Market Consultation (2)
ORBIT OBU

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1 Introduction

1.1 Subject

This document describes the second market consultation for a hardware platform used to implement the ORBIT[1] Train application known as the ORBIT On Board Unit (OBU).

The OBU will be built into each driver cabin of the entire rolling stock fleet of NS and other Train Operating Companies. The ORBIT system is a warning system (not a safety system) that informs the train driver when a signal at danger is approached at a too high speed.

The first market consultation was related to an OBU development with dedicated hardware including application software. This consultation is based on a revised development concept that will implement the OBU application on standard hardware.

This document is intended to describe the requirements for the OBU hardware and specify the related questions for information.

1.2 About the Dutch Rail sector

Rail transport in the Netherlands utilizes 6505 track-kilometers. The infrastructure is managed by ProRail. The trains are operated by a number of different operators like Nederlandse Spoorwegen (NS), DB Schenker, Arriva, Syntus, Veolia and Connexxion. The network is well developed and dense. Most of the network is electrified at 1.5 kV DC. Trains run frequently, with up to 8 or 10 trains per hour. The rolling stock operators have a total of several thousands of trains.

The national signaling system in the Netherlands is based on external lamp signals supported by the train safety system ATB. New track like the High Speed Line (HSL-Zuid) and the dedicated freight line to Rotterdam harbor (BetuweRoute) is provided with ERTMS. Despite the intense traffic, accidents are rare. Nevertheless signals at danger are passed about 200 times per year. ProRail and NS aim for a significant reduction of the red signal passes or 'signals passes at danger' (SPADS). The ORBIT system is part of the solution to accomplish this intention.

1.3 Reference documents

[1] (First) Market Consultation ORBIT, ProRail & NS, Joost Peters,
[2] EN50155:2001, Railway applications - Electronic equipment used on rolling stock
[3] CENELEC EN 50121-4 (versie 2000), Railway applications - Electromagnetic compatibility - part 4; Emission and immunity of the signalling and telecommunications apparatus,
[4] EN50264, Rolling Stock Cables
[5] Restriction of Hazardous Substances Directive 2002/95/EC, RoHS.
[6] EN 45545-2:2013, Railway applications. Fire protection on railway vehicles. Requirements for fire behaviour of materials and components

[1] ORBIT is the Dutch abbreviation for OOGST[2] Remcurve Bewaking In Trein which means OOGST braking curve monitoring in train.

[2] OOGST is the Dutch abbreviation for "Ontsluiting van Operationele Gegevens op Spoor en Trein", which means "the disclosure of operational (traffic management) information on track and train"

1.4 Overview

Section 2 "Generall Description" is an informative section explaining the scope of the ORBIT OBU and the overall ORBIT system. Section 3 specifies the functional requirements and Section 4 the questions.

2 General description

2.1 What is ORBIT

ORBIT is a non-failsafe warning system for the train driver. ORBIT gives a warning to the driver when a signal at danger is approached at a too high speed. The driver has to act, the ORBIT system does not intervene. ORBIT is not a safety system but a warning-system.

