAP organisation in Member States and to discuss a common view of a cooperation between NAPs or a European AP.

Development and dissemination of L3 SRTI messages
Three parties currently supply L3 data to NDW. In addition, a lot of L2 data is also supplied to NDW, which is not yet converted and transmitted as L3. NDW is in the process of generating L3 data based on the instructions of Dutch road authorities. This allows for example traffic centres to take traffic management measures such as warning road users (broadcast) and managing road inspectors and/or emergency services. Vehicle data therefore function as an important source for notifications on both national and municipal road networks and the provincial road network. It is recommended to further expand the number of L3 reports.
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Strength in collaboration
Vehicle data can be considered an important new source for SRTI reports. But not all categories are now covered by vehicle data. Vehicle data do not yet contribute to short-term road works, wrong-way drivers and unmanaged blockage of a road. This information is currently (partly) available to public partners. Together, it is possible to obtain a more complete overview of the eight types of SRTI reports. Advice would be to have additional public data become available for the ecosystem, for example by the NDW as L3 data.

2. Introduction

2.1 Background

In December 2018, the Ministry of Infrastructure and Water Management presented the 2030 Strategic Plan for Road Safety. The plan includes an ambition of zero road casualties: each road casualty is one too many. At the same time, it is concluded that the number of seriously injured road casualties continues to increase and that the decrease in the number of fatalities is stagnating. A downward trend in the registration of accidents is also visible. Without sufficient data, it is difficult to draw up a policy in this context and to monitor the road safety situation appropriately. All public authorities are now actively working together to structurally improve road safety. Other European Member States also have road safety policies and ambitions.

Traffic information can play an important role in this. Warning road users of dangerous situations such as temporary slippery road, reduced visibility, broken-down vehicles and accidents, can prevent accidents and limit consequences.

Vehicles are increasingly equipped with sensors that can detect and report unforeseen circumstances. The vehicles are also increasingly ‘connected’ and have a data connection (via 4G/5G) with the car manufacturer, for example for eCall (in which the vehicle connects itself with the emergency services in the event of a serious accident) and the transmission of data for maintenance, the remote execution of updates and in-car infotainment. Currently, approx. 37 percent of new cars are equipped with a built-in internet connection by European manufacturers. All new cars in the European Union are expected to be connected by 2022. As a result, vehicle data can make an important contribution to achieving the baseline target.

Since 2013, the sharing of vehicle data for road safety applications has been regulated in European Regulation 886/2013 action c. Although this imposes certain obligations with regard to sharing these road safety-related data, there turned out to be different interpretations. In 2016, the ACEA (the umbrella organisation of European vehicle manufacturers) came up with a position paper on how the automotive industry views vehicle data sharing with third parties. It describes, among other topics, which data, for what application and under what conditions they were prepared to share (such as the principle of reciprocity).

The Ministry of Infrastructure and Water Management saw the importance of ITS and sharing vehicle data and put the topic on the agenda together with Member States and the car industry during the EU Presidency of the Netherlands. At the first High Level Meeting in the field of Connected and Automated Driving, the ministers of transport, the European Commission and the industry prepared a list of priorities on this topic. One of the priorities was to start with a public and private task force known as the Data Task Force (DTF). It started on 24 May 2017 and is responsible for taking the first steps towards a harmonised exchange of vehicle data (ecosystem) with the aim of generating road safety information (Safety Related Traffic Information, abbreviated SRTI).

After a period of discussion, inter alia on European regulation, technology and conditions, parties came to a common understanding, laid down in a Memorandum of Understanding (MoU): an agreement made between eleven public-private parties to take the necessary steps towards data and information exchange.

The first step towards developing an ecosystem is to draw up a Proof of Concept (PoC): Data for Road Safety. The PoC is necessary to develop and test the exchange of SRTI messages between private and public parties, as well as to assess the various possible architectures and the agreement system from the MoU.

The PoC started at the ITS conference in Eindhoven on 3 June 2019 and was to end on 3 June 2020. Due to various causes (which are described later in this report), the test was extended up to and including October 2020. In October 2020, the partners signed the 'Multi Party Agreement - Data for Road Safety'. This lays the groundwork for permanent cooperation and exchange of data and information.

The Ministry of Infrastructure and Water Management asked Sweco to carry out a (mainly technical) monitoring and evaluation of the PoC. This report describes the final result of this evaluation.

2.2 Design of the Proof of Concept (PoC)

The PoC started with the signing of a Memorandum of Understanding (MoU) in which the various parties contractually fleshed out and signed the collaboration. As from 3 June, the participating partners included a number of European Member States (Netherlands, Spain, Finland, Germany, Luxemburg), service providers (HERE Europe and TomTom Traffic) and car manufacturers / OEMs, BMW, Ford, Daimler and Volvo).

During the pilot, the ecosystem was expanded by the accession of Austria, Belgium and the United Kingdom, suppliers (NIRA) and manufacturers Audi, Scania and Honda.

The DTF focuses on sharing the following eight types of SRTI messages:

1. Temporary slippery road ;
2. Animals/people/obstacles/debris on the road;
3. Unprotected accident area;
4. Short-term road works;
5. Reduced visibility;
6. Wrong-way driver;
7. Unmanaged blockage of a road;
8. Exceptional weather conditions.

The types of messages collected and shared differ per party.

European Regulation 886/2013 action c indicates the eight types of SRTI messages (at no cost to the end user) to be made available to a National Access Point (NAP), a role delegated to NDW (National Road Traffic Data Portal) in the Netherlands**.** This was fleshed out and supplemented in the MoU. It has been agreed between the partners data is to be shared 'in-kind' (based on reciprocity) to all partners in the ecosystem. The level of detail in which the data is shared, was also specified further.

The types of messages and the technical chain are explained in more detail in the next chapter.

2.3 Purpose and set-up of the investigation

With this investigation, the Ministry wants to gain insight into the following topics:

- The extent to which the parties contribute to the creation and/or improvement of the eight safety warnings;
- The quality, availability and timeliness of data sources offered by the parties;
- Review of the Extended vehicle concept and the compliance and completeness of the agreed standards;
- Analysis of the NAP structure and the use of the portal by private parties;
- Functioning of the ecosystem on the basis of data offered;
- Comparison between the quality of this data and the information currently available to road authorities.

To investigate this, the project is divided into two phases, a monitoring phase from January to July 2020 and a subsequent evaluation phase from August to September 2020.

During the monitoring phase, all data was made transparent on a monthly basis in an interactive dashboard (as shown in Figures 2.1 and 2.2). The dashboard made it possible to monitor the progress of all participating partners. Interactive selections could also be made per region, or per type of notification, in order to further investigate. During the monitoring phase, the quality of incoming data messages was assessed in collaboration with NDW.

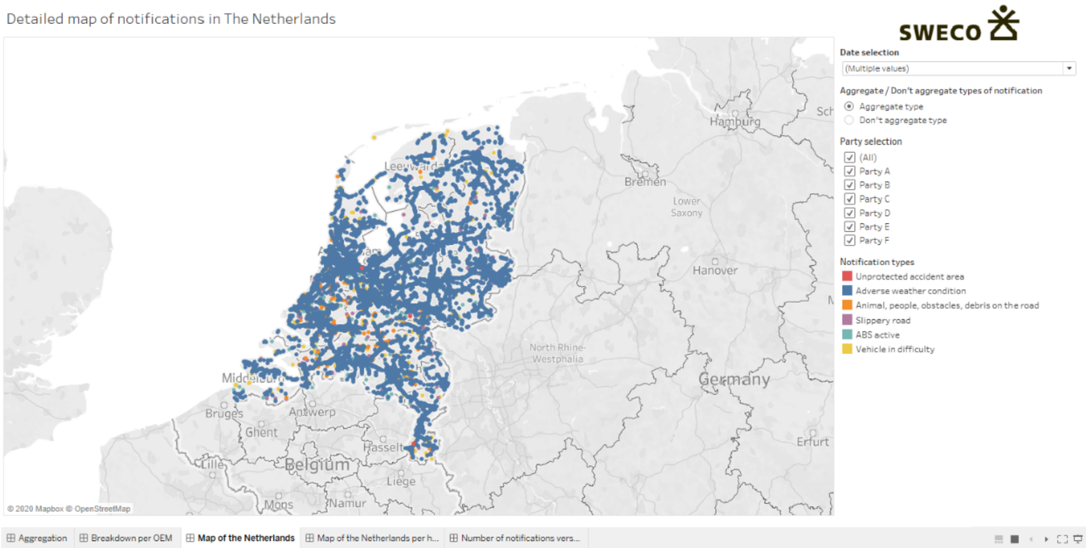

Figure 2.1 Dashboard with geographical representation of vehicle notifications

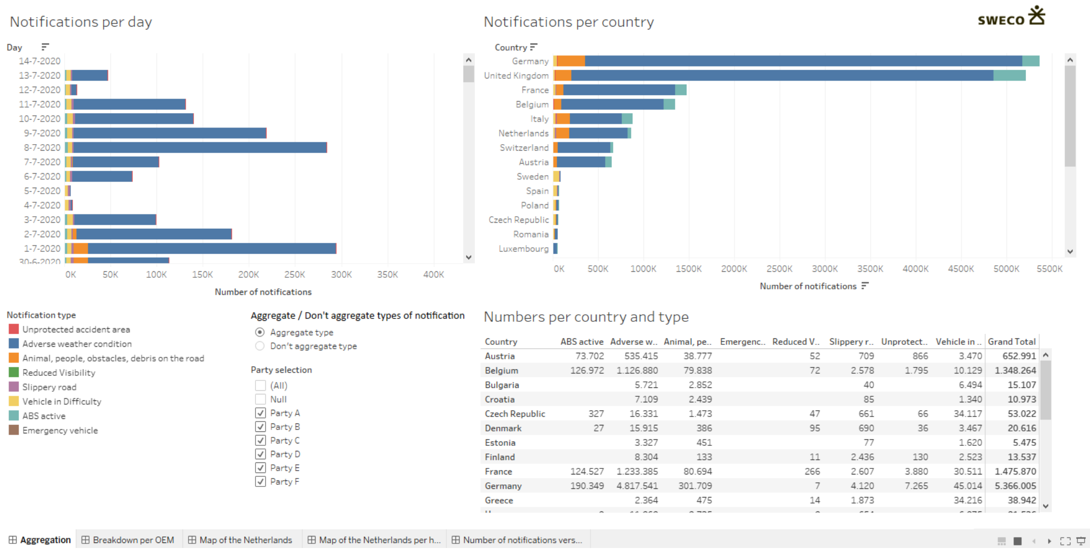

Figure 2.2 Dashboard with aggregated vehicle notifications

In the evaluation phase, with regard to data from June and July 2020, an analysis was carried out of the quality and added value of the vehicle data compared to data sources currently available to road authorities (such as UDLS and KNMI (Royal Netherlands Meteorological Institute)). The greatest added value is expected to lie in notifications for which no SRTI message is currently available, followed by reports that are already available but that can be detected in a shorter time frame by means the vehicle data. In addition, vehicle data can offer (limited) added value in terms of a possibly higher accuracy and/or as a validation of notifications from other sources in order to increase the reliability of, for example, an incident message. The various types of added value are shown in the figure below:

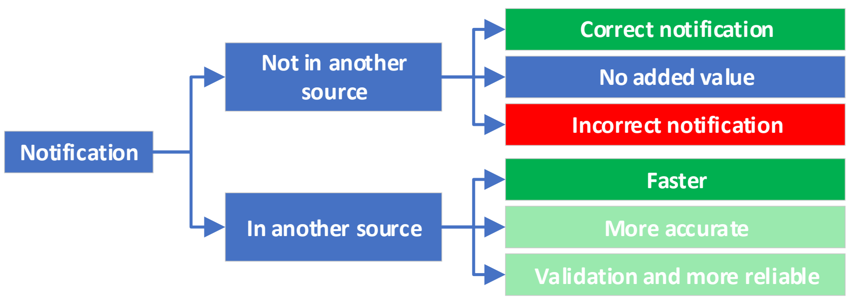

Figure 2.3 Forms of added value vehicle data

The investigation did not look at the use of the SRTI messages. Consequently, no statements are made about follow-up behaviour and its consequences in terms of road safety stemming from our analysis. In addition to this data analysis, two interviews were held to further investigate the experiences during the PoC and the functioning of the ecosystem. The evaluation focuses on the entire PoC of the DTF, SRTI messages from existing sources are required to compare the quality of vehicle data. Only data on accidents and broken-down vehicles currently available to Dutch road authorities (Ministry of Infrastructure and Water Management, and Provinces) are available at NDW. As a result, we can only make statements on the reports on the Dutch main and provincial road network.

