ROADART

H2020 - 636565

Research On Alternative Diversity Aspects foR Trucks

HARDWARE AND SOFTWARE FOR RF MODULES AND COMMUNICATION MODULE

DEMONSTRATOR

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Contents

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Acronyms

BPF	Band Pass Filter
CACC	Cooperative Adaptive Cruise Control
CAM	Cooperative Awareness Message
DC	Direct Current
DDS	Data Distribution Service
DSRC	Dedicated Short Range Communication
GbE	Gigabit Ethernet
GNSS	Global Navigation Satellite System
ITS	Intelligent Transport Systems
IQ	Inphase, Quadrature; complex baseband sample
LAN	Local Area Network; typically Ethernet based
LNA	Low Noise Amplifier
LPF	Low Pass Filter
OFDM	Orthogonal Frequency-Division Multiplexing
PA	Power Amplifier
PCB	Printed Circuit Board
RF	Radio Frequency
RTI	Real-Time Innovations, Inc.
RX	Receive
SMA	SubMiniature version A; coaxial radio frequency connector
SPI	Serial Peripheral Interface
T2T	Truck to Truck
T2I	Truck to Infrastructure
TX	Transmit

V2V	Vehicle to Vehicle
V2I	Vehicle to Infrastructure
VLAN	Virtual LAN
WP	Work Package

1 Introduction

1.1 Background

This document is the result of a deliverable for the ROADART project. This project aims to evaluate diversity techniques and antenna concepts in order to develop an in-vehicle platform for cooperative ITS systems for trucks and heavy duty vehicles in the Horizon 2020 call MG-3.5a-2014 "Cooperative ITS for safe, congestion-free and sustainable mobility."

The ROADART project is defined by means of 9 work packages (WPs):

- WP1 Requirements and Design
- WP2 Channel Measurements, Characterization and Modelling
- WP3 T2X Communication Techniques
- WP4 Development of the ITS communication platform
- WP5 Robust Cooperative Adaptive Cruise Control
- WP6 Integration
- WP7 Test, Demonstration and Evaluation
- WP8 Dissemination and exploitation
- WP9 Project Management

This deliverable is part of WP4: Development of the ITS communication platform.

The project and the objectives will be further explained in section 1.1.1 and 1.1.2.

1.1.1 The project

The main objective of ROADART is to investigate and optimise the integration of ITS communication units into trucks. Due to the size of a truck-trailer combination the architecture approaches investigated for passenger cars are not applicable. New architecture concepts have to be developed and evaluated in order to assure a sufficient Quality of Service (QoS) for trucks and heavy duty vehicles. An example of a specific use case is the platooning of several trucks driving close behind each other through tunnels with walls close to the antennas that support the communication systems. Due to the importance of tunnel safety, significant research effort is needed in order to check the behaviour of the antenna pattern, diversity algorithms and ray tracing models especially for trucks passing through tunnels. V2V and V2I systems specified from the C2C Communication Consortium are focussing on road safety applications. The ROADART project aims to demonstrate especially the road safety applications for T2T and T2I systems under critical conditions in a real environment, like tunnels and platooning of several trucks driving close behind each other. Besides that traffic flow optimization and therefore reducing Greenhouse Gas emissions are positive outcomes of the use cases demonstrated in this project. Demonstration and Evaluation of the use cases will be performed by simulation and by practical experiments on several levels. Besides evaluation on component and system level, the complete system will be evaluated in practice.

1.1.2 Objectives

The ROADART project aims to evaluate diversity techniques and antenna concepts in order to develop an in-vehicle platform for cooperative ITS systems for trucks and heavy duty vehicles in the Horizon 2020 call MG-3.5a-2014 "Cooperative ITS for safe, congestion-free and sustainable mobility."

1.2 The objective of this deliverable

The objectives of WP4 are:

- Develop the final system architecture based on the outcomes of WP1, WP2 and WP3. The architecture depends on the diversity technique chosen for the demonstration.
- Develop appropriate antennas for the integration into the trucks at the identified places in WP3/WP4.
- Develop the hardware for the RF modules placed on the truck.
- Develop the communication unit consisting of wireless communication modules and a microprocessor.
- Develop the protocol software for ITS V2V communication according to the up to date standardization from the C2C Communication consortium.
- Implement the interfaces to the control unit and the RF Modules.