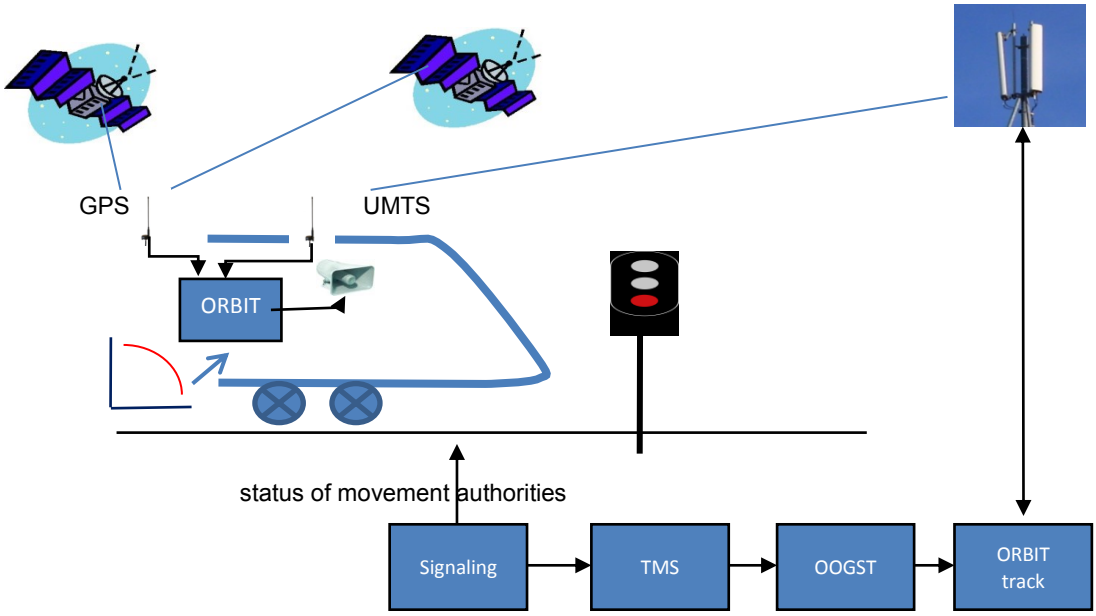

Figure 1: simplified system overview

The ORBIT system complements the ATB-system by warning the driver of a potential SPAD. For that purpose ORBIT combines signaling information from the traffic management system (TMS) with accurate speed and position information. The information from the traffic management system is communicated via OOGST[2] to the train. Accurate speed and position information on the train is obtained from GPS. ORBIT does not intervene (with for example Emergency Brake), it only warns the driver through acoustic signals.

[2] OOGST is the Dutch abbreviation for “Ontsluiting van Operationele Gegevens op Spoor en Trein”, which means “the disclosure of operational (traffic management) information on track and train”. OOGST informs each ORBIT train system about the geographical location of the first signal at danger on the actual route. The train system monitors the braking curve to the signal.