3. Description of the chain

3.1 Vehicle data

The PoC Data For Road Safety distinguishes between various levels for vehicle data and other types of data:

- **Level 1 (L1):**
  (rough) sensor data used in the vehicle for the analysis of systems, such as wheel speeds, steering deflection, wipers, fog lamp, etc. These data remain in the vehicle;
- **Level 2 (L2):**
  Data from one or more sensors from one vehicle that generate a trigger condition. This (rough) data is shared in the ecosystem;
- **Level 2' (L2'):**
  Improved Level 2 data by clearing, harmonising and validating a message with multiple vehicles and/or other makes. This is the basis for an SRTI message collected by a private or public party.
- **Level 3 (L3):**
  Vehicle data collected, processed and aggregated by public or private parties and transmitted as SRTI to end users.

The chain is included in this figure (by way of illustration):

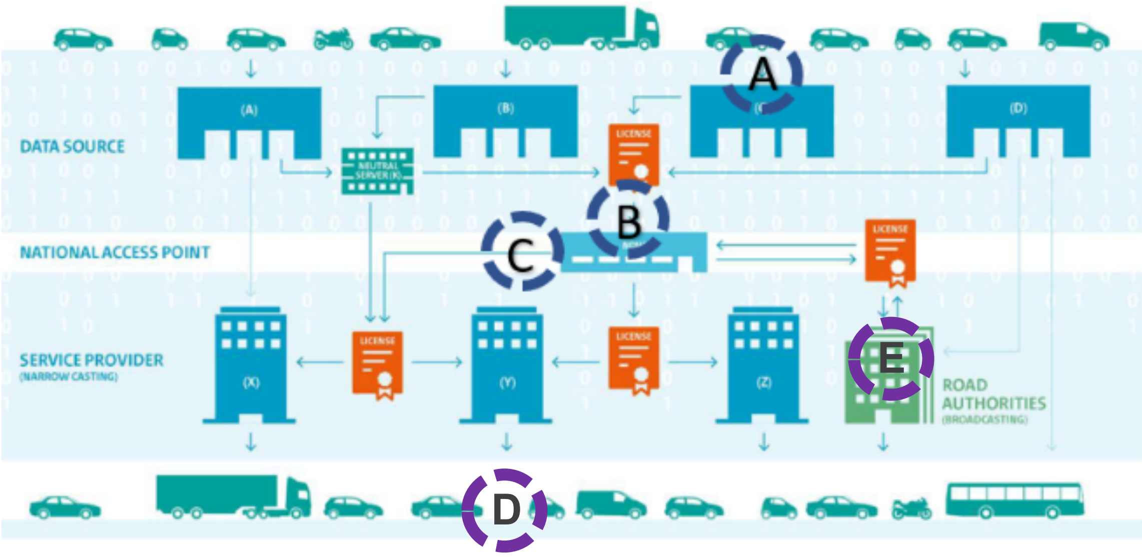

Figure 3.1 Vehicle data chain

At the top of the chain are the vehicles that produce L2 data (from the L1 data in the vehicle).
The top layer consists of OEMs and other parties that collect data from vehicles and function as a 'Data Source'. The L2 messages are collected and made available by the OEM/party itself (directly) or by an intermediate party (indirectly) via an 'Access Point' (A in the figure). In this layer, the data is enriched by the OEM/party itself or by 'Aggregators' to L2'. These Aggregators collect the L2 data from different parties, and clarify and harmonise the data.

The L2' is shared between the parties and is therefore also available at the 'National Access Point' (B). In the Netherlands, NDW performs this role.

The layer ‘Service Provider’ consists of two roles. The first role is that of ‘Creator’, a party that collects L2’ messages (C) and makes L3 messages from them. The second role is that of ‘Service Distributor’, a party that sends the L3 messages to the end user (D). It is possible that the two roles are fulfilled by one party. The L2’ messages can be obtained through NDW but also directly from Aggregators. The NDW itself can also create SRTI messages (L3) and send them to road authorities, such as Traffic Centres (E).

3.2 The extended vehicle concept and standards used

At the start, the Data Task Force did not prescribe a standard or protocol. After all, it was important to start sharing road safety information and data as soon as possible. Nevertheless, there proved to be no huge differences between the parties, also because they are still busy working on the development of these platforms. The choice of protocols and standards therefore went more or less organically. Data is exchanged in the ecosystem on the basis of the ‘extended vehicle concept’. In doing so, two standards are used: SENSORIS, and DATEX-II. This section provides a brief overview of these standards.

Extended Vehicle Concept

For the exchange of data from vehicles with external parties, vehicle manufacturers developed the ‘extended vehicle’ (ExVe) concept. Via ExVe, all vehicles are connected via the cellular network to a back-end cloud system of the vehicle manufacturer. Other parties can access data there (whether or not for a fee). In the ExVe concept, it is also possible to work with an intermediary (a neutral server) that collects vehicle data from various vehicle manufacturers, so that customers have to close fewer contracts. In addition, the vehicle manufacturer has no insight into the customer’s actions with the data, as a result of which competitive information is more secure. There is currently no neutral server within the ecosystem, although HERE is already collecting data from various brands (a number of which are also shareholder of HERE).

The development of ExVe has been going on for more than a decade. An oft-heard objection to the concept is that it is not possible for external companies to gain direct access to the vehicle. Although the owner must give permission to collect data, it is the vehicle manufacturer that determines which information is shared with which party. This discussion is less relevant to SRTI because European Regulation 886/2013 action c requires vehicle manufacturers to share traffic safety-related messages. Although alternatives are being developed, such as the On Board Application Platform and In-vehicle interface, ExVe is now the only available concept for the (large-scale) collection of vehicle data

The PoC provided the industry with the ultimate opportunity to demonstrate the concept’s effectiveness. At the start of the pilot, not all parties were equally far in its developments. Some were already collecting vehicle data on a large scale, whereas others were still in the process of putting back-end systems into operation.

SENSORIS

The SENSORIS (Sensor Interface Specification) protocol is used to exchange L2 messages between vehicles, the Access Point and Aggregators. SENSORIS was initiated by HERE and developed in collaboration with ERTICO – ITS Europe. The standard has now been embraced by many OEMs and suppliers. The specification only defines the content and coding of communication. SENSORIS does not prescribe how the sensor data is derived, it differs between parties and depends on, e.g., software and hardware used and the reliability of intervals used.

The structure of the data contains:

- Event: Vehicle data, location, circumstances, etc.;
- Data source: Sensors such as camera, GPS, etc. or a combination of multiple sensor input;
- Connections between events;
- History (optional): Speed, position, weather conditions, etc.

There are a large number of categories for the events that go beyond the safety-related SRTI messages. For example, there are also events at a motor level, for traffic behaviour and traffic manoeuvres. These events will later be processed into one of the eight SRTI messages.

DATEX-II

DATEX-II is a European standard for the exchange of traffic information and traffic data. The development of DATEX-I in the early nineties was started to facilitate the exchange of information between traffic centres and road authorities. Shortly thereafter, there was also a wish to share traffic information with service providers. In order to make this possible, the standard was further developed around the turn of the century to DATEX-II. This version is independent of language and no longer leaves room for misinterpretation by the data format. This allows the user to play the message as spoken text, to show it as an image on the map and to integrate it into the route advice of the navigation system. Thus, DATEX-II makes it possible to provide for the development of ITS services and the increasing need for information from (self-driving) vehicles.

The standard is of strategic importance to Member States, national road authorities and traffic centres. The standard has long been used for traffic information services and traffic centres and is used by various traffic management applications. It enables cross-border ITS services in Europe that contribute to the European policy formulated in the ITS Action Plan.

The maintenance of DATEX-II is therefore presided over by the CEDR (Conference of European Directors of Roads). All stakeholders in the field of traffic and transport may contribute to the development and maintenance of the standard. Part of the further development takes place in European Calls and maintenance takes place from the CEN Technical Committee 278, Road Transport and Traffic Telematics. For more information, please visit www.itsstandards.eu

DATEX-II can be delivered as XML or JSON and provides for several ways of exchanging data. Within the DTF, as also regulated in DR 886 action c, DATEX-II is prescribed for the distribution of SRTI messages containing location, time and category of the notification.

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4. Description of the monitoring phase

4.1 Participants

For this PoC, Sweco has been given access to the data of the Dutch National Access Point, which is provided by the National Road Traffic Data Portal (NDW). In the PoC, six parties ultimately supplied data to the NDW National Access Point. Three parties supplied Level 2 data and three parties Level 3 data:

- L2: BMW, Daimler, Ford;
- L3: Nira, TomTom, Volvo.

This report primarily focused on the Dutch part of the PoC, because all parties provided data for this purpose (some of the parties supplied data for the whole of Europe to the NDW and some for the Netherlands only).

In the rest of this report, the various parties are only mentioned anonymously. The report uses various pseudonyms to prevent the parties from being traced (*A-F, I-VI*, etc.)

Not all parties supplied data to NDW from the same point in time. The data flow has gradually become available. In part, this has to do with operational readiness of the various parties. This is a new development for all involved. At the time the pilot started, the developments to collect and access data were often still ongoing or were in a test phase. A decision by the European Data Protection Board, which drew up additional guidelines for obtaining permission from the owner for collecting vehicle data, also played a role. Some Vehicle manufacturers needed time to process these guidelines and to explicitly arrange permission.

Finally, the Corona crisis and the associated staffing challenges also played a part in the availability of the various data flows later than planned.

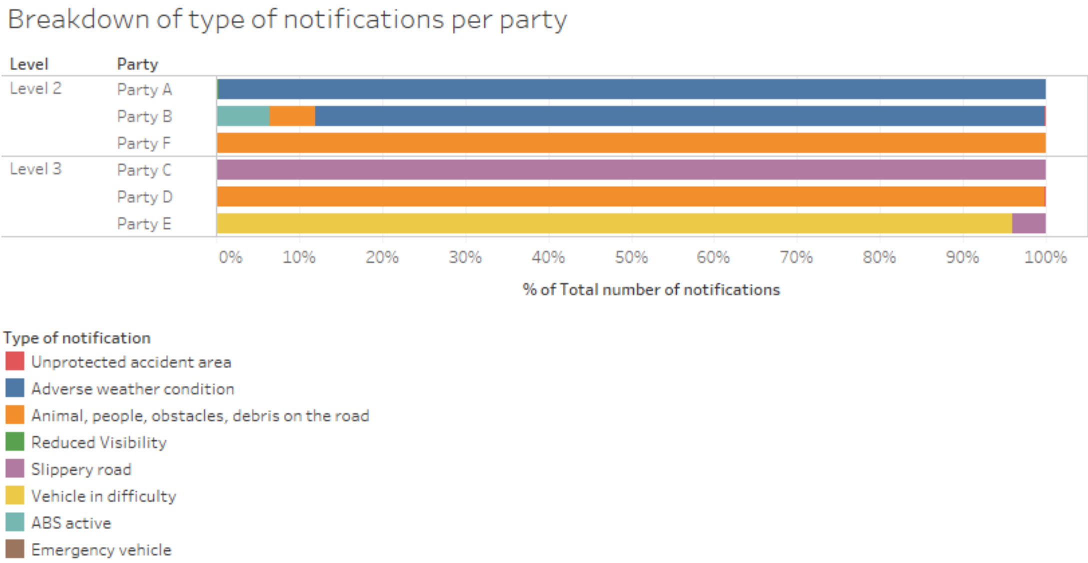
Below is an overview of moments in time at which data (as a continuous flow) became available at NDW:

- 1 January 2020;
- 24 March 2020;
- 30 April 2020;
- 6 May 2020;
- 9 May 2020;
- 11 May 2020.

