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Exchange of operationally valuable and safety-critical data within ecosystems

Jani Kariniemi*, Olli Rossi[2], Tomi Laine[3], Mika Ahvenainen[4], Jani Laiho[5]

1. Fintraffic Road Ltd; jani.kariniemi@fintraffic.fi

2. Fintraffic Road Ltd; olli.rossi@fintraffic.fi

3. Traficon Ltd, Finland; tomi.laine@traficon.fi

4. Traffic Management Company Fintraffic Ltd; mika.ahvenainen@fintraffic.fi

5. Fintraffic Road Ltd; jani.laiho@fintraffic.fi

Abstract

There are several national and international ecosystems that cater for close cooperation between public road operators and different industry players such as OEMs, service providers and logistics operators in exchange of safety-critical real-time event and road condition information. The paper analyses what added value the use of the available 3rd party datasets can bring to road operators, and how these datasets could be fused together and with traditional sources to provide new, high quality data feed for both operational traffic management and safety-related traffic information services. The paper will highlight the results of several either implemented or planned concrete use cases in Fintraffic Road Ltd's development work showing best practises what is needed to fully exploit the benefits of working with ecosystems, including the recent initiative to develop machine-learning based dynamic accident risk predictions.

Keywords:

Data exchange, Safety-Related traffic information, Ecosystems, Virtual VMS, Machine learning

Background and objectives

The EU Commission's delegated regulation on the provision of safety-related traffic information (SRTI) entered into force ten years ago on October 1, 2013. The regulation obliges road authorities and service providers to share and exchange the data they collect and make it available in a standardised format through the national access point (NAP). In 2020, the European Ministers of Transport together with industry players established the Data for Road Safety ecosystem to cater for the requirements of the Delegated Regulation and to facilitate the use of in-vehicle data for the creation of Safety Related Traffic Information. Data is exchanged within the SRTI Ecosystem for the sole purpose of road safety, without any financial compensation between the parties and within the agreed data privacy policy following the principle of reciprocity.

In addition, there are several other data ecosystems such as Waze for Cities in operation that offer operationally relevant real-time data for road operators. On national level, Fintraffic has established their own data ecosystem to foster development and exchange of traffic data with different players in the industry. In addition, Fintraffic has initiated so called 'Traffic Data Exports Cluster' which aims to help Finnish companies working with traffic data related products in their internationalisation efforts. The cluster has received funding from Business Finland.

The objective of this paper is to analyse what added value the use of the available 3rd party datasets can bring to road operators, and how these data could be fused together and with traditional sources to provide new, high quality data feed for both operational traffic management and safety-related traffic information services. The paper will highlight the results by several either implemented or planned concrete use cases. The planned implementations are part of the 'Digital Road' development initiative in Fintraffic Road Ltd, the National Road Operator in Finland.

Current status of data exchange and 3rd party data usage

Currently Fintraffic's operational situational awareness and information services provision is lying mostly on information provided by roadside equipment such as induction loops, traffic cameras and road weather stations. Regarding traffic incidents, there is a direct data exchange with Emergency Response Centre that sends information on traffic accidents that require authorities' intervention. In addition, the Emergency Response Centre has published "112 Finland" mobile application, through which drivers can directly call to the TMC to report an incident/road damage with accurate location information. In return, drivers can receive information of active traffic incident events in their vicinity through the application. The application has been downloaded 2 million times, so it may be used by most of the drivers in Finland. In addition, Fintraffic receives data on the ongoing winter maintenance activities from contractors' vehicles and have bought services from meteorological service providers.

Recently Fintraffic has been developing its data exchange practices with the Emergency Response Centre. There is a great value in the Ecall data that is currently received only in the Emergency Response Centre. Ecall datafields that would offer added value for SRTI warnings production are at least time stamp, coordinates, driving direction and vehicle class. The next steps in this development include studying the legislative constraints for data sharing as well as the technical solution to deliver the Ecall data to the traffic management centre. Addition to that, we are planning to add more information and datafields on Emergency Responce center

integration to allow faster operations and higher automation level in traffic management.