This deliverable shows the demonstrator of the RF modules and the communication unit.

1.3 Structure of the document

The document is structured as follows.

Chapter 2 shows pictures of four RF Modules for integration into two trucks.

Chapter 3 shows pictures of two Communication Units ready for integration into two trucks.

Chapter 4 shows a complete setup for one truck.

2 RF Modules

Figure 1 shows four completely assembled RF-Modules:

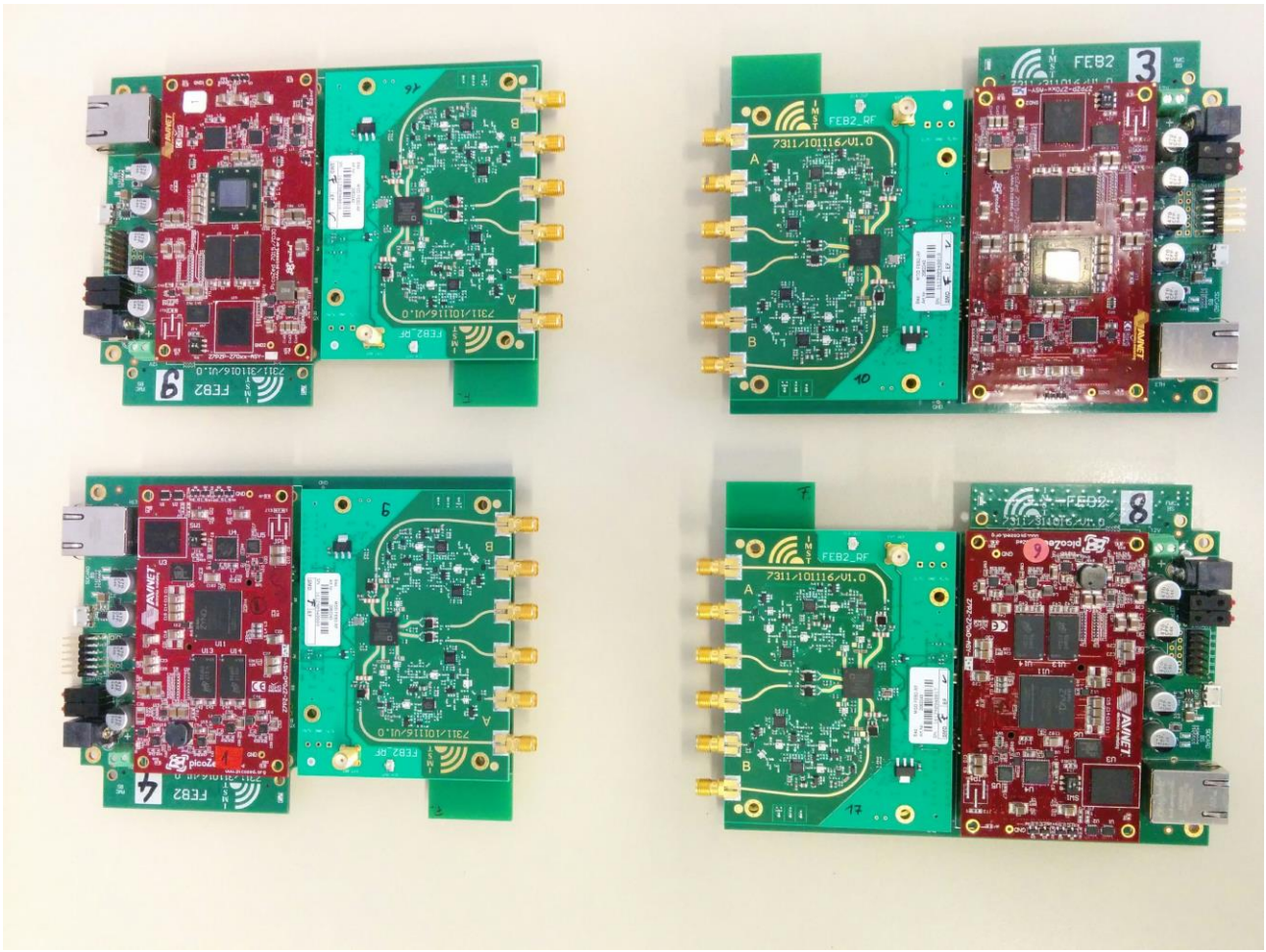

Figure 1 Four completely assembled RF-Modules

Each truck needs two of them. One goes inside the left mirror and one inside the right mirror.