The MoU contractually prescribes that L2 data may be retained for a maximum of 2 months for privacy and commercial reasons. This is why the analyses in this evaluation are based on data from June and July 2020.

4.2 Types of messages

There are differences between the parties in terms of the types of notifications provided. The broken-down vehicle per type of notification is shown in the figure below:



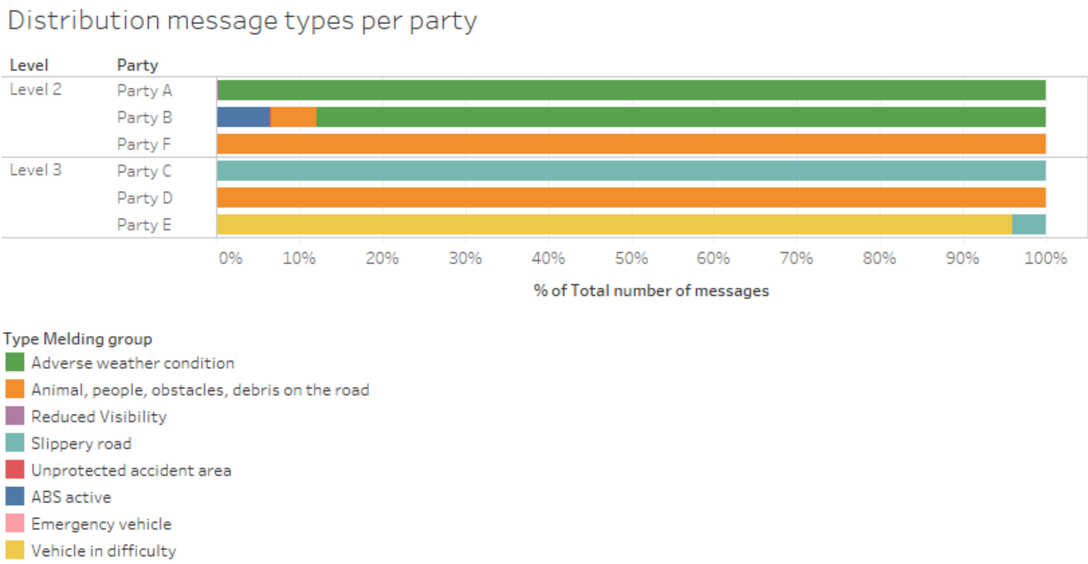


Figure 4.1 Types of notifications per party

The specific notifications per party are clustered and divided into more general categories, with as much classification as possible according to the 8 types of SRTI messages. Most parties do not know on the basis of which (combination of) sensors and triggers a notification is made. As a result, it is not clear which of the 8 types a notification belongs to. This concerns the notifications *ABS active* (which, based on the vehicle trace, is found both in the case of braking and accelerating), *Vehicle in difficulty* (of which it is unclear what kind of notification this is) and *Emergency vehicle* (which may be classified under *animal, people, obstacles, debris on the road*). These three types have therefore been included separately.

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Table 4.1 Clustering of vehicle data types according to the 8 types of SRTI messages

Types of SRTI-messages	**Vehicle data types**
Slippery road	adverseWeatherCondition: Adhesion NonWeatherRelatedRoadConditions_slipperyRoad
Animal, people, obstacles, debris on the road	hazard: BROKEN_DOWN_VEHICLE VehicleObstruction: brokenDownVehicle
Unprotected accident area	hazard: ACCIDENT Accident_accident GeneralObstruction: unprotectedAccidentArea
Short-term road work	*Not available from vehicle in this point in time*
Reduced visibility	adverseWeatherCondition: Visibility_fog
Wrong-way driver	*Not available from vehicle in this point in time*
Unmanaged blockage of a road	*Not available from vehicle in this point in time*
Exceptional weather condition	adverseWeatherCondition: heavyRainPrecipitation adverseWeatherCondition: Precipitation roadWeatherCondition_HYDROPLANING

Other	**Vehicle data types**
Vehicle in difficulty	VehicleObstruction_vehicleInDifficulty
ABS active	absStatus_ACTIVE
Emergency vehicle	VehicleObstruction_emergencyVehicle

Table 4.1 also shows that not all eight safety-related notifications are (yet) covered by the vehicle data currently available. Reason for this is that this type of notification must be made on the basis of object recognition by sensors that scan the road, for example by identifying traffic signs and people who want to cross. Only a limited part of the fleet is now equipped with this functionality. In the future, however, these notifications may become more widely available.

The table below shows the number of notifications per party per data category.

Table 4.2 Number of notifications per party and type within the Netherlands

Number of messages per type and party (The Netherlands)

	Level 2			Level 3		
	Party A	Party B	Party F	Party C	Party D	Party E
Adverse weather condition	32.790	662.896				
Animal, people, obstacles, debris on the road		92.105	6.048		48.305	
Reduced Visibility	1					
Slippery road				16.541		2.051
Unprotected accident area		664			100	
ABS active		41.262				
Emergency vehicle					2	
Vehicle in difficulty						81.530

In addition to an overview only based on the Netherlands, an overview of the number of notifications per type per country in Europe is given below. It should be noted, however, that not all parties have provided data for all countries, as a result of which the allocation across countries will not be representative for a further roll-out in Europe.

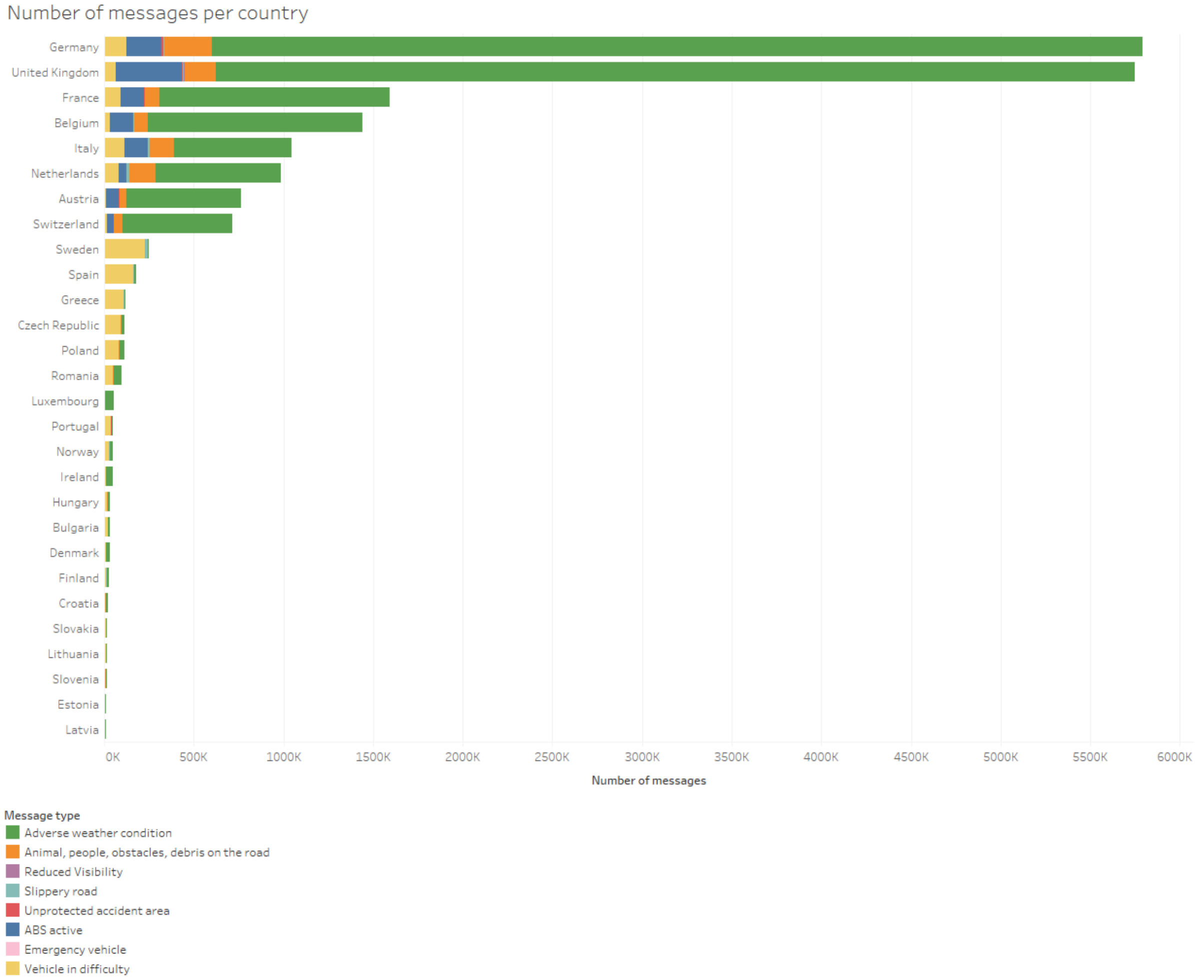

Figure 4.2 Number of messages per country

5. Functioning of the chain

5.1 Availability, quality and timeliness of the data

5.1.1 Availability

This analysis looked at messages from the period June - July 2020. Almost all parties do have periods in time in which no messages were received.

Table 5.1 Availability of data per party

Party	Delivery as from	Periods in time with no data
Party a	1 January	13-15 June, 4-6 July
Party B	24 March 2020	16 July
Party c	30 April 2020	25-29 June
Party d	6 May 2020	1-2 June, 24-26 July
Party e	9 May	3-6 July
Party f	11 May 2020	7-9 July

The reason for data not being available is partly due to NDW (faults, updates, etc.) and partly due to failing of the mutual communication between the respective party and NDW (for example, rejected messages due to updates of the XML schedules)[2].

Overall conclusion is that the data availability is generally good.

5.1.2 Vehicle traces

In most notifications, the L2 Parties also provide vehicle traces, with the last vehicle positions prior to a notification/incident. Party 1 and Party 3 usually deliver 21 vehicle positions. Exceptions to this are notifications of *accidents*, of which Party 3 generally has 4 positions available, and in the case of Party 1, the trace length also differs per notification for reports of *animals, people, obstacles, debris on the road.*

Table 5.2 Average number of points per vehicle trace per party and per category

Average number of points in vehicle trace

	Party		
	Party 1	Party 2	Party 3
Adverse weather condition		3,00	20,98
Animal, people, obstacles, debris on the road	24,48		21,00
Reduced Visibility		3,00	
Slippery road		3,00	
Unprotected accident area			3,81
ABS active			20,98

Party 2 always delivers 3 vehicle positions with the vehicle traces. In many cases (85 %), however, this is over the last 2 milliseconds. As a result, no useful traces can be made because coordinates overlap. For the category *adverseWeatherCondition Adhesion*, the timeperiod of the trace is longer, but still only 1 or 2 seconds. In addition, there is often a

[2] Email from Tony Meeuwsen (NDW), 27 July 2020.

different position in one of the three vehicle positions. This also explains the long average length of the vehicle trace in the table below. On the basis of a random check, the deviating position often appears to be the last position of the vehicle trace. Every time, the deviation seems to be either in the X direction or the Y direction and is therefore expected to be caused by a programming error and not by an unreliable GPS position. The deviating position also has a *horizontal AccuracyM* of 0.0 in the message (compared to, for example, 1.0 or 2.0 in the case of logical positions). However, there is also a *horizontalAccuracyM* of 0.0 for other points that does seem logical and/or plausible.