Fintraffic has partnered with Waze through the Waze for Cities ecosystem. The purpose of the broader ecosystem program is to help the users of the application and cities/road authorities to cooperate in order to exchange traffic information more widely than before. Waze's operating model is that it aggregates the observation data it receives from its users and authority partners on its own platform and distributes the resulting high-quality situational data for use by partners. The authority may use the data internally in the traffic management infrastructure and control centers to improve traffic conditions. Currently Fintraffic has integrated the travel time information provided from the Waze API to the operation system of the traffic management centre, helping the operators to form an accurate picture of the real-time flow and congestion. In addition, the Waze travel time information API is used on the roadside VMSs on Ring Road III in the Helsinki Region. This is a novel approach that can provide significant cost savings compared to previous data collection methods.

Figure – Presentation of travel time delays derived from Waze's travel time data in the VMSs on Ring Road III.

Regarding DfRS-ecosystem's data exchange, Fintraffic is currently providing safety-related data to ecosystem partners about unprotected accident scenes, road works and road weather stations through the national access point Digitraffic. Fintraffic is also preparing to use the available data from different ecosystem partners. In 2023 Fintraffic implemented a market study which proved that there are already potentially valuable data available for the ecosystem partners. One of the most valuable available datasets was the 'temporary slippery road' warnings that an OEM in the ecosystem produces from the in-vehicle systems and shares in an aggregated form

(so called L3 data) to ecosystem partners. Fintraffic received a sample dataset from an OEM covering all slippery road warnings from the whole Finland during January 2024. The dataset contained 2,4 million individual warnings derived from passenger cars. The locations of warnings can be seen in the heat map below, which shows that the warnings are concentrated around the large city regions and on the main highways where the traffic volumes are highest. The highest daily peaks occurred during days when there was a rapid temperature change or snowfall causing potential slipperiness.

