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PROGRAMME**



Dangerous **Good** Transportation **Routing**, Monitoring and
Enforcement

GOOD ROUTE
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On Board Unit (OBU) Short public version			
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FIGURE 1: GLOBAL ARCHITECTURE 2

Control Version

Vers.	Date	Author	Description
V1	03.11.2006	CRF	First document template draft.
V2	20.10.2007	CRF	First update
V3	31.10.2007	CRF	Second Update
V4	16.11.2007	USTUTT	Story book PDA portal integration
V5	01.12.2007	CRF	Revision after internal peer review
V5b	15.12.2007	CRF	New chapters added: <ul style="list-style-type: none"> o Communication overview (Siemens) o OBU's Benchmarking o V2V communication technologies Sent for peer review
V6	30.12.2007	CRF	Final after peer review
V7	January 2009	CRF	Revision upon EC comments as of 2 nd annual review.

List of abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
ADR	Accord Dangerous Route
ANSI	American National Standards Institute
ARP	Antenna Reference Point
B	Thermistor Constant
BER	Bit Error Rate
BT	BlueTooth
BTS	Base Transceiver Station
CAN	Control Area Network
CC	Control Centre
CE	Conformité Européene (European Conformity)
CHAP	Challenge Handshake Authentication Protocol
CR	Control Room
CS	Coding Scheme
CTS	Clear to Send
DAC	Digital-to-Analog Converter

Abbreviation	Description
DG	Dangerous Goods
DSS	Decision Support System
ECU	Electronic Control Unit
EMC	Electromagnetic Compatibility
EN	Enforcement Network
ES	Enforcement System
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FCC	Federal Communications Commission (U.S.)
FMS	Fleet Management System
FR	Full Rate
GPIO	General Purpose Input/Output
GPRS	General Packet Radio Service
GPS	Global Position System
GSM	Global Standard for Mobile Communications
HMI	Human Machine Interface
I/O	Input/Output
IMEI	International Mobile Equipment Identity
IP	Internet Protocol
ISO	International Standards Organization
ITU	International Telecommunications Union
Kbps	kbits per second
LED	Light Emitting Diode
Mbps	Mbits per second
MMI	Man Machine Interface
OBU	On Board Unit
OEM	Original Equipment Manufacturer
PCM	Pulse Code Modulation
PDA	Personal Digital Assistant
POI	Point Of Interest
PPP	Point-to-point protocol
PSU	Power Supply Unit
RAM	Random Access Memory
RF	Radio Frequency
RFID	Radio Frequency IDentification
RTC	Real Time Clock
RTS	Request to Send
SIM	Subscriber Identification Module
SMS	Short Message Service
SPI	Serial Peripheral Interface
TMC	Traffic Management Centre
TPMS	Tyre Pressure Monitoring System
UART	Universal asynchronous receiver-transmitter
WSN	Wireless Sensors Network

Executive Summary

The current Deliverable constitutes the short public version of D3.2: “OBU”, prepared in the context of WP3 “ On Board Telematic System ” of the GOOD ROUTE project and which describes in detail the selected architecture and the implementation of the GOOD ROUTE functionalities.

The objective of this document (the full version) is to describe the vehicle architecture that has been developed for the GOOD ROUTE project in order to satisfy the needs for vehicle status monitoring, cargo status monitoring, wireless communication capabilities and driver messages interfaces.

The vehicle telematic system has been divided into tractor architecture and trailer architecture. It has been decided to adopt two OBUs in order to make it possible to have autonomous and independent capabilities for vehicle and cargo monitoring.

The hardware platform of the two OBUs will be constituted by the telematic box that IVECO is going to adopt in its commercial vehicles to supply telematic services to customers. The application software dedicated for each OBUs will be developed within GOODROUTE Project.

In order to guarantee a general approach, independent from the type and brand of trailer and the kind of dangerous good it has been decided to develop a “trailer” emulator and to adopt it in the vehicle demonstrator integration instead of a real trailer. Moreover this solution assures the capability to perform tests every where and with every truck driver.

The wireless communication system is constituted by a GPRS device for long range communication and a DSRC system For short range communication. The short range communication system has been adopted to support enforcement requirements and eventually V2V capabilities.