The table below shows the average length of the vehicle traces per party and per category.

Table 5.3 Average length of vehicle tracking per party and type

Average length (distance in meters) of vehicle trace

	Party		
	Party 1	Party 2	Party 3
Adverse weather condition			313,1
Animal, people, obstacles, debris on the road	2.942,3		198,0
Slippery road		12.884,2	
Unprotected accident area			992,7
ABS active			237,6

The graph below shows the spread of the length of the vehicle traces (with logarithmic scale). This shows the large spread in Party 2's notifications, caused either by the short time span (several milliseconds and therefore a very short length) or by incorrect positions (unrealistically long lengths).

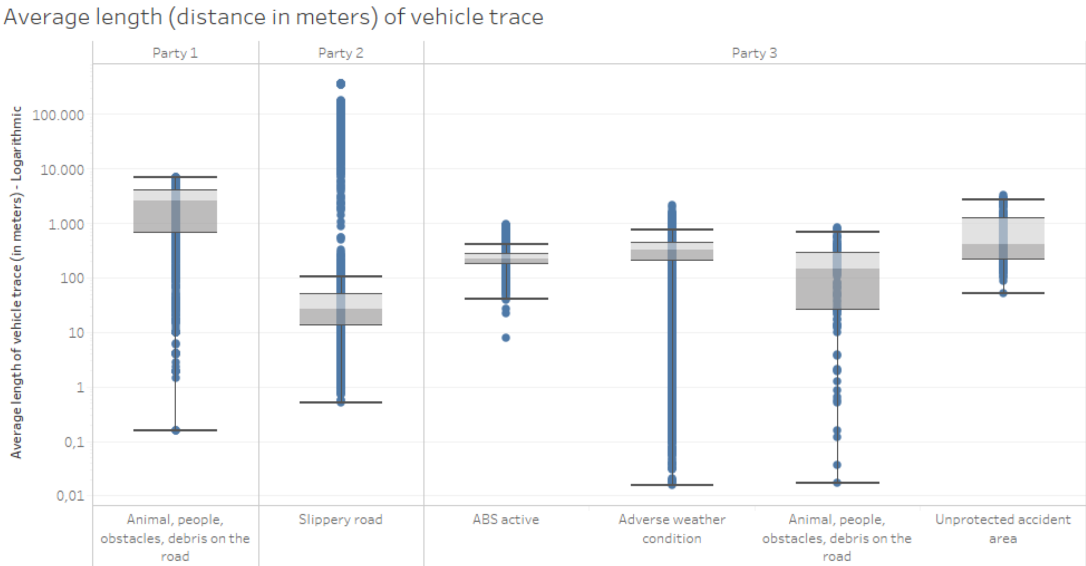

Figure 5.1 Box plot spread of length of vehicle trace (logarithmic scale)

If we look at an individual vehicle trace, the vehicle trace positions can be seen to also be properly matched with the road network in the case of more complex routes.

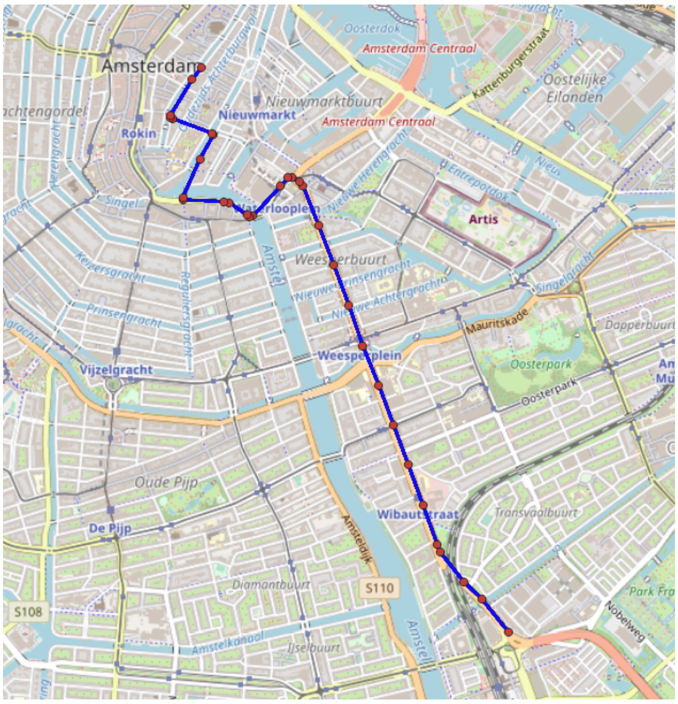

Figure 5.2 Example vehicle trace

The conclusion is that the quality and usability of the vehicle traces is good. There were, however, occasional deviations with impossible vehicle traces (as discussed at Party 2).

5.1.3 <u>Latency</u>

The latency (or delay) of messages is an important feature for determining the usability and added value of vehicle data. The lower the latency, the more up-to-date the messages and the sooner action can be taken in unsafe situations. Messages that are too old may be outdated and will therefore be less reliable.

The latency can be determined at various points in the chain (from vehicle sensor to on-board computer, from vehicle to the party's back-end, from party to National Access Point (NDW), from NDW to service provider, etc.). Within this pilot, it was decided in the analysis to look at the time between the incident (as registered by the vehicle) and the time when the safety notification(s) file became available on the NDW server for users.

During a certain period, one of the parties reported incident times in the future. These notifications result in a negative latency in the calculation and have therefore not been included in the analysis.

Most parties supplied the messages to NDW by means of a push message (new messages are sent by the sender to the recipient). With one of the parties, the data was collected by NDW every 10 seconds by means of a pull-request (the periodic collection of available messages, initiated by the recipient). The messages were also retrieved many times over. Prior to the analyses, duplicates were removed from the messages as much as possible. It turned out that after some time (often after one or a few hours) there were still small (unexplained) variations in the message and the SessionID, as a result of which some messages occurred twice in the ultimate data set. All messages with a latency of more than 1 hour were therefore disregarded.

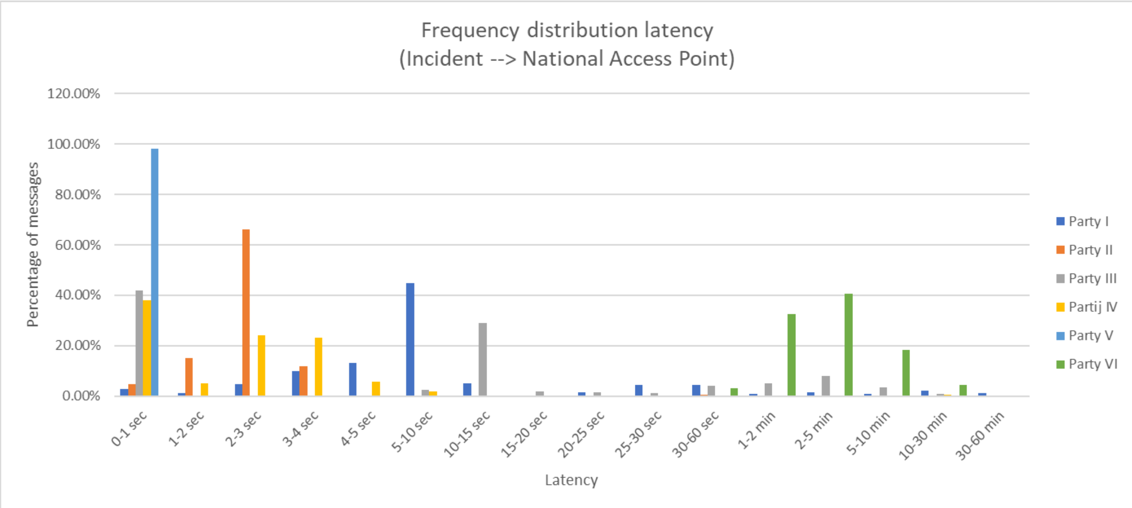

Figure 5.3 Latency frequency distribution

The above graph (**Fout! Verwijzingsbron niet gevonden.**) shows the latency frequency distribution per party.
It can be seen that Party VI's messages have a much higher latency than those of other parties. This is because Party VI receives messages from another party via NDW, subsequently improves these to L3 data and then returns them to NDW. However, the original time of the incident is, understandably, retained by Party VI (and used as the time of the incident to determine any delay).

If we disregard messages with a latency of more than one hour and messages from Party VI, then

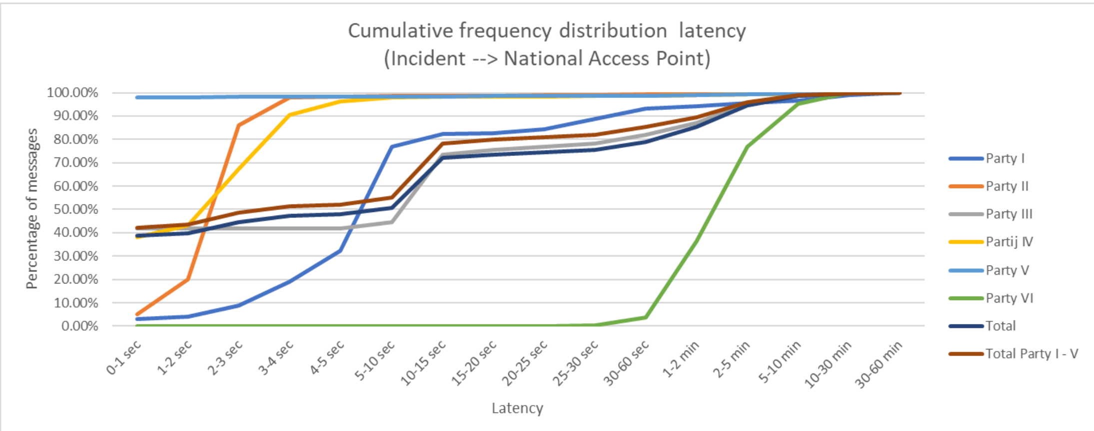

Figure 5.4 shows that the latency of 52% of the messages falls within 5 seconds, 85% within 1 minutes and 96% within 5 minutes.

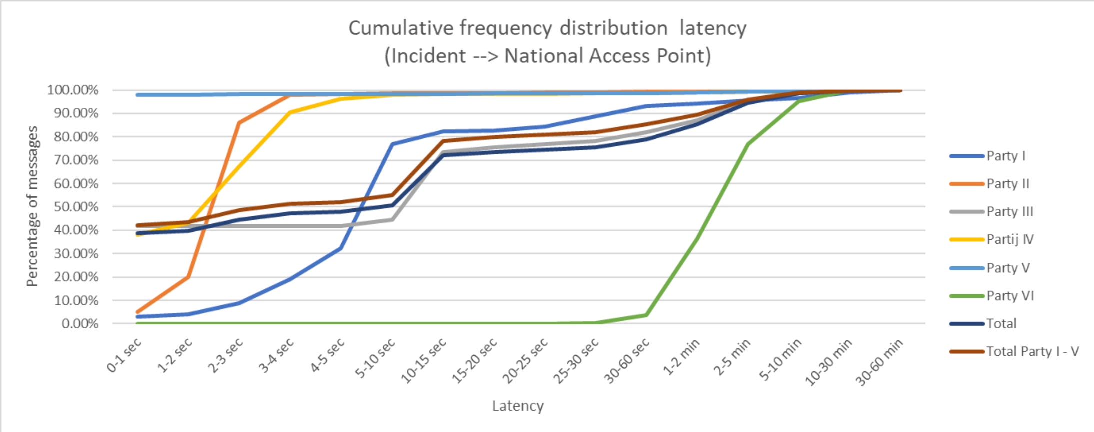

Figure 5.4 Cumulative latency frequency distribution

To conclude, 85% of the messages arriving within 1 minute are certainly suitable for use as an SRTI message.