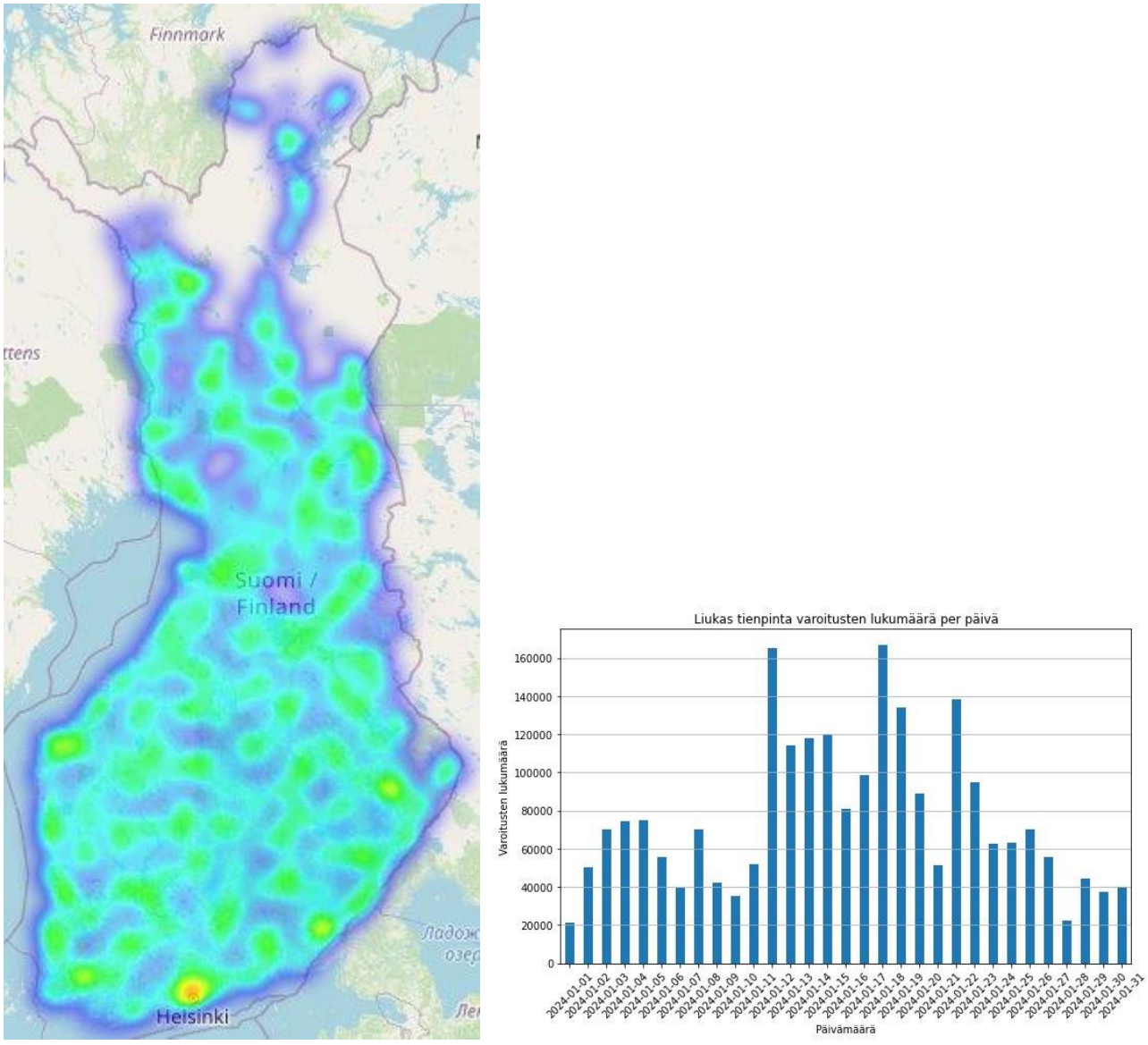

Figure – Geographical and daily occurrences of slippery road in the OEM SRTI data.

In a more detailed validation that was implemented by Antti Karhunen at Solutra Ltd the occurrence of slippery road warnings in the OEM sample data was compared to the slippery road warnings and friction measurements produced from the nearby road weather stations. This comparison proved that most of the slippery road warnings in the OEM vehicle data occurred during times when the measured friction was also low. However there were differences in correlation of the two datasets between studied locations.

In the OEM data there were also an amount of warnings at times when no low friction was measured. There is an preliminary indication that partial cause for this may be the fact that the friction measurement is made only from the main driving lane, in which the friction may be higher than on the passing lane which may be more covered in frost or ice due to less traffic volume. OEM measurements are naturally made from all lanes which may explain this difference, which leads to the conclusion that OEM's slippery road warnings could be used as a secondary data source to complement road weather stations data to all lanes and to road stretches where no weather stations exist.