Within the development activity the following outputs have been completed:

- Tractor OBU integration in the vehicle together with short range communication system.
- Trailer OBU integration with a RFID reader and WSN devices for trailer cargo monitoring will be integrated
- Vehicle status monitoring tool
- Cargo status monitoring tool
- The communication tool between tractor and trailer
- The communication tool between tractor OBU and GOOD ROUTE Control Centre.

Due the confidential nature of the Deliverable contents, this document provides only the overall system overview. The detailed specifications and components, the interface aspects and any other outcomes may be found only in the full version of the Deliverable, which is kept strictly confidential.

This document constitutes a revised version, addressing the 2nd annual review comments, incorporating results from the technical validation tests for the vehicle platform, final driver HMI and results coming from the HMI usability tests.

1 Introduction

This document is prepared in the context of GOOD ROUTE (Dangerous Goods Transportation Routing, Monitoring and Enforcement) European funded project and specifically within the framework of WP3: “On board Telematic System”.

The document incorporates the work held in the context of A3.1: “Autonomous on board sensors for cargo and vehicle vehicle monitoring”, A3.2: “On board data fusion and information synthesis”, A3.3: “On board HMI”, A3.4: “OBU integration, technical verification and optimisation” and A3.5: “Interface to V2V system”.

The main scopes of the document is the definition of the information and parameters needed to monitor vehicle and goods and the description of the communication links used to share and transfer data among the vehicle, the control centre and the infrastructure.

The document is divided into the following main Chapters:

- Overall system architecture.
- The On Board Unit description. All the main h/w aspects are included.
- Tractor on board architecture for vehicle monitoring.. Among the main functionalities in this chapter the on-board HMI for enforcement application and alarms signaling is also descript.
- Trailer on board architecture for cargo monitoring. The description of selected devices integrated in the included.
- Tractor OBU Communication links architecture; in this chapter also The short range communication system developed for enforcement application and eventually for V2V is showed
- On board Navigation system HMI.
- Communication system requirements analysis.

Integration/validation aspects will be added after on road validation tests which are foreseen to be completed by M26 (February 2008).

As part of the Deliverable the following (prototype) items will be delivered:

- Tractor OBU integration in the vehicle together with short range communication system.
- Trailer OBU integration with a RFID reader and WSN devices for trailer cargo monitoring will be integrated
- Vehicle monitoring tool
- Cargo monitoring tool
- The communication tool between tractor and trailer
- The communication tool between tractor OBU and GOOD ROUTE Control Centre

2 Overall System Overview

The architecture of the dangerous goods transportation application developed in GOOD ROUTE is shown in the following figure.

