SCOTT:
Secure COnnected Trustable Things

Critical Area Trustable Warning System Demonstrator

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1 EXECUTIVE SUMMARY

Over the last years, the number of accidents along the European railway lines are increased due to safety deficiencies. A high number of these incidents are focused on the level crossing and working areas, which are classified as critical scenarios.

In order to enhance the security and safety in the railway domain, the WP20 is focused on develop a wireless Trustable Warning System for critical areas (TWS). The system performed will be able to detect possible obstacles, which are on or near the track. Furthermore, the system will broadcast the relevant warning information to the vehicles in the vicinity and the train, in case of an emergency manoeuvre is required by the last one. As a last purpose, the developments of the WP20 are an alternative to the current wired technologies since the communications between the track and the train are wireless.

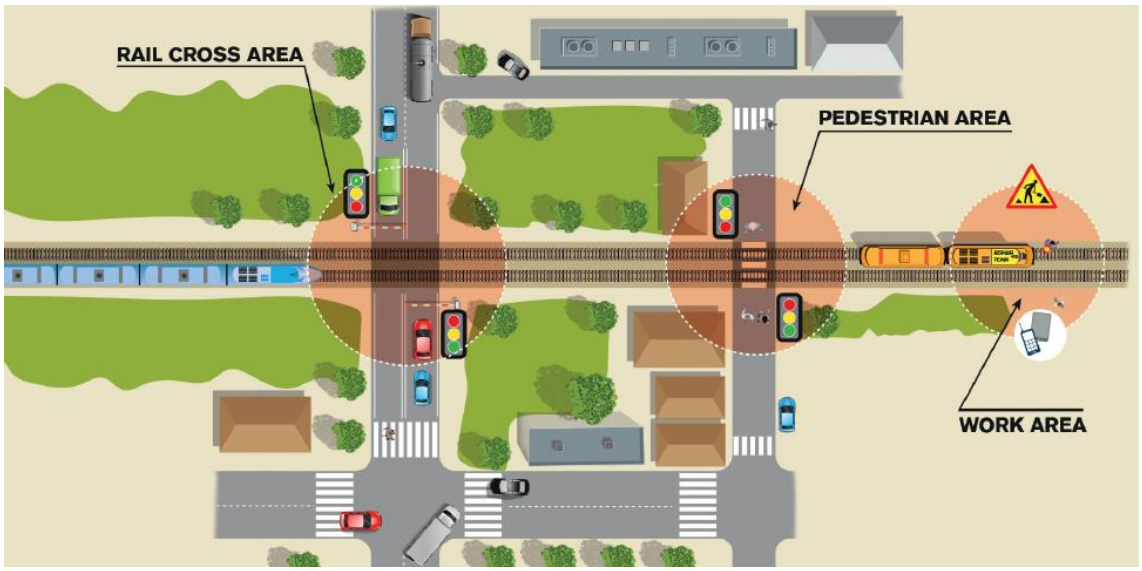

Figure 1: WP20 – Overall View

Key words: wireless trustable warning system, critical areas, railways

2 LIST OF AVAILABLE DEMONSTRATORS

2.1 Demonstrator A

2.1.1 Demonstrator title

Trustable Warning System.

2.1.2 Demonstrator location

The scenario considered is Havelländische Eisenbahn AG (HVLE), located near Berlin in Germany. For this scenario, the location known as "*Location 2*" will be used.

The location 2 is placed near to Spandau station and the length is 6 kilometres. The movements for the WP20 demonstrator will be carried out from Location 2A to Location 2B approximately, which are indicated below.

- Location 2A
    - Location: 52°32'8.2"N, 13°11'22"E
- Location 2B
    - Location: 52°34'02.2"N, 13°11'30.2"E

2.1.3 Demonstrator Partners

Following, the participating partners in this demonstrator are enumerated:

- Indra Sistemas S.A. (INDRA)
- Mondragon Unibersitatea (MGEP)
- Instituto Tecnológico de Informática (ITI)
- Universidad Politécnica de Madrid (UPM)
- JIG

2.1.4 Functional description

2.1.4.1 Key functionalities

The "*Trustable Warning System*" demonstrator aims to evaluate the properly operation of the safety system developed within the WP20. The key functionalities of the demonstrator includes:

- Collect and report obstacle information from the wireless sensor network at the critical area:
    - Weight data
    - Volume data
    - GNSS
    - Velocity
- Secure wireless communications Vehicle-to-everything (V2X)
- Handle safety decisions and procedures for establish the priority at critical areas.

- Processing and display real-time information of the priority data in the information system.