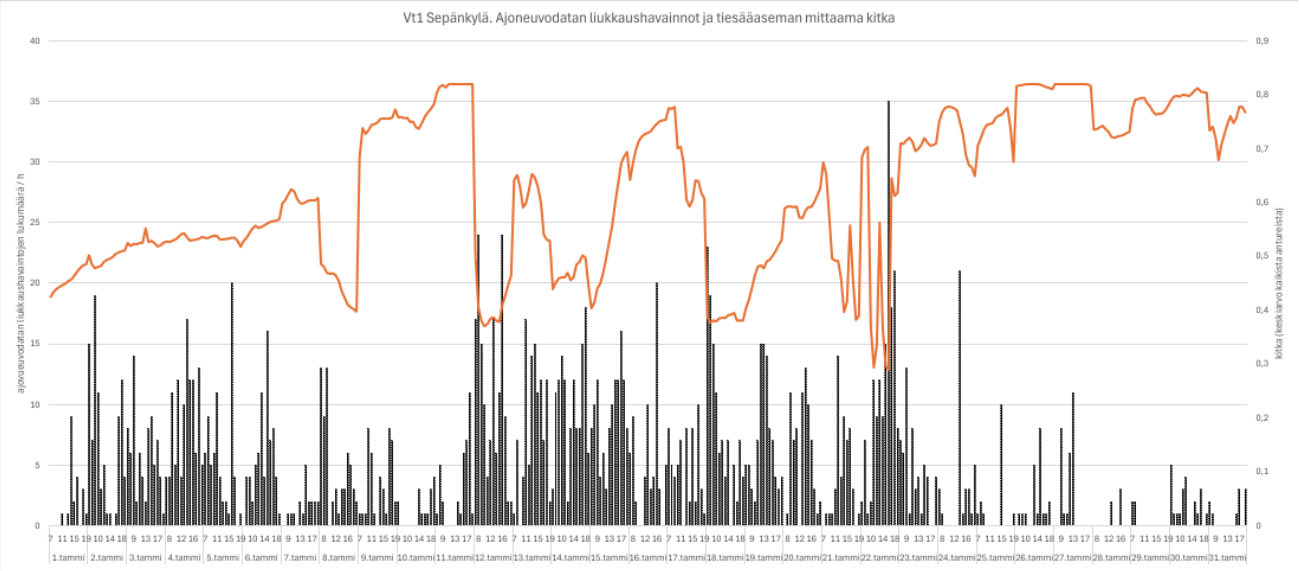

Figure – Comparison between the OEM slippery road warnings (black) and measured friction level (orange) at the nearby road weather station.

The preliminary conclusion from the data validation is that even though Fintraffic cannot solely rely on the OEM slipperiness data to accurately define the location/severity of slipperiness for operational purposes, the data can be used to validate the slipperiness warnings generated from traditional measurements and their analytics. Data can also be used to expand the road weather monitoring to the whole cross-section of the road (all lanes) and also to generate network-level (or link-level) slipperiness warnings when the data is fused to point-based slipperiness measurements from weather stations. The fusioning of the existing measurement data and analytics with the vehicle generated warnings, and also other data sources such as weather models, would be the next step in the development process. A note was made in the validation that the vehicle generated warning data would be more useful for the road operator if the data contained information about the actual friction or information of the severity of slipperiness.

Potential of speed data created with FCD-method

Fintraffic is currently validating speed data from different sources and planning a model to integrate new data with existing comprehensive traffic volume recording services such as a) control point-specific recording of traffic volumes, b) measurement of travel times and traffic flow, c) general traffic volume measurement, d) regional light traffic volume recording. We have analysed available real-time traffic speed data from various vendors. Our focus is to use Floating car data to refine actual speed information for road network and get more

precise speed information to our traffic operators. After inspecting data by means of coverage, estimated vehicle amounts, Spatial resolution and Temporal coverage we see that data is precise and it can be used for traffic management center operational work and applications. Some of the benefits would be – Better information on friction and driving conditions for citizens and transport companies - Possibility to improve safety by targeting treatment measures at problem areas - Possibility to save on treatment costs by optimizing procedures.

Dynamic Routing in cooperation with service providers

As part of Real-Time Traffic Information Delegated Regulation RTTI DR 2022/670 development in the traffic information ecosystem, the key use cases were reconfirmed to be :

1. Maximum speed (relevant for ISA)
2. Road works and road closures
3. Car routing (traffic circulation plans, traffic management measures, school and environmental zones).

Dynamic routing is not simple black and/or white case on operative traffic management. We have started discussion about digital routing possibilities with navigation companies, about how we could apply somewhat dynamic routing based on traffic circulation planning information.

Further use of 3rd party data in the enrichment of operational traffic management and information services

Fintraffic has prepared a study of different 3rd party datasets and evaluate the added value they could offer both to the traffic management processes as well as information services provision. The study covered the following new data sources:

- Use of internal data products (road weather info and traffic situation info products) in the provision of SRTI-warnings
- Use of ECall-data in cooperation with the Emergency Response centre
- Use of Waze's crowdsourced incident information API
- Wide usage of different SRTI-messages derived from DfRS ecosystem's aggregated feeds
- Data from road maintenance contractors' vehicles
- Data from national ecosystem partnerships such as from bus operators' or logistics companies vehicles.