3 Communication Unit

Figure 2 Two communication units

Each truck gets one communication unit.

4 Setup

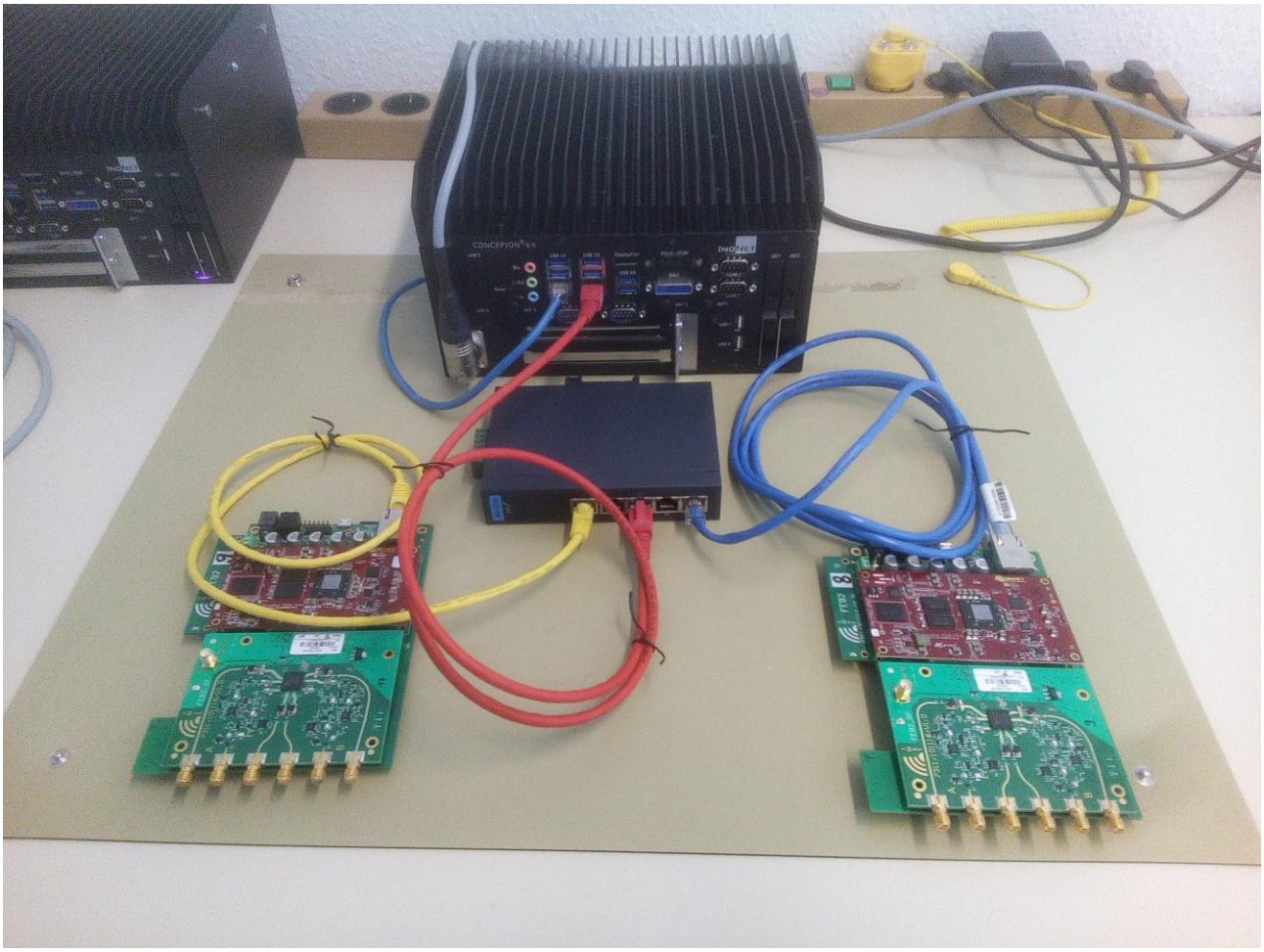

Figure 3 Truck-Setup: Communication unit with two attached RF modules

One RF modules goes into the left mirror, the other one into the right mirror. Ethernet-Switch and communication unit will be placed inside the cabin.