5.1.4 Duplicate entries

The data collected has been cleared by eliminating duplicates from all messages as much as possible, by filtering subsequent messages with the same SessionID (as much as possible; not all messages contain a SessionID) or by filtering subsequent messages with the same time and location. It was already discussed in the previous paragraph that in the case of one of the parties, the repeated pull-requests often involved minor changes in the messages that caused the duplicates. Also with other parties, data also regularly contains 'double notifications'. These are notifications with the same location and time but with a different SessionID, or messages without a SessionID, but indicating almost the same location and/or time.

On the basis of random checks, it seems that it is always the last location (at the time of the incident) that differs, whereas the earlier locations from the vehicle trace are identical (which indicates that this is indeed the same vehicle). However, if the final position differs materially, it may be unclear whether it concerns one or more vehicles reporting the incident.

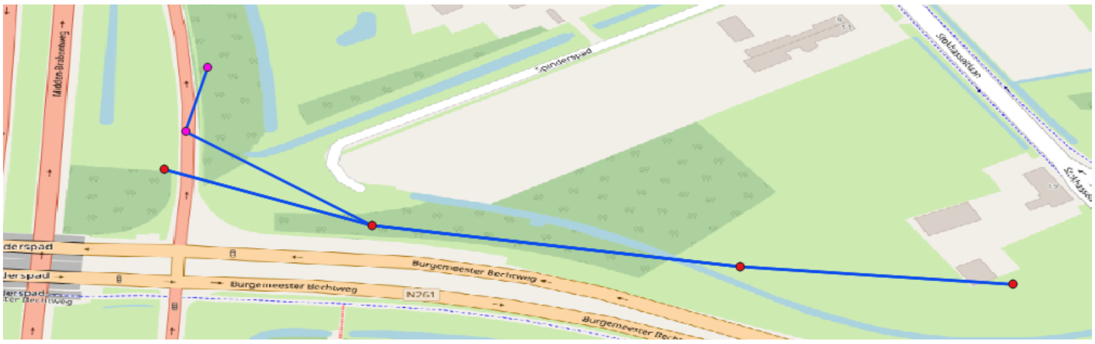
Figure 5.5 Example of 2 accident notifications with different (final) locations but the same time and party

5.2 Assessment of the Extended vehicle concept and use of standards

An assessment of the validity of messages was performed by NDW when messages were processed. In this context, messages (after a start-up period) were classified into either *valid* or *invalid*. NDW tested for logic of the times stated (not too old and not in the future) and validation of the XML and protobuf files against the corresponding schedules.

In this period, only one party had messages that NDW considered *invalid*. A random check shows that these are messages where the times mentioned are not consistent (for example, the start time of the incident is after the time of reception of the message. In total, this applied to 0.02% of the messages (approximately 2K of the 10M).

The Extended vehicle concept and the standards applied function well. This makes it possible to access vehicle data and share it with other parties within the ecosystem.

5.3 Analysis of the organisation of the NDW

For the PoC, NDW developed a system that is able to receive data from various L2 sources, after which data is anonymised and combined so that it can be purchased as a single data flow without a traceable supplier. For each supplying party, its own connection must be set up, because each party has its own API or delivery method.

The system is set up in such a way that processes do not affect each other if sufficient system resources are available. NDW monitors this.

Customers can be connected by NDW (on a message queue) to receive the data. The NDW viewer is now performing this task for demo purposes. These connections to the queue still have to be established manually (in the context of the PoC). Annexes 3 and 4 include figures of the high-level architecture of the ecosystem and the NDW organisation.

In addition to L2 systems, L3 systems were also set up. These also retrieve data from various sources and import these into a central database from which an up-to-date picture and updates can be provided to customers. This is currently being developed further, commissioned by the National Traffic Management Consultation (LVMB). The aim is to bring incidents and accidents in L3 into the NDW viewer and to be able to properly assess the usability of these data for the traffic centres.

During the PoC, one party retrieved L2 data from NDW for the generation and return of L3 data. In addition, Sweco had access to the L2 and L3 data for monitoring and evaluation purposes. Neither party experienced any problems in this respect.

To date, only the NDW viewer retrieved the L3 data stream. NDW is in the process of connecting the other parties to the L3 stream, but these parties still need to implement the correct DATEX protocol in order to be able to retrieve it.

5.4 Functioning of the ecosystem

The purpose of the DTF is to build a sustainable and scalable ecosystem for the creation and exchange of road safety data and road safety information. The ultimate functioning of the ecosystem consists of a hard/technical part (described in the other paragraphs) as well as a soft part, such as the collaboration between parties and the strategic importance of the party's services.

In order to assess the collaboration within the existing ecosystem and to give a glimpse of the future, two interviews were held: with ACEA on behalf of the OEMs and with TomTom from a Service Provider's perspective. A summary of the discussions is provided in the Annex.

During the PoC, the participating partners worked well together and the vehicle data was shared with all other parties in the ecosystem. In the interviews, both ACEA and Tom Tom indicated that the collaboration and sharing of each other's (vehicle) data are both of added value. This only makes the information more useful and relevant to the user. Prior to the DTF, it was also difficult to gain access to vehicle data.

It is important for parties to have free end-to-end use for the interest of the public and to have the application for road safety not be mixed with commercial applications such as asset management (for example measuring the quality of the road surface or the presence of traffic signs). The wish is to continue using the data only for SRTI.

ACEA considers data and information to be a new business for everyone. This translates into the need to further develop knowledge and have organisations adapt to this task. Positive steps have already been taken to this end in the PoC.

TomTom emphasises that traffic information is an operational service that must be available 24/7. Failures must be kept to a minimum. The chain must be as robust as possible without any unnecessary levels. It was sufficient for the PoC to demonstrate the functionality. However, this does need further improvement for the future.

5.5 Comparison of the quality with the current processes of road authorities

5.5.1 Location of the notifications

In order to determine the exact location from where various notifications are made, notifications are linked to the (nearest) road from the National Road File (NWB). This then determined the distribution of the various categories of notifications across the various types of road authorities. Across all notifications, more than 91% of the notifications take place on the municipal road network.

In case of the number of accidents, the share of motorways and provincial roads is greater. The distribution here is also more in line with the national distribution of traffic fatalities by road authority[3], but still underrepresenting motorways and a slight overrepresentation of provincial and municipal roads.

Table 5.4 Distribution of messages received by road manager and type

Number of messages per type of road authority

	Road Authority					
	National	Provincial	Municipal	Water Authority	Other	Grand Total
Accident	11,1%	14,8%	70,9%	3,3%		100,0%
Broken down vehicle	3,1%	2,7%	93,0%	1,1%	0,2%	100,0%
Emergency vehicle	100,0%					100,0%
Vehicle in difficulty	4,6%	2,6%	89,4%	1,6%	1,8%	100,0%
Grand Total	3,7%	2,7%	91,5%	1,3%	0,8%	100,0%

[3] SWOV, https://theseus.swov.nl, consulted on 5 August 2020. Accidents involving 1 or more passenger cars by road manager in 2018.

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5.5.2 Accidents and broken-down vehicles

With the available data, an analysis was made, in which vehicle notifications are linked to existing sources available to road authorities and Waze[4]. The difference in time and position between both sources was examined. This way it can be determined whether vehicle notifications result in time savings. Vehicle notifications may also result in additional notifications that do not appear in other sources.

In these notifications, a distinction was made between broken-down vehicles and accidents. Many broken-down vehicles occur on non-through roads on the underlying road network (non-continuous roads in residential and industrial areas). These broken-down vehicles are less relevant from a road safety point of view, because there is often no roadblock or dangerous situation on these roads due to the broken-down vehicle. On the other hand, accidents are always relevant, even on non-through roads on the underlying road network.

During the period of analysis, there were 17 vehicle notifications of **accidents** on motorways and provincial roads. Any double notifications were filtered. This number is relatively low because only one party supplied direct accident notifications, there was less traffic as a result of the Corona crisis, notifications were only matched in relation to provincial and national road networks and the accidents had to take place within the connected vehicle fleet of the party in question.

Of these 17 notifications, 3 vehicle notifications on motorways and 2 notifications on provincial roads could be linked to an SRTI message. The other 12 notifications could not be matched to an SRTI message and thus provided new information. It can also be concluded that vehicle data notifications are available sooner than SRTI messages, ranging from 7m 42s to 21m 48s in time saving. The average time saving is 11m 43s. A little nuance is in order, considering that traffic centres generally receive information on an incident a few minutes earlier than it is available in the SRTI feed. The difference in place varies from 0m to 495m, with an average distance of 195m between the vehicle notifications and the SRTI message.

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[4] NDW has an agreement with Waze to receive and supply data, which is why this source of crowd sourced data was also included in the analysis.

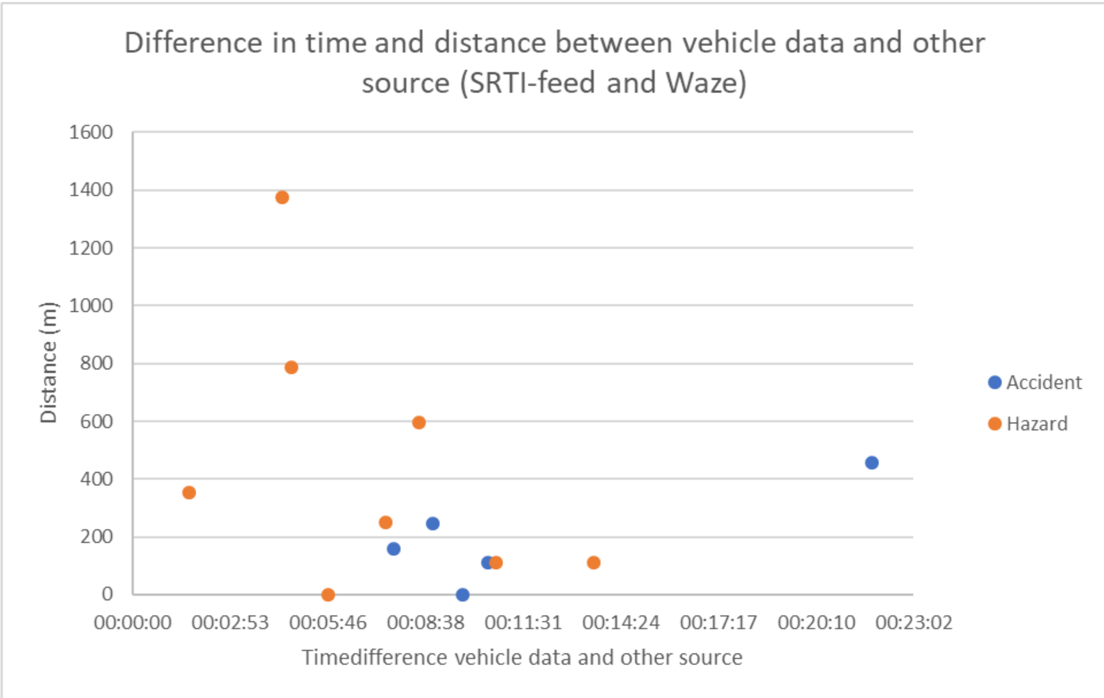

Figure 5.6 Spread in time difference and distance of matched accidents and broken-down vehicles

The following images contain 2 examples of notifications that could be linked.