Fintraffic has recently developed two "internal" products, i.e. road weather information and traffic situation information products, that after a validation period will be used in the operation of VMSs as well as variable speed limits, as they bring an improved capability to react quickly to the changing conditions. In addition, they will be important engines in developing the respective SRTI warnings. The idea behind developing analytics is to automatise certain parts of the information service production processes in order to decrease data handling latency, improve event coverage and to produce even quality in all circumstances. The next step would be to fuse the above listed third party datasets to the analytics engine and with the mentioned existing products, in order to produce even more precise situational awareness and SRTI warnings.

'Virtual VMS' – high coverage warning messages through the NAP and ecosystem partners

Using both existing and new input data, and extensive data analytics, Fintraffic will introduce a new concept

called Virtual VMS. The concept means basically the ability to provide traffic and road weather related warnings through different digital interfaces in a similar manner than through traditional roadside VMS warning signs. The innovative approach naturally is, that the warnings can be provided not only from locations with an existing roadside VMS, but also from any other location that encounters such dangerous conditions. In Finland the length of national road network is 78 000 km and therefore it is clear the service coverage through virtualisation can be basically unlimited whereas in the traditional world only the highway sections with very high volumes can be instrumented with VMSs cost-effectively.

Virtual VMSs can cover the following warning types:

- temporary slippery road (taking into account also the implemented road maintenance actions such as salting and snow ploughing)
- heavy snowfall/rain warning
- snow on road warning
- high wind warning
- reduced visibility warning (rain, snowfall, fog)
- road works warning (stationary and moving road works)
- incident warning
- jam tail warning

Currently Fintraffic Road has already implemented a beta-level warning production regarding weather-related events that is available for operators of the national Traffic Management Centre.

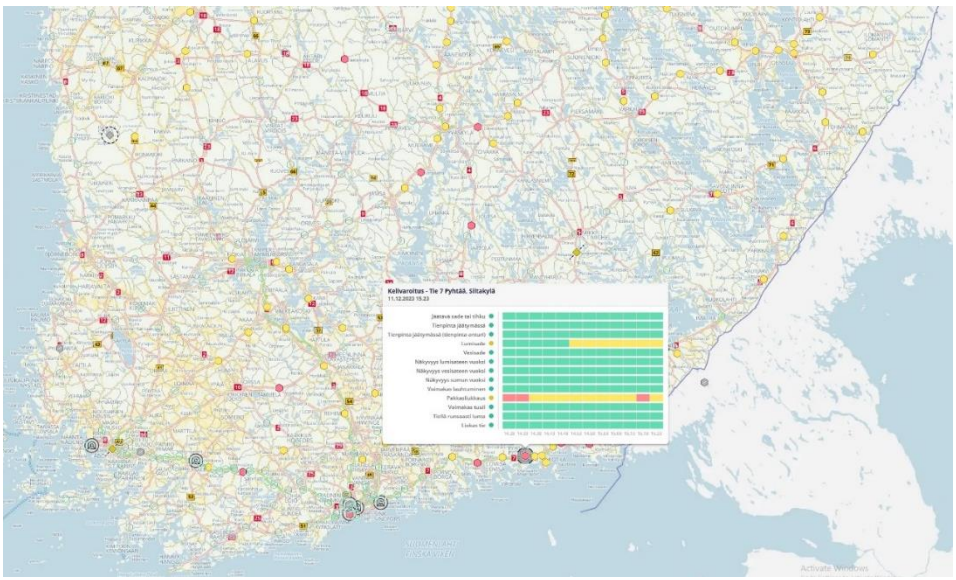

Figure – Weather-related warning presented in the situational awareness tool of the Traffic Management Centre.

At first phase, the production of Virtual VMS warnings and their distribution through the NAP to the ecosystem will facilitate high-quality content to different existing end-user services in connected vehicles and e.g. mobile applications. However, the planned processes will also cater in the near future the development and provision of C-ITS services such as In-Vehicle Signage, Hazardous Location Warning and Road Works Warning. In the

planning of the production processes the increased quality requirements in terms of e.g. timeliness and location accuracy arising from the C-ITS quality standards will be addresses already in the first phase.