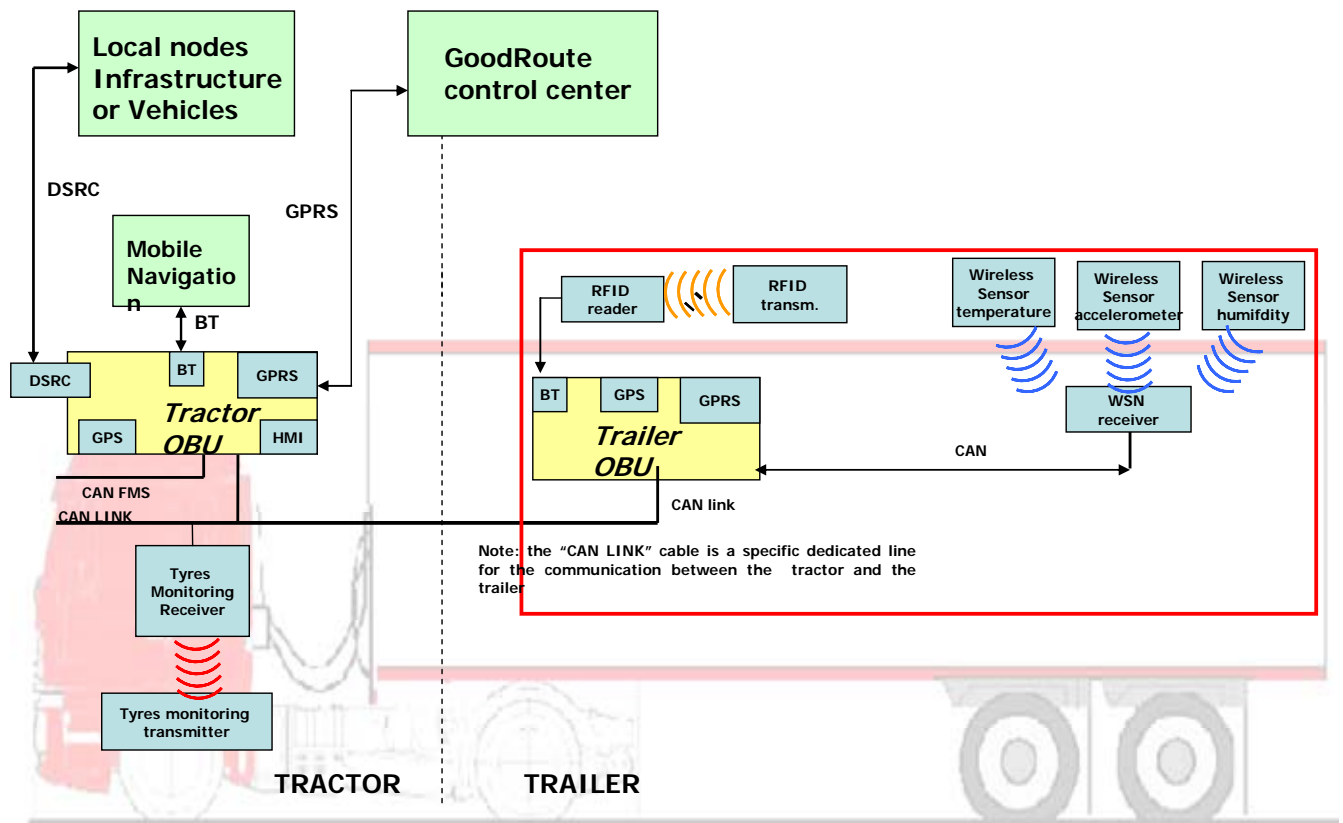


Figure 1: Global architecture.

The figure highlights the high level architecture that is integrated to provide all functionalities envisaged by the GOOD ROUTE. The main entities are:

- The truck , consisting of a tractor and a trailer
- The control centre
- The local nodes

There are two telematic units in the truck. The first is installed in the tractor in order to collect information about the vehicle operations and to manage the short/long range communications and the second one should be installed in the trailer in order to collect information on the transported goods status; dangerous goods are stored in the trailer. In the GOOD ROUTE demonstrator the second telematic unit is installed in the trailer emulator.

The unit installed in the tractor has also the capability to communicate with the unit installed in the trailer and with the control centre. The information exchange between the two on board telematic units is achieved through a dedicated CAN link.

The tractor unit is connected to the vehicle control network through the CAN FMS protocol.

Both the tractor and the trailer OBU will be integrated into the same type of device, the Blue&Me™ device developed by Fiat Auto, Magneti Marelli and Microsoft Automotive Business Unit, a solution based on Windows Mobile for Automotive, which performs in-car communication, information, and entertainment functionalities. Blue&Me is available on new and restyled models from the Fiat Group (FIAT Automobiles , IVECO, CNH).

Blue&Me includes a voice command system completely integrated into the vehicle and an information display. An advanced voice recognition system immediately reads incoming SMS messages aloud,.

Both the tractor and the trailer OBU are the Blue&Me™ device developed by Fiat Auto, Magneti Marelli and Microsoft Automotive Business Unit, based on Windows Mobile for Automotive, which performs in-car communication, information, and entertainment functionalities. Blue&Me™ includes a voice command system completely integrated into the vehicle and an information display. Some simple voice commands from the driver are recognized by the system. The Blue&Me™ device is characterized by having on board Bluetooth device for short range wireless communication, GPRS device for long range wireless communication, GPS device for positioning and navigation, USB interface, 2 high speed CAN interface, 1 low speed CAN interface.

The HMI functionalities are based on front panel display visualization or on vocal messages obtained through a text to speech tool, already integrated in the OBU. The voice messages are used through radio connection and microphone integration:

The main subsystems of the GOOD ROUTE trailer emulator architecture beside the OBU are a Wireless Sensors network for cargo monitoring and RFID reader + RFID tag for cargo identification.

In order to monitor dangerous goods, the trailer emulator will be equipped with sensors, RFID, specific TAG or active sensors with low power consumption; all data will be collected by the trailer unit and sent to the tractor telematic unit which will gather all the information about the truck.

The data acquired by the on board telematic unit can be sent to the control centre and/or to a local node upon request or spontaneously after a warning condition detection. The local node shall provide enforcement procedures applied locally and notify the driver about them. Alternatively, others solutions can be provided by the control centre taking into account global suitable strategies. The control centre is able to exchange information with the vehicle through GSM/GPRS while local nodes will use short range communication link.