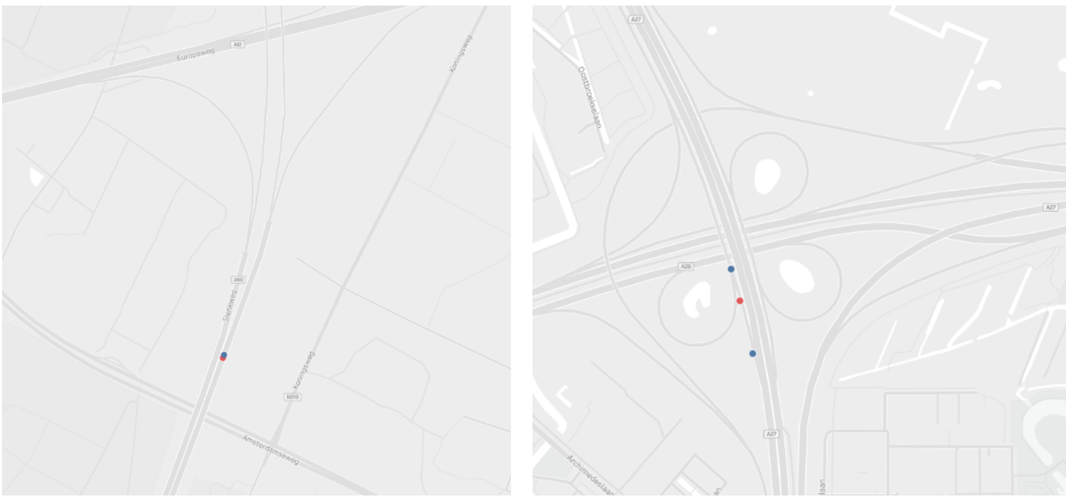

Figure 5.7 Examples of matched incidents (blue is vehicle data, red is SRTI message)

In addition to time saving relating to accidents on motorways and provincial roads, a significant part of the accidents also proved ‘invisible’ in the SRTI feed (and therefore also at the traffic centre and salvage services). This share is even larger for the underlying road network, where there is almost no insight into incidents from a traffic (information) point of view at all. During the months of June and July 2020, there had already been data on 300 accident notifications on municipal roads from only one party.

In addition to accidents, there are also **broken-down vehicle** notifications. The number of broken-down vehicle notifications is much higher than the number of accident notifications.

In this case, a considerable number of these notifications were false alarms (it turned out that there was no roadblock or obstacle), such as reporting a 'broken down vehicle' at a service area along a motorway.

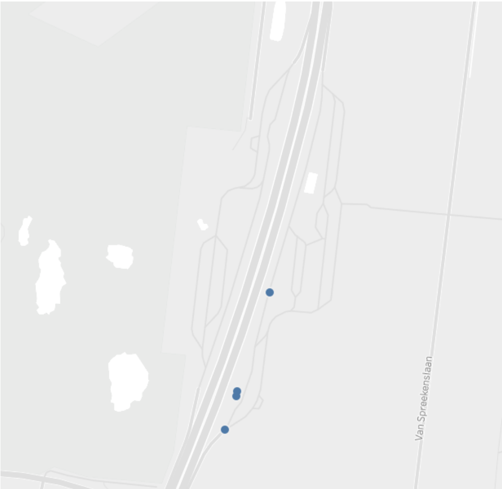

Figure 5.8 Example of broken down vehicles at a service area

32 *possible* matches were found manually among vehicle data and SRTI messages from NDW (a combination of notifications from road authorities and the Waze application, with which NDW closed a contract). In many cases, it is still uncertain whether this actually involves the same broken-down vehicle, or whether by coincidence several broken-down vehicles were discovered nearby, and within a short period of time. This means that there is a need for more insight into how the notification comes about. If we assume that all matched broken-down vehicles in which the vehicle notification comes less than 1 hour earlier than the SRTI or Waze message all belong together, then if a strict selection is made, the average time saving of notifications based on vehicle data is 7.5 minutes. Faster detection and handling of broken-down vehicles results in less traffic jams, as well as a smaller risk of accidents resulting from stationary vehicles.

5.5.3 Temporarily slippery roads

The number of notifications for *Adverse weather condition* and *Slippery Road* and the average precipitation in the Netherlands per day over the months of January - July 2020 were also considered. The longer period of analysis was used in order to prevent the analysis from only dealing with the relatively warm and dry summer months. The graph below shows a fairly good connection between the two. Differences can still be a result of the time of precipitation (more vehicles in rush hour, more notifications) and differences between various parts of the Netherlands (local precipitation does not have much influence on the national average).

Clearly visible, for example, is the low number of vehicle notifications in the period between mid-March and mid-April 2020, when it did not rain as much in the Netherlands.
From the end of April, the number of parties increased from two to six, which also led to an additional increase in the number of notifications.

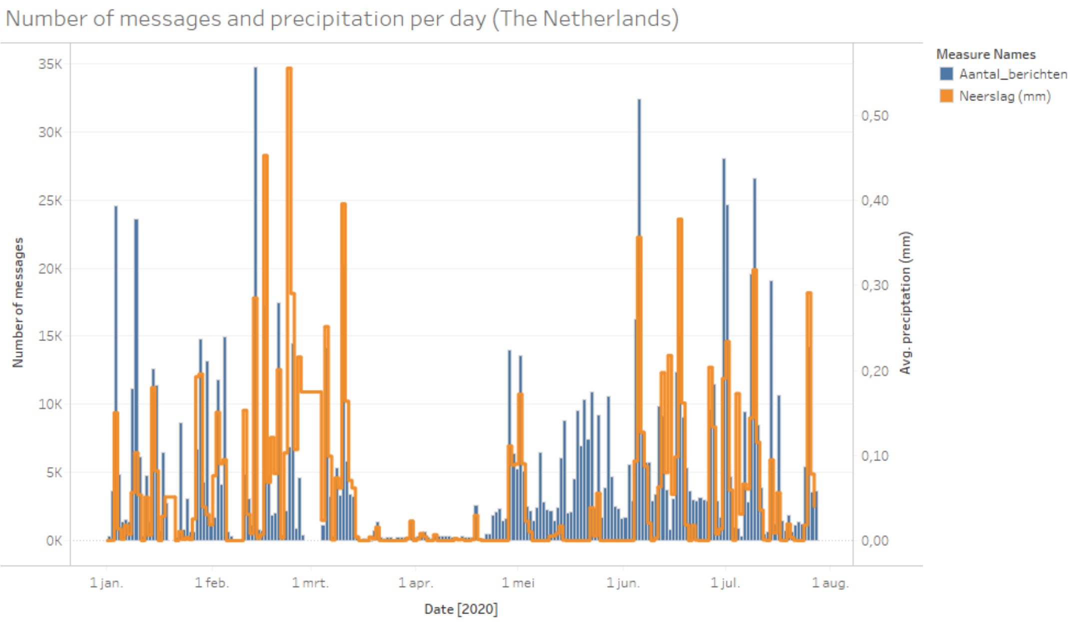

Figure 5.9 Number of messages (adverse weather condition and slippery road) and precipitation per day

The correlation is often less clear per hour on a specific day, but the precipitation differences per region compared to the national average are a stronger factor. In this case, too, the number of notifications is highly dependent on the number of vehicles on the road, as a result of which, for example, at night, there are always fewer notifications than during rush hour.

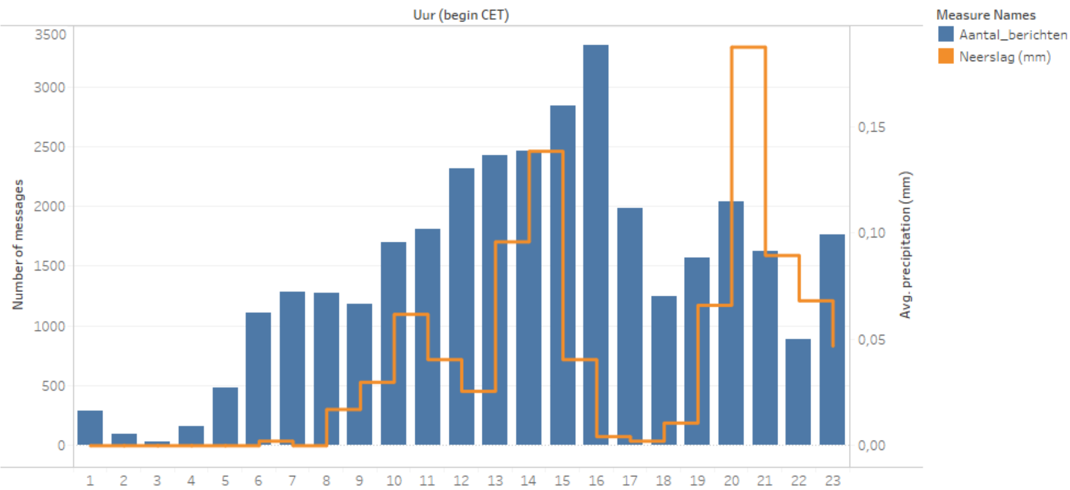

Figure 5.10 Example of the number of messages and precipitation per hour(Netherlands)

If we compare the notifications of slippery roads of all Parties together with the weather situation onBuienradar.nl, we see a clear similarity. The concentration of notifications relating to Slippery Roads thus gives a good indication of heavier rain. The images below show the precipitation on 27 July 2020 and the notifications in the *Slippery Road* category. Only notifications in the Netherlands are shown in these images.

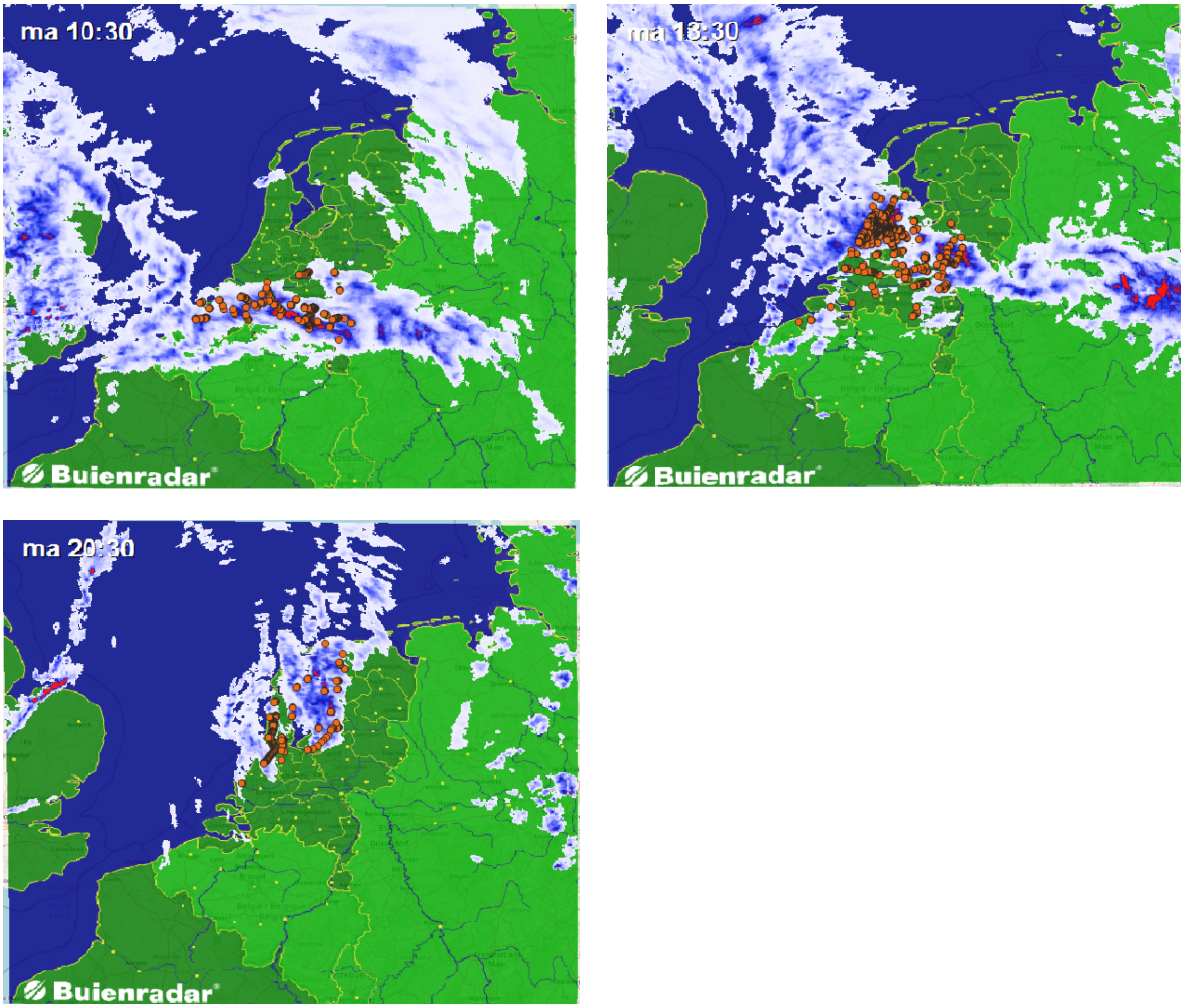

Figure 5.11 Examples of the relationship between (heavy) rain and notifications of Adverse weather condition and Slippery road

5.5.4 Reduced visibility

One fog notification was received during the period of analysis. Of course, fog is also partly dependent on the season and less common in summer time. This one fog notification concerned a stationary vehicle on a parking lot, around 13:00h. Fog at that time is not very likely. In the minutes prior to the notification, several notifications were also sent at the same location for *adverseWeatherCondition: Precipitation*.