Dynamic accident risk analytics engine

In addition, Fintraffic Road has started a development project which aims at developing a dynamic accident risk analytics engine. The idea is to fuse a variety of statistical and real-time data and to produce with the help of machine learning/AI dynamic accident risk predictions. The predictions will be used as an input to e.g. routing and information services and can take the form of areal or point/road specific risk predictions. Fintraffic has applied cooperation agreement with University of Jyväskylä faculty of Information Technology. With the help of real-time data, machine learning and artificial intelligence, it is possible to improve the safety of traffic. The aim is to study and analyse the risk of accidents on the Finnish road network from the driver's perspective on the basis of various road condition and weather conditions, accident history, data from the Transport Centre and Traffic Measurement services, and information from external sources (e.g. Data for Road Safety ecosystem). First result will be a data model that utilises historical and real-time traffic, road condition and accident data to predict traffic patterns, risks and congestion.

Development of the National Access Point and cooperation within ecosystems

Traffic operators in Finland have joined forces to create innovative data-use solutions and a fair digital operating environment within an open data ecosystem, the Traffic Data Ecosystem[1]. This cooperation seeks to provide competitive and scalable traffic and mobility services for both Finnish and international markets – solutions that will enable safe, low-emission and user-oriented travel and transport chains that combine different modes of transport.

Over the coming years, renewing traffic will, above all, be about making much better use of all kinds of traffic-related data. In order to create the strongest possible foundation for a sustainable transport system in Finland and enable the breakthrough of new traffic services and solutions, data must flow smoothly between routes, vehicles, different modes of transport, service providers and end users. It doesn’t matter what we’re talking about – travel chain services, autonomous vehicles, boosting the efficiency of logistics nodes, shortening warehousing times for goods, or the increasing volume of drone traffic.

One of the key enablers of this data flow is the National Access Point (NAP). The basis for the creation of the National Access Points is the ITS Directive of the European Union together with the Delegated Regulations that were created under it. A National Access Point (NAP) is a node in which traffic related data are concentrated and published in the form of datasets. Each European Union member state operates one or more access points for different types of traffic data.

NAPs are also set up to facilitate access, easy exchange and reuse of transport related data in Europe, in order to help support the provision of EU-wide interoperable travel and traffic services to end users. Fintraffic participates in the NAPCORE iniative, where the partners aim to harmonize the NAPs across the EU to facilitate

[1] https://www.fintraffic.fi/en/trafficecosystem

just this – a smooth data delivery.

Fintraffic operates the NAPs for Realtime Traffic Information (RTTI), Safety Related Traffic Information (SRTI) and Multimodal Travel Information Services (MMTIS) in Finland. The operation and development work aims to facilitate the NAPs primary function – make data easily available for the ecosystem. Fintraffic has also taken measures to build tools and services for data providers to harmonize data and evaluate data quality.

Active dialog towards data users, service providers etc. is one of the key elements for operating a successful NAP. To achieve this, Fintraffic actively cooperates with other iniatives like the European Mobility Data Space, Data For Road Safety and RTTI Task Force.

Development of direct road user feedback

The Traffic Customer Service[2] is a national, joint advisory service of the Finnish Transport Infrastructure Agency, the Centres for Economic Development, Transport and the Environment (ELY Centres) and Fintraffic for matters pertaining to highways, railways and waterways. The service is intended for all users of state-owned traffic routes.

The service enables road users to give feedback, ask questions and provide suggestions for improvements and notifications related to state-owned traffic routes. The service also allows users to keep track of feedback and notifications in their own area. Feedback related to the condition of a traffic route are forwarded to the contractor in charge of maintaining the road in question. They will then make a decision on the measures to be taken based on the quality requirements set for the road. Notifications falling under the contractor's responsibility include e.g. damage on paved highways (holes, pits); water on the road; a tree fallen on the road; or the slipperiness of the road.

Users can keep track of the status of their feedback on the Feedback Channel map if they have agreed to its publication when leaving the feedback via the webform. The map also shows feedback given by other people. The topics of the messages forwarded to the contractor (such as the need for snow ploughing or levelling a gravel road, damage to road paving) are published automatically on the Feedback Channel map. The publication of such messages does not require permission from the feedback provider.

