D5.1: Connectivity unit onboard implementation report

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Control sheet

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1.1	20/04/2018	J-Charles Pandazis	Add statement statement on the connectivity unit functionality.

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Abstract

OptiTruck features a “connectivity unit” that offers wide processing capabilities and communication features of mobile communication protocols and Wi-Fi. It also embodies advanced navigation functions provided by GPS, topographic roadmaps (ADAS maps) and attributes. The information exchange from the vehicle to the cloud-computing system will also be facilitated via the connectivity unit.

This deliverable explains the connectivity unit features, gives a system and SW overview, demonstrates the functional operation of the connectivity unit integrated onboard the vehicle.

Publishable Executive Summary

Objective

The objective of this report is to describe the mechanical, electrical and software integration aspects of the electronic module that will be mainly used to realize the vehicle-to-cloud (V2C) connectivity features of the optiTruck project. This module also provides the necessary software and data infrastructure to realize predictive vehicle control functions due to its topographic map storage and processing capabilities.

One of the fundamental goals of the optiTruck concept is to improve powertrain control system performance, and consequently fuel efficiency, by properly utilizing available computational resources onboard and offboard (via cloud computing) the vehicle. The connectivity electronic module acts as a data gateway to the cloud and it also offers extensive on-chip computational capabilities. Therefore, it is considered as one of the key components of the optiTruck control system.

Overview of the Report Content

As a result of mechanical integration activities including a detailed assessment of several packaging locations, thermal and vibration analyses, the electronic module is mounted in the overhead console of the truck using a custom designed bracket. The module uses three external antennas located on the cabin roof for GNSS/GPS, cellular (GSM) and Wi-Fi connectivity. A robust M2M (Machine-to-Machine) SIM card is integrated inside the electronic module which enables mobile communication with the cloud servers.

The module has multiple CAN transceivers to provide communication with in-vehicle networks in the range of 250 kbps and 1 Mbps baud rate. The SAE J1939 protocol is supported as a commercial vehicle standard for CAN communication. The electronic module has a dual-core controller architecture to handle both time-critical operations (e.g. real-time sensor inputs and vehicle-bus communications) and complex “soft real-time” operations (e.g. optimization routines, map processing functions and V2C communications).

The multi-layered software architecture allows Ford Otosan to develop software applications for the optiTruck project using an application programming interface (API) provided by the electronic module supplier. This API provides several features including access to electronic horizon map attributes according to the ADASIS standard, CAN communication services, diagnostic services, wireless communication services and acquisition of embedded sensor data.

The vehicle-to-cloud communication is facilitated by the onboard connectivity unit. A secure implementation of the Message Queuing Telemetry Transport (MQTT) protocol is utilized for realizing bi-directional data exchange between the vehicle and the optiTruck cloud systems. A text based data exchange format is preferred for implementation. Example datasets include route position offset, road slope and vehicle speed setpoint from the cloud to the vehicle; actual GNSS location, vehicle speed and fuel consumption from the vehicle to the cloud. The data exchange workflow is also outlined in the report for an arbitrary selection of waypoints along the route.

As a result, the connectivity unit is fully integrated into the truck and ready for the implementation of new software functionalities required by subsequent WP4 and WP5 tasks.

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