2.2 Scope of the ORBIT On Board system

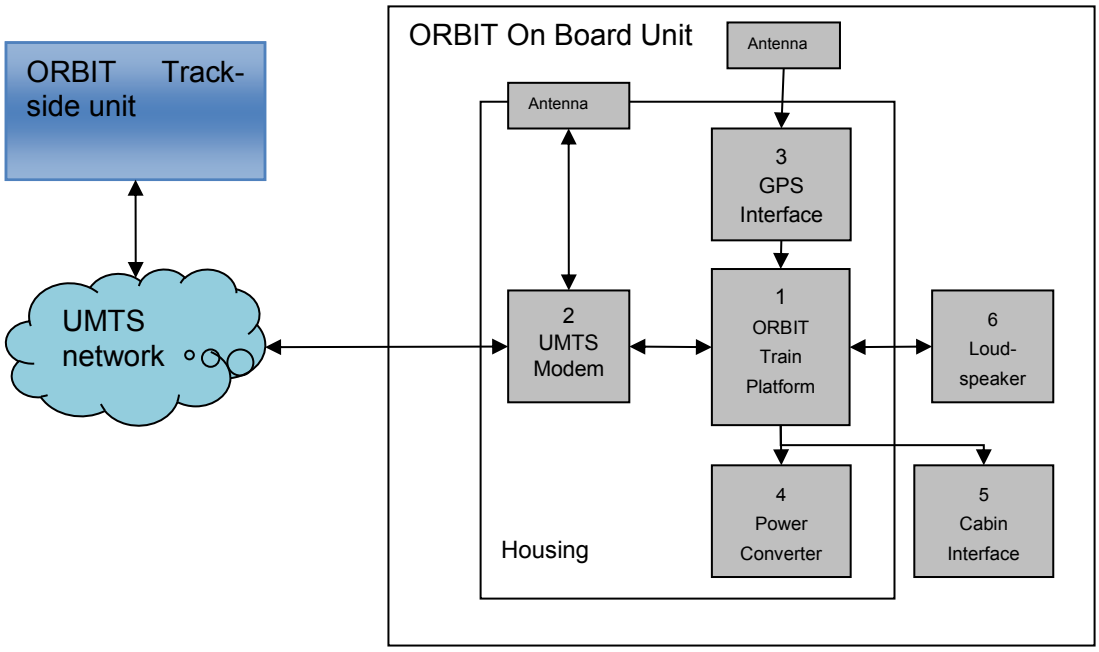

Figure 2: ORBIT configuration

The main architecture of the ORBIT system consists of:

- Track side equipment that collects actual train data from the Train Management System (TMS) and that sends this data via UMTS to the train.
- Train side (On Board) equipment that calculates speed and distance and warns the driver when a red signal is approached at a too high speed.

The scope of this requirements specification is limited to the on-board system hardware and some general application and drivers. This ORBIT-onboard system should consist of:

1. ORBIT Train Platform or Main computer
2. Antenna and Modem for interfacing via the UMTS network with the ORBIT Track
3. Antenna and Receiver for GPS (positioning)
4. Power Convertor for interfacing with the train's power supply
5. Potential-free contacts for interfacing with the train signals (drivers desk activated)
6. Loudspeaker for warning the driver
7. Cubicle/housing for components including terminals, connectors, wiring etc.

The ORBIT application software for the on-board system is NOT part of the scope. Firmware of hardware components and a Linux operating system is part of the scope.

2.3 Project Status

In 2013 the ORBIT project has tested a first prototype of ORBIT during two months. During the test 10 trains were equipped with a working prototype and during the trial period a lot of insight was gained about the functional and technical feasibility of ORBIT functions and its interfaces like GPS and communication via UMTS. These insights are incorporated in this revised market consultation which deals with the final hardware.

After this market consultation detailed specifications and requirements will be drawn for the final hardware and application software.

The next phase of the project will implement the final hardware and application software in a set of 50 trains during a test period of a few months. After successful completion of the test the aim is to install ORBIT within a year in most of the trains running on the main Dutch Rail network.

3 System requirements

3.1 General

This section specifies the normative requirements for the ORBIT On Board Unit (from here referred to as OBU)). These requirements are meant to give information about the context of the information request. .

3.2 General requirements

Gen.1 The ORBIT On Board Unit shall provide the following items (including hardware and drivers):

- Gen.2 a main processor unit with connections to the interface equipment specified below;
- Gen.3 a state of the art position, speed and acceleration sensor based on GPS;
- Gen.4 a UMTS modem for communication;
- Gen.5 digital Inputs to sense e.g. active driver cabin selection;
- Gen.6 an audio output to warn the driver ;
- Gen.7 an audio input to test the well functioning of the audio output;
- Gen.8 digital outputs for future applications;
- Gen.9 Visual indicators for diagnostic purposes;
- Gen.10 an Ethernet connection (10/100/1000 Mbps) for future applications.
- USB interface for service and future applications

Gen.11 The OBU shall be provided with a power supply suitable for application in trains

Gen.12 The OBU shall provide a platform for running user applications like the ORBIT application (not in scope of these requirements).

Gen.13 The OBU shall be provided with all software needed for development of applications, like compilers and online debugging tools.

Gen.14 The OBU shall be provided with a demonstration application with the following functions:

- recording of the actual speed, location and acceleration and quality of GPS with a frequency of at least 1 Hz;
- a web-server application accessible via 3G and/or 4G.
- real time logging of the above mentioned information in a web browser accessible via 3G and/or 4G.

Gen.15 The OBU including all interfaces shall comply with the EN50155 (especially class T3 and section 5.2.1) EN50121-3, EN50264, EN 45545-2:2013 and the supplier shall comply with the ROHS directive.