If there is an urgent issue which clearly endangers traffic on the road network, users should report it primarily to the Road Users' Phone Service (24/7).

There are multiple ways to contact the Traffic Customer Service:

- Message feedback can be provided on the Traffic Customer Service website around the clock.
- There is also a chat channel available on weekdays at 9 AM—3 PM. A virtual chat agent guides users to the correct information or, if necessary, brings them in touch with a customer advisor during the daily chat hours. At other times, a virtual chat agent will always be available.

[2] https://liikenne.palautevayla.fi/feedback

- The Traffic Customer Service can also be contacted by phone on weekdays at 9 AM—3 PM.
- Users can also send an e-mail to the Traffic Customer Service. Users will receive a tracking link for tracking the issue by e-mail.
- The lastest addition to the ways in which feedback can be provided is Fintraffic Mobiili[3], a mobile app that provides real-time information on Finnish roads and rail traffic. Information on traffic disruptions and warnings are sent as push notifications directly to the users. The application can also be used to report any traffic problems and disruptions users might encounter and to track previously reported issues.

The mobile app allows the most direct 2-way feedback loop for the road users, they will be able to receive traffic announcements issued by the Road Traffic Management Center, report issues and observations on the road and follow the actions taken by the contractors based on user feedback.

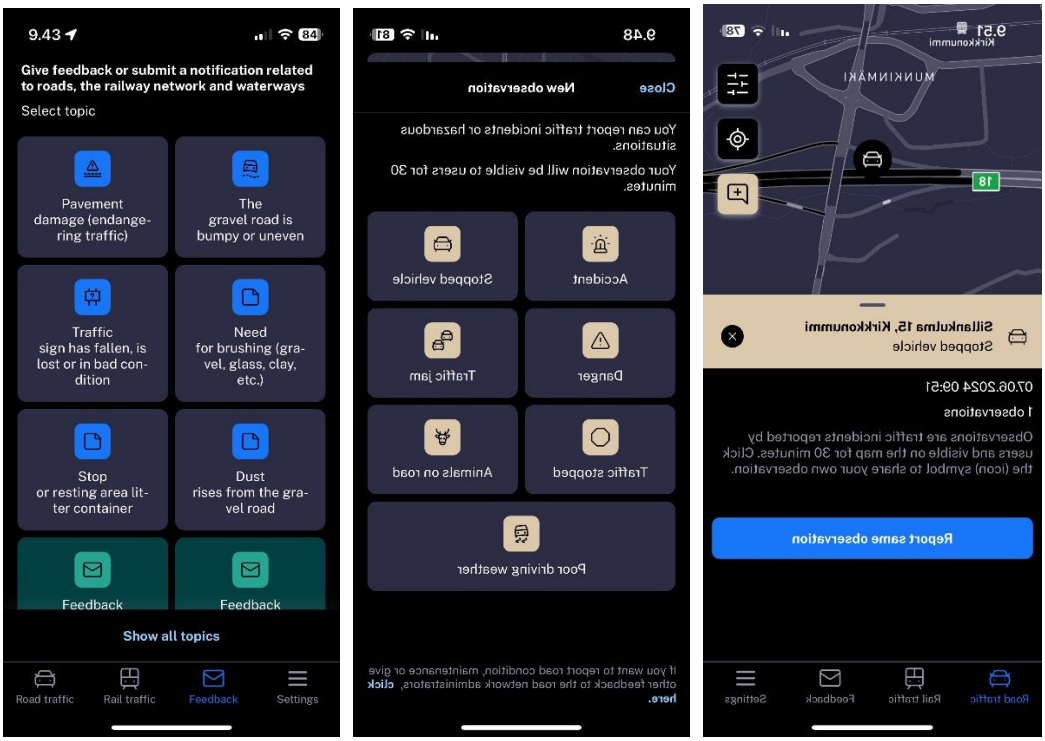

Figure – Feedback and observation reporting in Fintraffic Mobiili

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