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energising mobility

Cooperative ITS Trials in Bristol (Flourish) and Belgium (Intercor)

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C-ITS Services in a connected world

C-ITS stands for 'Connected Intelligent Transport Systems'. It's the traffic industry term used to describe data services (delivered through a combination of both hardware and software) that connect infrastructure and traffic management systems to users such as Connected and Autonomous Vehicles (CAVs). Examples of this are signals or traffic management systems that are now able to communicate *directly* with vehicles that are equipped with connected technology, allowing for real-time displaying of information set from these systems. These services are not restricted to (autonomous) vehicles alone, however, as cyclists, pedestrians can all participate in this evolving environment via smartphones or other devices with connectivity.

Our view is that over the next few years, this connectivity between users and infrastructure is expected to increase, allowing for more services to be provided to users. By participating in innovation projects such as FLOURISH (UK) and Intercor (EU), early deployment and evaluation of such services can be done. This helps us provide insight into the benefits they can offer in both enhancing our ability to collect and monitor traffic data, as well as improve management of traffic in a more sustainable and safer way. Through our work in creating real-world testbeds in cities and motorway environments, these 'connected corridors' provide important insight and a glimpse into what we can expect to see when an ever increasing amount of connected users drive our roads.

Connecting Traffic Management Systems to Road Users: The Dynniq FlowSense Platform

Our FlowSense platform is used to achieve this direct communication between road users and infrastructure, be it in urban (city) or inter-urban (motorway) environments. FlowSense is hosted to allow for a scalable and flexible way to connect various types of infrastructure and traffic management systems to users, using a micro-services based architecture. This ensures the platform can support various interfaces and use cases, depending on the user and type of information that is required to be provided. We provide FlowSense 'as-a-Service'.

Example services that allow drivers to receive the following information directly in their vehicle:

- Real-time traffic signal status (Red / Amber / Green state) and a countdown timer, including lane specific information
- Speed advisory message to allow you to ride a 'green wave' of signal lights
- (Adjusted) speed limit information
- Indication whether you have received traffic light priority (this can be both conditional priority (e.g. for trucks or buses) or hard priority (e.g. for emergency service vehicles)

- Indication from which direction emergency vehicles are approaching
- Road Works Warnings
- Slow or Stationary Vehicle Warning / End of Queue warnings
- Accident warnings
- Lane specific signage (e.g. Red X, merging, lane specific speeds)
- Weather condition information

The way we obtain, process and distribute this information can be broken down into **three** layers:

1. Data generation: generated from traffic controllers, traffic management centres and data feeds (e.g. Elgin, weather forecasts) which are sent to FlowSense;

2. Data collection, processing and distribution: FlowSense interfaces with infrastructure and central systems or data feeds to receive generated data. This data is then processed and formatted into pre-defined ITS message formats[1] and secured to ensure privacy and user anonymity, before being sent to the user;

3. Information presentation: ITS-G5 and/or 3G/4G communications is used to get the information to users. It is presented using a smartphone application or embedded in an existing in-vehicle system (e.g. SatNav or dashboard)

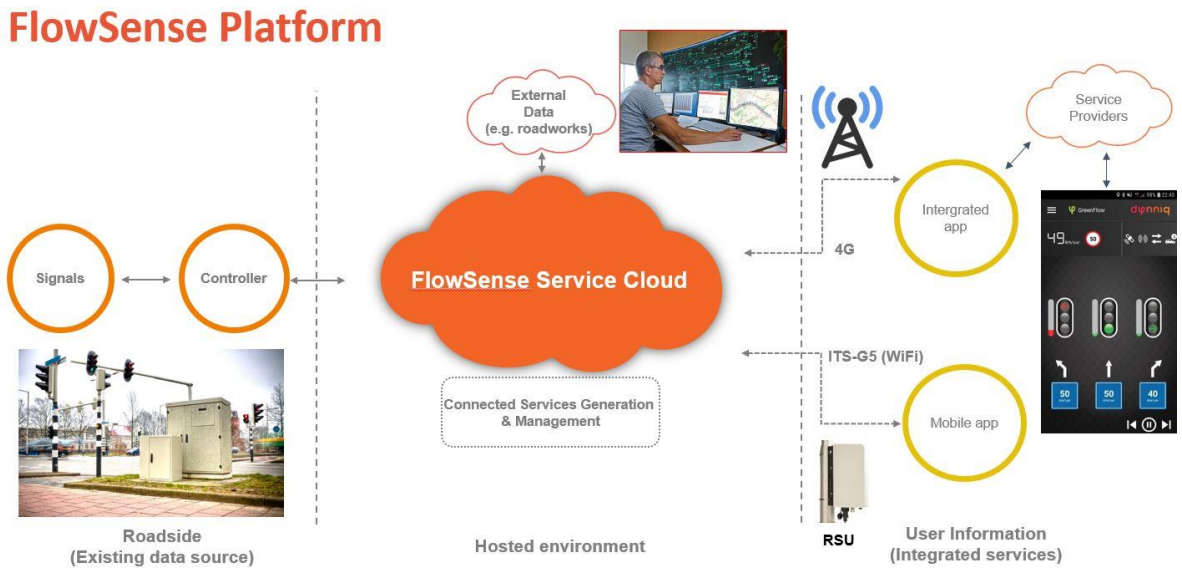

Figure 1: Dynniq's FlowSense Platform - Connecting Road Users with Infrastructure

FLOURISH: Piloting ITS services in urban environments

The FLOURISH project was a 3-year £5.5m part-funded InnovateUK innovation deployment consisting of multiple partners that was aimed at developing and evaluating the benefits of CAVs, it ended in June 2019. Our involvement in the project was to deploy ITS services in the city centre of Bristol, with support from the Council. We created a real-world testbed consisting of 6 RSUs placed throughout a set route in the city, with two Toyota test vehicles equipped with 2 OBUs to provide in-vehicle services to via our

[1] https://www.etsi.org/technologies/automotive-intelligent-transport

GreenFlow app. Simulated messages and vehicle data were sent and received through FlowSense to test ITS services.