Gen.16 The OBU shall start itself as soon as the power supply is connected.

3.3 Microcomputer requirements

3.3.1 Performance requirements

Mp.1 The processor performance shall be suitable for the ORBIT train application characterized by the following:

- Processing GPS input at least each second

- Performing a simple train speed guarding task at least each second
- Receiving simple commands via 3G or 4G network
- Recording GPS input at least each second.
- Transmitting recorded data daily.
- Up to two times per hour playing an small speech quality audio file with a duration of 30 seconds

3.3.2 Software and applications

Sa.1 The OBU shall be provided with a recent Linux operating system including a file server application giving remote access (via 3G and/or 4G) to the Linux file system via standard and safe protocols.

3.4 Interface requirements

3.4.1 Position and speed sensing.

GS.1 The position and speed interface shall provide an accurate position (2.6m) , speed (0.1m/s) and acceleration (0.2m/s^2) with a update frequency of at least 1Hz.

GS.2 The position and speed interface shall be provided with at least one GPS antenna that can be mounted near the front window inside the driver cabin. As maximum cable length between antenna and the OBU of 10m has to be taken into account.

3.4.2 UMTS modem

UMTS.1 The modem shall be suitable for communication via the 3G or 4G network.

UMTS 2 The modem shall include an antenna that will be mounted inside the train within a suitable distance of the modem.

3.4.3 Digital input/ output interface

DIO.1 The digital inputs and outputs shall be electrically isolated.

3.4.4 Audio input/output Interface

Au.1 The audio output shall be able to achieve 105dBA output level

Au.2 The audio output shall be low noise

Au.3 The audio output shall include a suitable loudspeaker

Au.4 The audio output power shall be adjustable through the use of software

Au.5 The loudspeaker shall be able to be switched off by the application to reduce noise when no audio output is needed.

Au,6 The audio input shall include a microphone suitable to test the correct functioning of the loudspeaker.

3.4.5 Power supply

Pow.1 The power supply shall be able to deal with a wide range of input voltages (e.g 24V DC to 110V DC).

3.5 RAMS requirements

RAMS.1 The MTBF of the OBU shall be in the range of 10-50 years (including all interfaces) taking into account 24 operational hours per day.

RAMS.2 The MTTR shall be less than 30 minutes and includes the time for diagnoses and repair.

3.6 Physical dimensions

PD.1 The ORBIT main system (Train platform, GPS interface, UMTS modem and Power supply; see figure 2) shall be integrated in a single housing. However, distribution of components across multiple sub-housings may also be an option.

PD.2 The housing maximum dimensions shall be limited.
(Explanation: Every rolling stock series has its own configuration. The space for installing ORBIT is very limited but nevertheless in general a housing of 200x240x100 mm will fit.)

3.7 Preinstalled software

PS.1 The supplier shall deliver each OBU after the delivery of the prototypes (see 3.8) with an installed ORBIT train application provided by ProRail/NS Reizigers.

3.8 Proposed planning requirements

The proposed planning for the delivery of the OBU platforms is as follows:

Date	Deliverable
RFP	**Demonstration (see Gen.14) with a prototype**
Week 1	**4 prototypes**
Week 8	**First series of 100 pieces**
Week 9 – ??	**Roll out of at least 1400 pieces**

4 Information request

4.1 Questions

Q1 The project aims for:
- a quick implementation
- low project risk (e.g. proven technology, open systems, standardized components, non propriety based standards).
- service lifetime of at least 15 years (e.g. high exchangeability of components, high compatibility)application allowed in a railway vehicle
- First time right.

What strategy will be applied to achieve these project aims?

Q2 Provide a compliance list of all requirements. When a requirement is not feasible provide an explanation why not.

Q3 Which requirements have great effect on the price per unit?

Q4 How can the GPS device distinguish between direct satellite view and reflections due to high buildings? How does this affect the accuracy and reliability?

Q5 How fast is recovery of the GPS after losing fix due to tunnels, station roofs of high buildings? For example is it possible to fix within 100m driving with a speed of 100km/h?