This one notification is insufficient to be able to make a proper statement about the reliability and value of reduced visibility notifications.

6. Conclusions and recommendations

6.1 Conclusions

The previous chapters describe the monitoring phase and the evaluation of the functioning of the chain. This chapter summarises the findings and results on each topic.

Contributing to the creation and/or improvement of safety warnings
During the PoC, more and more parties joined the ecosystem. In total, there are three parties that supply L2 data, and three that supply L3 data.

The parties all provide a different set of types of notifications. Most parties focus on 1 or 2 types of notifications. One OEM provides 4 types of notifications. Temporary slippery road is the most common in this respect, followed by broken-down vehicles. Only one party supplies accident data and only one party supplies reduced visibility data. There is only one fog notification, which, however, is considered unreliable. Based on this one notification, no definitive conclusion can be drawn as to the reliability and usability.

The temporary slippery road notifications cannot be immediately forwarded as an SRTI message. Although the notifications can easily be correlated with the precipitation data, it is mainly the large number of notifications that require post-processing (clustering and filtering).

As a result, vehicle data currently mainly contribute to information about:

- Unprotected accident area;
- Animals/people/obstacles/debris on the road (broken-down vehicle).

In the case of post-processing, there is also information on:

- Temporarily slippery roads;
- Exceptional weather conditions;
- Reduced visibility.

Vehicle data do not yet contribute to the following notifications:

- Short-term road works;
- Unmanaged blockage of a road;
- Wrong-way driver.

One of the reasons for the absence of these last three types of SRTI messages is that they are created on the basis of object recognition by the vehicle (such as visual observation of traffic signs). Only a limited part of the fleet is currently equipped with this functionality. At the same time, these are the types of notifications that are available within the public domain. The public and private partners therefore complement each other in this respect.

Quality, availability and timeliness of data
Once the provision of data from all parties was in progress, the data was of good quality. During the PoC, each party was unable to supply any data on one or more days, but in a number of cases this was also due to NDW or due to a change in the specifications. In general, the provision of data is constant and stable.

Vehicle traces are also included in L2 messages. These are coordinates of a few seconds before (and sometimes also after) the report. This makes it possible to determine the vehicle position more accurately, for example in order to determine on which lane the vehicle is located at a traffic junction. The traces can be used for L3 data. With one party, the accuracy of the vehicle trace is unsatisfactory and, as a result, cannot be used. The reason lies in the short period of time between the positions (as a result of which they are located together) and the last of which cannot be used.

With regard to timeliness, the latency was examined (the time between the incident as registered by the vehicle and the time the message is made available on the NDW server). In doing so, the time it takes for a notification to be created in the vehicle until the time at which the message is received by NDW was examined. The analysis shows that 52% of the messages are received within 5 seconds, 85% within 1 minutes and 96% within 5 minutes. L3 notifications may have a much higher latency of 1 to 5 minutes. This is because one of the parties first purchases these from NDW and then returns them. However, the original time of the incident is retained.

For road safety-related messages, in general the faster the notification is known, the faster road users can be warned and the smaller the risk of the occurrence of an unsafe situation or even an accident. The 85% of messages that arrive within 1 minute are certainly suitable for this. Messages with a latency of more than 5 minutes are less suitable and may also be outdated in some cases (depending on the type of notification) or already known via another source (depending on the road type).

Assessment of the Extended vehicle concept and use of standards
During the PoC, NDW performed a check on the validity of messages. Only temporary incidental deviations were observed in this respect.

The data standard SENSORIS is used by two of the Level 2 parties. The third party uses SDII, but this party is also expected to transfer to SENSORIS. SENSORIS does not indicate how sensor data is derived, this differs between parties and depends on, e.g., the software and hardware used and reliability intervals used. At present, it is still unclear to the parties that are to create L3 data from this exactly how notifications will be effected. The L3 messages comply with DATEX-II.

Final conclusion is that both the Extended vehicle concept and the standards applied function properly. This makes it possible to access the vehicle data and share it with other parties within the ecosystem.

Set-up of the NAP and purchase of the portal by private parties
During the PoC, all parties were able to supply data to NDW, which implements the NAP on behalf of the Netherlands. NDW did develop its own specific connection for each party, partly because of the difference in standards that are still being used (and that are accepted). This means that development work is needed to connect new parties.

During the PoC, two parties used L2 data from NDW. One party for the purpose of generating L3 data and Sweco for this monitoring and evaluation assignment. Neither party experienced any problems in this respect. NDW is therefore ready for delivery and distributing to private parties.

To date, only the NDW viewer retrieves the L3 data stream. NDW is in the process of connecting TomTom and TMFG to the L3 stream, but they still need to implement the correct DATEX protocol to be able to retrieve these.

One of the reasons for the limited uptake is that end users, such as road users and traffic centres, mainly need L3 data. Most of the parties that are now part of the ecosystem act as data supplier and are not in the role of service creator or service provider. NDW is working on generating L3 data itself (on the instructions of the National Traffic Management Consultation) and also showing them in the short term in the NDW viewer and thus bringing them to public users such as Rijkswaterstaat and provincial and municipal road authorities.

In the interview, TomTom indicated that it was pleased with the role of NDW as NAP. The NDW gave them easy and reliable access to data of various parties. They would also like to see the data in other Member States made available in a similar manner, or, even better, in a single European Access Point.

Functioning of the ecosystem
The purpose of the DTF is to build a sustainable and scalable ecosystem for the creation and exchange of road safety data and road safety information.
During the PoC, the participating parties worked together and the vehicle data was shared with all other parties in the ecosystem. There have been no significant events such as a failure or delay in delivery.

In order to gain insight into how the parties experienced the PoC and the ecosystem, two interviews were held. One with the umbrella organisation of OEMs (ACEA) from the perspective of a data supplier and one with a service provider (TomTom) as purchaser of data and supplier of L3 data.

Both partners are positive about the DTF, the PoC and the ecosystem that was created. Although much coordination was still needed in the run-up, the partners got to know each other better and worked well together. The maturity of the organisations (operational readiness) in this area has increased and during the pilot, all partners shared data to a greater or lesser extent, for several months and for several types of notifications.

The partners interviewed are satisfied with the role of NDW as a neutral aggregator and the stability and reliability they deliver in the chain.

Both partners believe that the data supply and exchange must be continued after completion of the PoC in terms of functionality. It is important to maintain the focus on the eight SRTI messages without extending to other types of notifications or use cases. Both see great added value in the joining of new parties, such as more OEMs and more service providers. The more data the better. The principle of reciprocity has added value for both partners interviewed.

However, efforts are still required to make large-scale upscaling possible within the Member States and at the European level. Not all parts of the chain have been sufficiently developed and are ready for large quantities of data. This is necessary for a stable provision of services to end users.

Comparison with the current information available from road authorities
For this research question, the vehicle notifications were compared to SRTI messages based on other data sources, provided by the Ministry of Infrastructure and Water Management (UDLS) and Waze. The analysis was performed for June and July 2020. This matching of notifications to existing sources was focussing on broken-down vehicles and accidents.

Over all notifications, more than 91% of vehicle notifications take place on the municipal road network. Although these may include many useful notifications, these notifications could not be validated with the existing SRTI sources because they are only available on the national and provincial road network.

Only 1 party delivered reports of **accidents** during the PoC. In the period analysed, there were 17 vehicle notifications of accidents on motorways and provincial roads. Of these 17 notifications, 3 vehicle notifications on motorways and 2 notifications on provincial roads could be linked to an SRTI message.

12 of the 17 notifications therefore provide new information. The only limitation in the analysis is that it is now unclear on the basis of which criteria the vehicle generates an accident notification and how serious the accident is. It is possible, for example, that the accident is less serious and that it is possible to drive on without the intervention of salvage services or emergency services. These smaller accidents are now not included in the accident registration. If notifications are assumed to be correct, the L2 data offer a large number of new potential SRTI messages from a larger area than from which notifications are now available. Especially on the provincial and urban road network, a limited number of accident reports are now available. Vehicle data provide a major new source of information and are therefore of added value.

This is positive for the (quicker) deployment of emergency workers, but also for road safety. Because the location of these accidents (and also broken-down vehicles) can be passed on to service providers, they can also use these to issue warnings for road users. Earlier evaluation studies on in-car notifications show that road users adjust their speed in a timely fashion in the event of in-car notifications of accidents and broken-down vehicles[5]. This, in turn, results in a lower chance of (follow-up) accidents.

Finally, it can be concluded that accident notifications are received earlier than SRTI messages from the existing sources, ranging from 7m 42s to 21m 48s in time saving. The average time saving amounts to 11m 43s. The difference in location varies from 0m to 495m, with an average distance of 195m between the vehicle notifications and the SRTI message.

In addition to accidents, there are also **broken-down vehicle** notifications. The number of broken-down vehicle notifications is much higher than the number of accident notifications. A significant part of these notifications do not involve an actual roadblock. This involves, for example, reporting to a care centre along the motorway. 32 *possible* matches were found manually between vehicle data and notifications from Waze/SRTI. In many cases, it is still uncertain whether this actually involves the same broken-down vehicle, or whether by coincidence several broken-down vehicles were discovered nearby, and within a short period of time. There is a need for more insight into the emergence of the notification. In a strict selection of the broken-down vehicles that could be matched, the time saving was 7.5 minutes compared to the existing sources. In order to be used as an SRTI notification, a subsequent processing must be done on the data (such as on-site check and filtering).

The average incident duration of an accident or a broken-down vehicle is around 45 minutes[6]. If we assume that an incident – on an average basis - is known in the traffic centres 3 minutes earlier than it is available in the SRTI feed, this is still a potential reduction

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[5] BeMobile, *Evaluatie opvolggedrag en impact* (Evaluation follow-up behaviour and impact)*; Talking Traffic*, 10 July 2020

[6] De Verkeersonderneming, Final report *Optimalisatie incidentafhandeling in de regio Rotterdam* (Optimisation of incident handling in the Rotterdam region) *Beter Benutten Vervolg, 2017 – 2018*, October 2019

of the average incident duration of 19% in the event of accidents and 10% in the event of a broken-down vehicle due to a shorter detection time.

6.2 Recommendations

More insight into the creation of reports increases the usability
It is currently still unclear on the basis of which sensors and triggers L2 messages (events) are generated. There will also be differences between vehicle manufacturers. For road authorities and parties who create L3, when processing the information, it is useful to know what the reason is for notifications, so that the correct action can be taken. For example, it is now unclear how a broken-down vehicle or temporary slippery road is defined.

It is recommended to get more insight into the emergence of these L2 messages and perhaps reach some degree of uniformity on this. For example, filtering (at geographical locations, such as care facilities) or cross checks (with notifications from other vehicles) can be made possible. This may contribute to a further increase in the reliability of reports. Reports can therefore better be used as a supplement to the current accident registration.