The control centre shall monitor the vehicle and shall verify if the driver has appropriate driving behavior. If necessary, the control centre can apply some enforcement policies that are established in accordance with the local authorities and can decide to send messages to the driver with the suggested guidelines or with the indication to stop the vehicle. A police-car, with the assistance of

a device having the capability to communicate with the truck telematic unit, can request the truck to send information about the vehicle functionality and the transported dangerous goods status; after having checked the received data, the police can adopt an opportune strategy to stop the vehicle.

3 Conclusions

This document is prepared in the context of GOOD ROUTE (Dangerous Goods Transportation Routing, Monitoring and Enforcement) European funded project and specifically within the framework of WP3: “On board Telematic System”.

The document incorporates the work held in the context of A3.1: “Autonomous on board sensors for cargo and vehicle vehicle monitoring”, A3.2: “On board data fusion and information synthesis”, A3.3: “On board HMI”, A3.4: “OBU integration, technical verification and optimisation” and A3.5: “Interface to V2V system”.

The main scopes of the document is the definition of the information and parameters needed to monitor vehicle and goods and the description of the communication links used to share and transfer data among the vehicle, the control centre and the infrastructure.

The following (prototype) items accompany the current document:

- Tractor OBU integration in the vehicle together with short range communication system.
- Trailer OBU integration with a RFID reader and WSN devices for trailer cargo monitoring will be integrated
- Vehicle monitoring tool
- Cargo monitoring tool
- The communication tool between tractor and trailer
- The communication tool between tractor OBU and GOOD ROUTE Control Centre

Integration/validation aspects have been added in the revision of the full Deliverable D3.2: “OBU, after technical validation tests performed prior to the Pilots.

The validation plans for the iteration tests of the development phase have been the following:

- Technical testing of the tractor OBU for vehicle data monitoring.
- Technical testing of the DSRC module and Tractor OBU interface for the Enforcement Application.
- Technical testing of the Data Transmission to Control Centre through GPRS link.
- Technical testing of the WSN development and interface to trailer OBU.
- Technical testing of RFID reader/writer and interface to trailer OBU.
- Technical testing of Tractor OBU and Trailer OBU communication through CAN link.

At the end of the technical iteration tests, each single component has been tested on a test bench in laboratory and then the overall system has been tested to validate the functionalities in laboratory. After the validation in laboratory, tests has been held with the vehicle in CRF premises and then in a driving testing circuit. The final validation tests have been performed in the Italian test site (Frejus tunnel in Bardonecchia). All data acquired during the travel have been sent to CRF GOOD ROUTE Control Centre emulator. In addition, with the assistance of the ADR office of the Frejus tunnel, the enforcement module with a CRF local node emulator has been tested.

Finally, both sounds and web-portal addressing the driver interface and presented in this document have undergone their final evaluation through usability tests in order to find final optimisation potentials and to ensure a satisfying degree of usability. In this revised version of D3.2, the final interface aspects of the navigation system are finally provided together with the usability tests results.

References

1. Aransay, A., GOOD ROUTE-TID-V2V Communication, Internal report, CN 027873, GOOD ROUTE project, June 2007.
2. <http://www.car-to-car.org/>
3. Leuteritz, J., GOOD ROUTE-USTUTT-D-WP3-A3_3-Storybook_PDA, Internal report, CN 027873, GOOD ROUTE project, October 2007.
4. Ramón de C., M4.1.2-State of the art communication technologies for the GOOD ROUTE project, Internal report, CN 027873, GOOD ROUTE project, December 2006.
5. Hamborg, K.-C. (2002). *Gestaltungsunterstützende Evaluation von Software: Zur Effektivität und Effizienz des IsoMetrics^L Verfahrens*. In: M.Herczeg, W. Prinz, & H. Oberquelle (Hrsg.), *Mensch & Computer 2002* (pp. 303-312). Stuttgart: B.G. Teubner.
6. Leuteritz, J.-P. (2007). *Methoden zur Evaluation von Small Display Devices*. Unpublished diploma-thesis. Stuttgart: Fraunhofer IAO.
7. Mayhew, D. J. (1999). *The usability engineering lifecycle: A practitioner's handbook for user interface design*. San Francisco, California: Morgan Kaufmann Publishers.