Q6 How can the reliability of the UMTS connection be optimized when the antenna is mounted inside the train?

Q7 How can the reliability of the position and speed measurement be optimized when the GPS antenna is mounted near the front window inside the driver cabin?

Q8 Most of the trains are equipped with two driver cabins. Each one for another driving direction. The GPS antennas will be mounted as close to the front window of the driver cabin as possible to offer the best view on GPS satellites. Normally an OBU will be installed in each driver cabin dealing with only one driving direction. However, there are also trains that use one driver cabin for both directions.

Is there a practical and economical solution for driver cabins used in two directions?

Q9 Is one OBU using two GPS antennas a practical and economical solution for freight locomotives (length of the locomotive about 20m) and/or improved accuracy?

Q10 What are the dimensions of the complete OBU? What are optimal dimensions and housing configuration in relation to performance and price?

What are the dimensions of the parts outside the housing?

What mounting methods are provided for the housing and the other parts?

Q11 What is the best possible planning for the roll out of 1400 OBU's?

What is a realistic planning for a demo?

What is a realistic planning for delivery of a series of 4 prototypes?

Q12 Is it possible to have the series provided with a 4G modem instead of a UMTS (3G) modem? What are the estimated additional costs per unit?

Q13 What suggestions do you have to improve the requested MTBF (in- and excluding the loudspeaker and microphone)? What are the estimated additional costs per unit? Can references be provided?

Q14	What strategy will be employed to achieve a short MTTR?
Q15	Due to installation of the series in railway vehicles the quality requirements on delivery and service during system life cycle will be very high. Provide at least two references illustrating experiences in a high quality environment.
Q16	Optionally, maintenance and service will be outsourced. What contribution can be provided to the maintenance and service organisation?
Q17	What are the maximum cable lengths for the UMTS and GPS antenna?
Q18	What installation time is needed for the OBU including all parts?
Q19	What is the estimated power consumption for the OBU?
Q20	What requirements or constrains does the supplier have for application of the OBU and/or the surrounding of the OBU?
Q21	What is the weight of the individual components comprising the OBU?

5 Administrative conditions

5.1 Language

Your offer shall be either in the English or the Dutch language, as you prefer.

5.2 Procedures & Policies

ProRail and NS will treat the information provided by respondents regarding this market survey as confidential. ProRail and NS will therefore not disclose this information to third parties.
It is not permitted to gather information on ProRail or NS on this subject, other than through public sources or from Mr. Dennis Veld (dennis.veld@prorail.nl).
Other ProRail and NS employees or employees employed by third parties who are or have been contracted by ProRail or NS, may not be accessed. This condition remains in effect until ProRail and NS notify otherwise by means of a written notification.

5.3 Liability

In no way rights or binding obligations can be derived from this market consultation. The market consultation is not an assignment nor does it imply, nor can it be interpreted as such nor does it compel ProRail or NS to start a selection process.
If ProRail and NS decide to start a tendering process, this market consultation does not imply any obligation to ProRail or NS to invite suppliers to participate in such a tendering process.

The cost of compiling and delivering the response shall be borne by the respondents. By using this market consultation ProRail and NS and the respondents indemnify each other from any claim in anyway.

5.4 Secrecy

This document is sent for the purpose of issuing a response to ProRail and NS and should be treated as confidential. Use, reproduction and disclosure of information or parts thereof from this market consultation or of any verbal or written communication related to this market consultation, is not permitted.

5.5 Communication

All communication regarding this request for information should be directed to the contact person of Project ORBIT Dennis Veld with the above mentioned E-mail address or to telephone number: 0031882317385.

We would like to hear from you or from your organization in this market research via the E-mail address: dennis.veld@prorail.nl.

Project ORBIT prefers communication by E-mail. Please make sure to start the subject field of your E-mails with the reference: “[ORBIT]” (without the quotation marks).

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