L2 data for accidents and broken-down vehicles are already easily usable
The notifications regarding accidents are already useful for generating SRTI messages. Service providers can create reliable SRTI messages by checking, for example, Floating Car Data. For broken-down vehicles, this can be done by relatively simple filtering and checks for areas of interest, such as for through roads with a flow function (in accordance with Sustainable Safety).

Ready for new parties joining the ecosystem
All partners are positive about the ecosystem and indicate that it is desirable for others to join. The advice is to actively invite new partners to do so. With more OEMs and service providers, more data becomes available, resulting in greater coverage of notifications and reliable information. Private parties indicate that no immediate expansion in use cases is desired: they want to stick to the current eight SRTI messages. The newly signed multi party agreement provides an important basis for the continued development of the ecosystem. Member States can support this by actively recruiting new partners.

Extension of types of SRTI messages
At present, only a limited type of SRTI messages are shared per party. It is recommended that further discussions be held with these parties regarding an expansion within the eight SRTI alerts.

Continued development of chain and standards
All vehicle manufacturers are currently further developing the data infrastructure required for the large-scale roll-out of data sharing. During the PoC, it was demonstrated that the chain functions properly and that the standards applied are effective. Some partners are more involved in the roll-out in this context than others. A further development of the chain is recommended in order to facilitate a large-scale roll-out with 24/7 services.

Development of NAPs in the Member States
There is a difference in the way Member States have set up their National Access Point. In the long term, a European Access Point may be an option. The parties are still unclear about this possibility. It is recommended to further develop the organisation of the NAPs in

the Member States, to cooperatie between the NAPs and to come up with a possible proposal for a European NAP.

Development and dissemination of L3 SRTI messages
The L3 data is necessary to send actual warnings to road users and thus contribute to road safety. The NDW is ready to provide for this as an NAP

Three parties currently supply L3 data to NDW. In addition, a lot of L2 data is also supplied to NDW, which is not yet converted and transmitted as L3. NDW is in the process of generating L3 data on the instructions of Dutch road authorities. This allows for example traffic centres to take traffic management measures such as warning road users (broadcast) and managing road inspectors and/or emergency services. The vehicle data is therefore an important source for notifications on both the national and municipal road networks as well as the provincial road network. It is recommended to further expand the number of L3 reports.
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Strength in collaboration
Vehicle data are an important new source for SRTI reports. But not all categories are now covered by vehicle data. Vehicle data do not yet contribute to short-term road works, wrong-way drivers and unmanaged blockage of a road. This information is currently (partly) available to the public parties. Together, it is possible to obtain a more complete overview of the eight types of SRTI reports. The advice is to have these additional public data to become available for the ecosystem, for example by NDW as L3 data.

Annex 1 Report of interview ACEA

The ACEA is a branch organisation of European car manufacturers. This interview was held on 28 August 2020 with Mr Van Tomme, Director of Smart Mobility. Mr Van Tomme has been involved from the very beginning in setting up the DTF and putting various topics on the map at a European level and in various Member States. In doing so, ACEA plays the role of representing the various parties vis-à-vis the world of politics, but also vis-à-vis its own members, to draw attention to and explain new EU directives.

The reasons for ACEA to participate in the DTF are both of a technological and operational nature. It is a new field of work that is in full development. ACEA wants to work proactively with road authorities and play a role in this development by participating in round table discussions with governments and the EU.

Partners want to contribute to road safety and consider this to be of value to their customers. The provision of road safety information in the vehicle is part of this. Partners are also working on algorithms for automated driving. Vehicles are increasingly taking decisions themselves. Vehicle data is of added value for this purpose, such as information on closed roads, bad weather and fog. The added value of this is particularly important for freight traffic.

Experiences during the PoC
ACEA looks back on the PoC from a positive perspective. Various new partners were added during the period, including a number of competitors. The parties got to know each other and confidence increased. It is positive that it is a public-private partnership created by industry and Member States, and not a top-down initiative from the EU: the EU has adopted a neutral role. It was a cooperative collaboration in which everyone added something to the ecosystem, as a result of which value has indeed been added. The end users (road users) gain from this by an improved supply of information.

The ACEA considers data and information to be new business for everyone. This translates into the need to further develop knowledge and adapt organisations. Steps have been taken in this regard.

The start-up and contractual recording in the MoU took longer than expected. Subsequently, a Licence Agreement was drawn up as a follow-up to the MoU, which also describes the governance. Important to the partners is a free end-to-end use of the data for public interest and road safety and to have these data not automatically be used for commercially profitable use cases such as asset management, for which governments are now purchasing data from OEMs and other parties. The ACEA has a problem with messages being bundled, passed on and sold as a commercial service.

Developments and a glimpse of the future
There is a difference in operational readiness between parties, both in developments in the vehicle and in back-end for data collection and processing. First, the above data infrastructure (cloud environment) must be ready, after which vehicles will follow.

A number of partners are now in the process of adapting the organisation to these developments. The premium brands in particular are actively involved in this. For example, the VW group and Car.Software set up an independent business unit for the entire group. It will be a commodity within 4-5 years. But other brands are also increasingly active in this respect.

ACEA is curious about the developments surrounding the European Federation of NAPs.

It is important for parties that all partners cooperate in the ecosystem and add value by sharing each other's vehicle data. This only makes the information more useful and relevant to the user.

If the structure of the DTF remains as it is, ACEA expects an increasing interest, possibly also from new players such as large tech companies (which are now involved in the development of cloud services for parties behind the scenes). The Ministry could support this by pooling the various sources of information from different angles. The more users and data, the greater the added value.

Annex 2 Report of TomTom interview

This interview was held on 31 August 2020 with Stephanie Leonard (spokesperson for the European projects), Donald Leckie (Architect FCD Platform) and Robin Tenhagen (Software Engineer Live Traffic and participant in the technical meetings).

TomTom's role in the Data Task Force is that of service provider. They receive L2 data, enrich it with other data sources and make L3 data from it that they distribute via various channels.

TomTom's reason for participating in the DTF was to be part of the implementation and to be ‘compatible’ with it. Prior to the DTF, it was difficult to gain access to vehicle data. TomTom wants to use data in its own services. Improving road safety and informing road users is part of their services.

Experiences during the pilot
TomTom looks back on the PoC from a positive angle. At the beginning, some time was lost by coordinating and discussing roles and definitions (such as L2 and L2’). They thought that this would have already been better coordinated. Not all of the partners had made equal progress with the implementation of the data infrastructure and still had a limited number of use-cases.

The Netherlands has NDW as NAP. However, not all countries have organised this in a similar way. In some Member States, there only was a web portal. Diversity in the implementation and approach of the NAPs costs a party like TomTom more trouble to collect data from the participating Member States. At the beginning, there were also some technical problems. In addition, not all notifications could be properly correlated. In the meantime, all of these problems have been resolved.

HERE has played the role of Aggregator in the ecosystem. TomTom is reluctant to collect data from a party that is also a competitor. TomTom is therefore pleased with a neutral party (also) receiving the data.

Some APIs where TomTom must retrieve data are outdated. The data is not ‘pushed’ but must be retrieved for a specific geographical area. Currently, the realised data infrastructure is not yet scalable. TomTom emphasises that traffic information must be considered an operational service that must be available 24/7. Failures must be kept to a minimum. The chain must be as robust as possible without any unnecessary levels. With respect to the PoC it was sufficient to demonstrate the functionality of the chain. This needs to be improved for the future.

Use of L2 data
TomTom is interested in all types of notifications and collects as much data as possible to make this into L3 by:

- Collecting data from various sources in the Fusion Engine;
- Clustering of events such as accidents;
- Depending on the type of notification, validating with the traffic situation (from FCD);
- Determining events.

TomTom regards L2 data to be a valuable addition to data they now have at their disposal, for example the ABS notifications. There are already other sources for incidents and weather conditions, for example. However, vehicle data can, for example, contribute to greater accuracy or to reducing latency.

The data is not yet used in algorithms relating to, for example, the choice of route. A point of attention for TomTom is the comprehensibility of notifications for road users. The information must be clear at a glance and the driver must be able to process it within a few seconds. It should not become too complex. The L3 data is distributed via Live Traffic, navigation systems and on the vehicle dashboard.

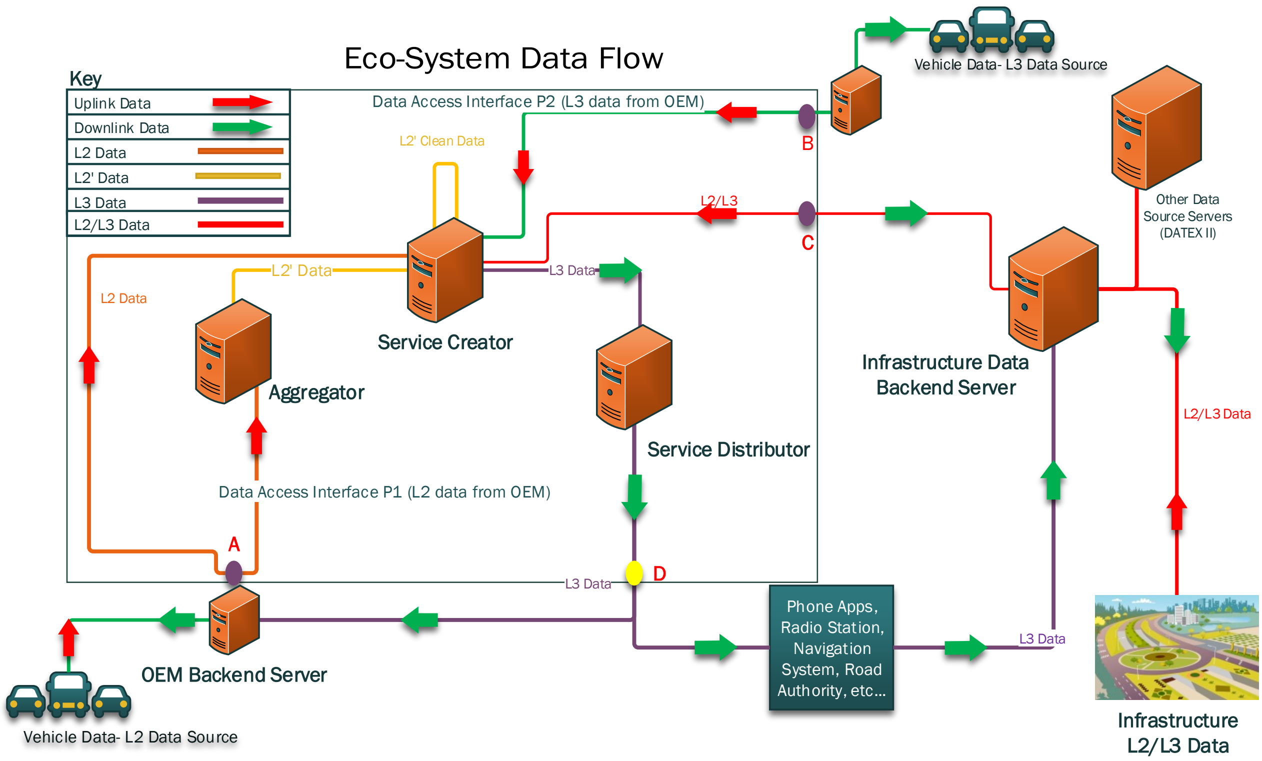
Future of the ecosystem
TomTom would like to see more parties join the DTF. The more OEMs, Member States and Service Providers, the better. TomTom would like to see the eight current use cases maintained and not expanded.

TomTom is pleased with the role of NDW as NAP and would like to see this set-up in other Member States as well. An umbrella organisation would be TomTom's preference. The fewer connection points for TomTom, the better. Data handling and scalability are important in this context.

Point of attention is clarity about the content of notifications. There is a difference between parties. More uniformity is considered to be good.

L3 data from other partners is less relevant to TomTom. At most to validate the own notifications.

Annex 3 Ecosystem architecture



SWECO

Annex 4 Organisation NDW