2.1.4.2 Key components (list of Technology Building Block)

The following Building Blocks (BB) are involved in the WP20 demonstrator:

- BB23.A "*Dependable Wireless Sensor Network with enhanced energy, robustness and QoS trade-off*"
- BB23.I "*Safety for critical traffic infrastructure*"
- BB23.J "*Reliable Wireless Multi-hop Communications*"
- BB23.K "*Reliable Wireless PHY and MAC*"
- BB26.A "*Autonomous Wireless Network*"

2.1.4.3 Simplified architecture of the demonstrator

A simplified structure for the WP20 demonstrator is shown in the figure below.

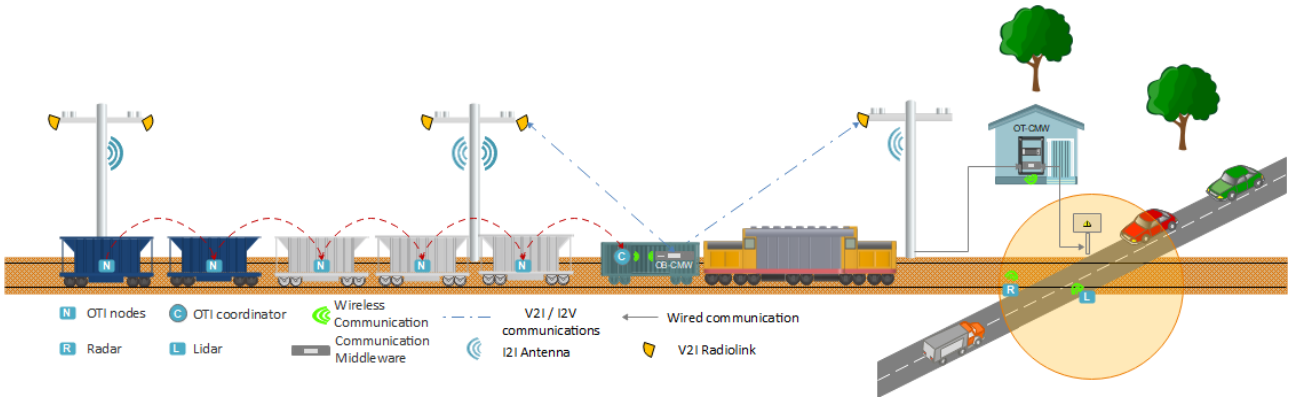

Figure 2: WP20 – Simplied structure of the demonstrator

2.1.4.4 Media (links to videos, pictures, diagrams)

2.1.4.4.1 Location

The following figure shows the location 2 that is considered for the WP20 demonstrator. The red lines indicate the tracks on Location 1 (used for the WP19) and Location 2, the blue one links both locations, which is name In-between, track.

Figure 3: Locations Track and route between them on satellite picture of the area

2.1.4.4.2 Rolling Stock

The rolling stock chosen for the demonstrator is shown in the pictures below. It is distinguished between the traction and the wagons.

The locomotive V160 has been selected for the tests due to the bidirectional capabilities that are useful for the WP19 demonstrator.

Figure 4: Locomotive V160

Concerning the composition for the demonstrator, there are two different wagons required. One the one hand, it is necessary a flat wagon (See Figure 5) to install a cage with all the equipment for the communications.

Figure 5: Flat Wagon

On the other hand, the wireless sensor networks will installed on two types of wagons: White Hopper (See Figure 6) and Super Self Discharging Train (SSDT) (See Figure 7)

Figure 6: Faccns Hopper Wagon

Figure 7: SSDT Hopper Wagon

2.1.4.4.3 Wireless Sensor Network

For gathering obstacle information at the critical zone, the Lidar and Radar technologies are used. The figure below shows the hardware of the radar and LIDAR.

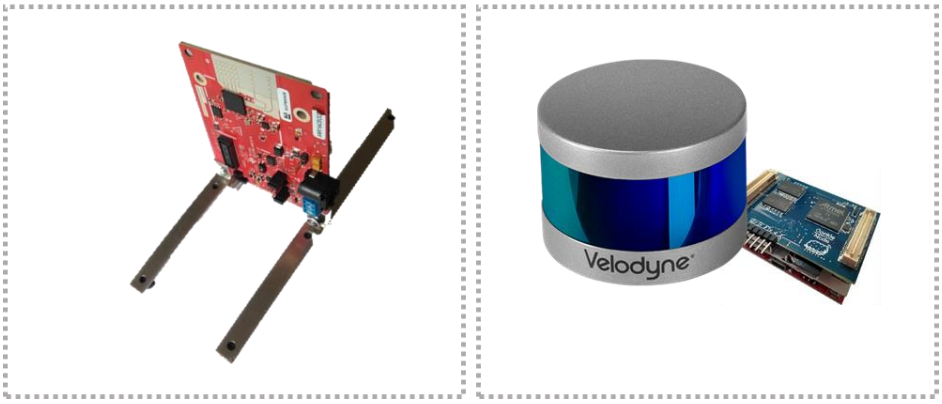

Figure 8: Radar (Left side) and Lidar (Right side)

In addition, in each wagon will installed wireless sensor nodes (See Figure 9) for collect information about the position.