The Project deployed these services through three separate Car Trials:

- V2X functions for early warning of vehicles of Accident, Road Works, Stopped or Slow Moving Vehicles
- V2X function of In-Vehicle Information (IVI) setting Speed Control and receipt of speed warning on the in-vehicle app
- Speed profile and monitoring of average speed
- Interaction of GPS accuracy received via OBUs to indicate a proximity warning message to a simulated accident site
- Generation of GPS message traces (zones) for vehicles that enter to allow vehicles to receive messages relevant in specific areas of the city
- Secured communications: achieved deploying various security permutations for sending and receiving encrypted messages (PKI) on both roadside and in-vehicle ITS devices, ensuring secure data transfer and user anonymization for ITS services

By testing these services in an urban environment, the benefit of proactively informing drivers was able to be demonstrated. Informing drivers of upcoming events helps increase alertness levels with regards to encountering any (potentially unsafe or outright dangerous) situations ahead. This can, in turn, enhance road efficiency.

Intercor Belgium: cross-border ITS in inter-urban environments

The Intercor Belgium TESTFEST was the fourth and final test event of the three-year €30m (US$33.7m) InterCor project that was funded by the European Union under the Connecting Europe Facility (CEF) program. It focused on ITS services deployment, testing and evaluation work on the Ten-T corridors across Europe, to stimulate collaboration and facilitation of the development of these services for future standardization frameworks across the EU.

This TestFest, hosted by the Flemish Ministry for Mobility and Public Works and ERTICO-ITS Europe, saw participation from across our ITS teams in both Croatia, the Netherlands and Belgium. It resulted in a culminating testbed across the InterCor project teams from Belgium, France, the Netherlands and the UK to pilot services in vehicles from various countries in the Flanders region of Belgium and the Netherlands. The aim of this final TestFest was to enable vehicles and the related road infrastructure as well as the Flemish central traffic management system to communicate with road users through cellular, ITS-G5 or a hybrid combination thereof. Services tested were focused on demonstrating how management of these connected corridors could be done to can improve safety, efficiency and driving comfort for users and logistics vehicles.

The site was split between a local stretch of road with GLOSA services and a motorway corridor where dynamic and static traffic information messages were shown to the test vehicles equipped with various sets of ITS equipment and from different countries. This allowed for testing of the consistency of ITS services through a single central ITS platform, FlowSense, to ensure seamless transitioning when crossing borders. C-ITS stations were deployed along the corridor to send relevant information to the vehicles used during testing about real-time road and traffic conditions. The TestFest is helping work towards creating a harmonized systems to ensure service availability and continuity across countries in Europe, and ultimately increase road safety, sustainability and efficiency.

Using a centralized 'IF2' interface, messages were able to be exchanged between central ITS systems between countries, as to ensure that drivers crossing the border were provided with an uninterrupted server through a 'handover' of the user to the relevant local traffic authority. This testing was done between Belgium and the Netherlands as well as Belgium and France.

ITS services tested consisted of:

- Roadworks Warnings, with information received from both external partner Be-Mobile and the Flemish Traffic Centre
    - This included movable roadworks vehicles that re-located during the TestFest, allowing for much more dynamic monitoring of the vehicles and creating local warning messages once they were redeployed as stationary roadworks
- Probe Vehicle Data (PVD)
    - Stationary vehicle detection
    - Data logging for evaluation purposes
- In-Vehicle Signage (IVS)
    - Specific signage – Traffic data feed from the central Traffic Centre
        - Gantry signs
        - Lane closure
        - Accidents
        - Free text messages
- GLOSA; in urban environment only
- Public-Key Infrastructure enabled securing of messages sent/received

Figure 2: Dynniq's GreenFlow in-vehicle app displaying traffic messages in real-time at the Belgium TestFest

Evaluating the benefit of C-ITS services

Through both FLOURISH and Intercor projects, we were able to deploy live testbed environments where the FlowSense platform enabled ITS services operation, traffic monitoring through Probe Vehicle data and evaluation of data transmitted between users and infrastructure.

Although evaluation of the project in Belgium is still on-going, a number of early findings and lessons learned can be observed.

First, from participants' experience, however, positive feedback has been received regarding the accuracy and real-time access to information that was enabled through such services. The benefit of

ITS services is expected to further increase as more connected vehicles emerge on roads, as current testbeds only involve a relatively small amount of vehicles.

Second, Matthew Cockburn, Bristol City Council's Project Manager – City Innovation mentions that the ability to be able to have a more direct way of providing relevant information to road users is an advantage over how information us currently being provided. This reflects a step-change in the way information presentation and traffic management of road uses is performed: road signage is a 'passive' way of providing information to users and often does not provide much contextual information (think of signage with 'Accident ahead' warnings). With In-vehicle services becoming both more real-time, accurate and location based (per user) this is thus changing to more active and even pro-active traffic management (e.g. 'Accident ahead in 750 yards, reduce speed now to 40').

Lastly, connected and autonomous vehicles numbers are expected to significantly increase in the next few years. Automotive manufacturers already have 4G-enabled services built-in to vehicles, and ITS-G5 equipment is also to be released this year. This unlocks the potential for vehicles to become truly connected through platforms such as FlowSense. Through continued testing of services in both city and motorway environments, we are committed to bringing ITS services to road users to improve the efficiency, sustainability and safety of traffic management in a more connected world!