5 Software

The control unit delivers received CACC message (over the air) to the truck network via the standardized DDS protocol. Messages originating from the truck network are forwarded via the air link. Figure 4 shows a screenshot of this application.

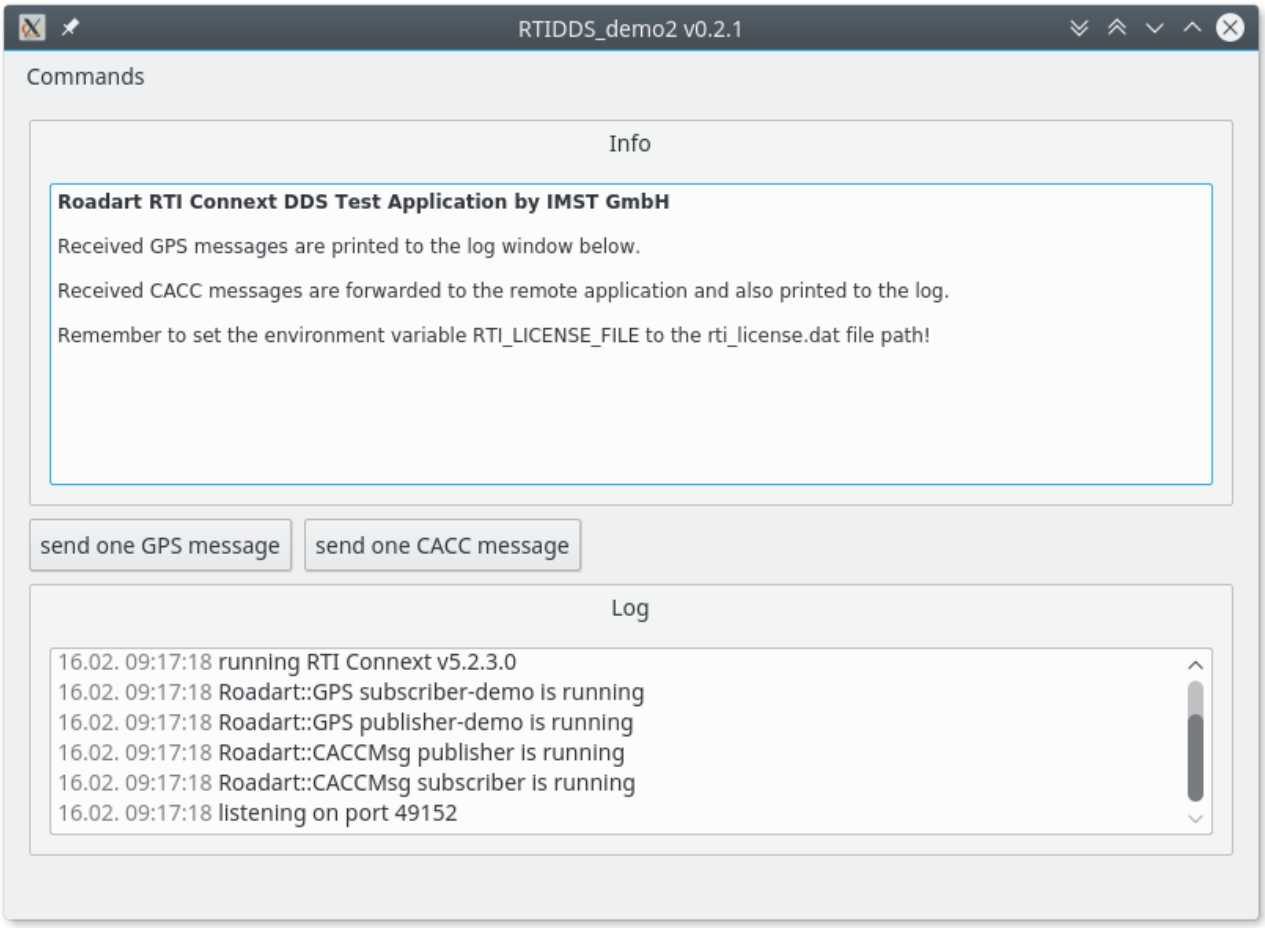

Figure 4 DDS application

The ITS G5 stack needs additional information about the position and some other sensors to make its decisions. The GPS (or more general GNSS) messages from the truck network (again via DDS) provide this information.