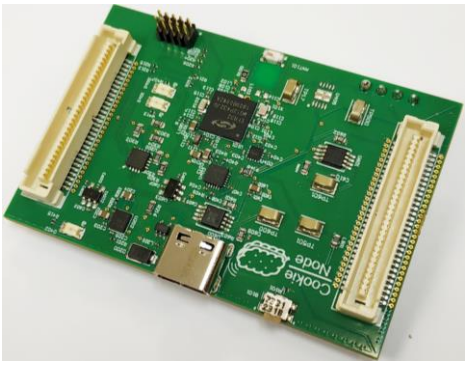

Figure 9: BB23.A node

2.1.4.4.4 Wireless Sensor Network Coordinator

The entity in charge of collect all the information gathered by the sensors and send it to the communication middleware is the wireless sensor network coordinator.

In the Figure 10 is shown the WSN coordinator provided by ITI.

Figure 10: Wireless Sensor Network Coordinator

2.1.4.4.5 Communication MiddleWare

The hardware used for handle application messaging, formatting and representation is shown in the figure below. The hardware of the communication middleware, which is shown in the following figure, is used both for on board and for on track.

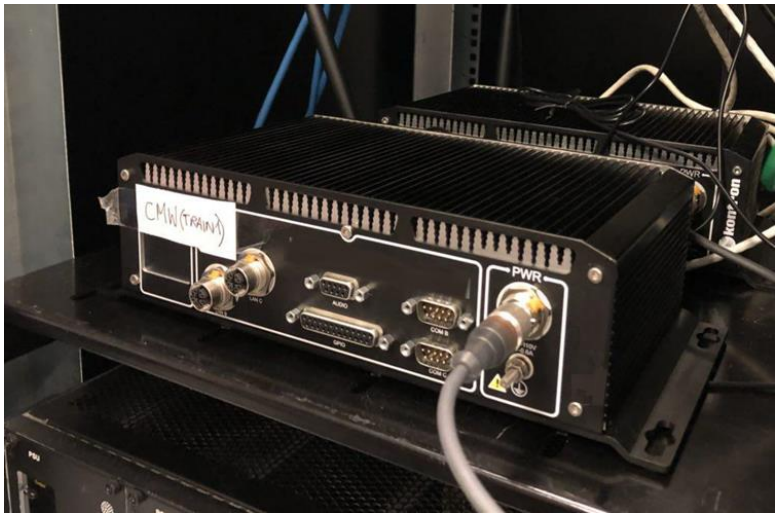

Figure 11: CMW hardware

2.1.4.4.6 Communications

Regarding the communications, it will be test the V2X, which have been tested before at Indra facilities in Madrid. The equipment for the V2X communications used for the tests is shown in the Figure 12.

Figure 12: V2X radio equipment

In addition, the BB23.K "*Reliable Wireless PHY and MAC*" has performed a solution to enhance the reliability of the wireless connectivity in railway scenarios (V2X communications). In the following figure is shown the equipment used for the V2X communications.

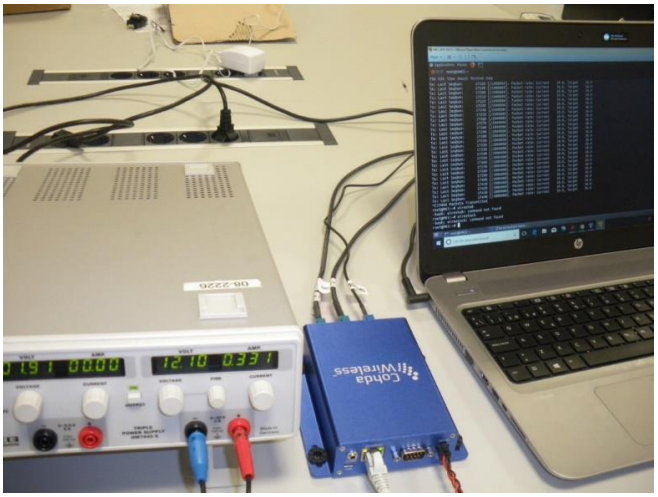

Figure 13: Cohda MK5 OBU equipment

A. ABBREVIATIONS AND DEFINITIONS

Term	Definition
BB	Building Block
HVLE	Havelländische Eisenbahn AG
INDRA	Indra Sistemas S.A.
ITI	Instituto Tecnológico de Informática
MGEP	Mondragon Unibersitatea
SSDT	Super Self Discharging Train
TWS	Trustable Warning System
UPM	Universidad Politécnica de Madrid
V2X	Vehicle to Anything