**SAFESPOT INTEGRATED PROJECT - IST-4-026963-IP**

**DELIVERABLE 4.4.3**

**SP4 – SCOVA – Cooperative Systems Applications**

**Vehicle Based**

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**Equipped Trucks Integrating the Safety Margin Applications**

<table>
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<td>Authors (per company, if more than one company provide it together)</td>
<td>Erik Nordin, Lars Bjelkeflo, Benjamin Guincestre, Volvo</td>
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## Revision Log

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<td>Erik Nordin, Volvo</td>
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<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CAN</td>
<td>Controller Area Network</td>
</tr>
<tr>
<td>COSSIB</td>
<td>Cooperative Safety Systems Infrastructure Based</td>
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<td>CVIS</td>
<td>Cooperative Vehicle-Infrastructure System</td>
</tr>
<tr>
<td>ECU</td>
<td>Electronic Control Unit</td>
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<td>ExtMsgApp</td>
<td>External Message Application</td>
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<td>FCW</td>
<td>Frontal Collision Warning</td>
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<tr>
<td>FUP</td>
<td>Front Under-run Protection</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<td>HMI</td>
<td>Human Machine Interface</td>
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<td>LAN</td>
<td>Local Area Network</td>
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<tr>
<td>PC</td>
<td>Personal Computer</td>
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<tr>
<td>RCS</td>
<td>Road Condition Status – Slippery Road</td>
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<tr>
<td>SAFEPROBE</td>
<td>In-Vehicle Sensing and Platform</td>
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<td>SCOVA</td>
<td>System Cooperative Vehicle Based Application</td>
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<tr>
<td>SP</td>
<td>Sub Project</td>
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<tr>
<td>TS</td>
<td>Test Site</td>
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<tr>
<td>UDP</td>
<td>User Datagram Protocol</td>
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<tr>
<td>VANET</td>
<td>Vehicle Ad-hoc Network</td>
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<tr>
<td>VRU</td>
<td>Vulnerable Road User</td>
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<tr>
<td>VRUAA</td>
<td>Vulnerable Road User detection and Accident Avoidance</td>
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<td>WP</td>
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EXECUTIVE SUMMARY

In this document the equipped trucks integrating the Safety Margin Assistance are presented. All of the related developments have been carried out by VOLVO, achieving a system implementation compliant with the SAFESPOT reference architecture. Such implementation is designed in order to collect and store data retrieved from local sensors and from sensors belonging to other vehicles or to infrastructure units; these data are received through the wireless communication network and used by suitable driver’s support applications.

The developed system is able to understand in an automatic way when a dangerous situation holds in the surrounding scenario and to warn the driver accordingly. Overall objectives considered during the implementation phase of the system (SP4-SCOVA - WP4) are reported hereafter:

- to implement the Safety Margin algorithms for the computation of the characteristic parameters;
- to develop the safety applications to be used in the validation and evaluation phase;
- to tune and improve the developed applications based on preliminary test and validation results.

The present document is an accompanying report of Deliverable D4.4.3 (consisting of the actual truck demonstrator vehicles), shortly illustrating how these vehicles are equipped. The most part of the components and sub-systems, with a specific focus on the technology platform developed by SP1-SAFEPROBE, have been detailed in deliverable D1.4.2 – “HW and SW specifications of prototype and test bed components” [1].
1. Demonstrator vehicles provided by Volvo

1.1. Functionality

Volvo is in charge to provide the trucks for the SAFESPOT project. The system is implemented in three normal productions trucks: a Volvo FH-520 6x2 tractor, a Volvo FH-520 6x2 rigid, and a Renault Premium Distribution Truck. In the Volvo demonstrators the functionalities needed to host and to demonstrate the following SP4 applications are implemented.

- FCW – Frontal Collision Warning
- RCS – Road Condition Status – Slippery Road
- VRUAA – Vulnerable Road User detection and Accident Avoidance

All these applications have been initially introduced in D4.2.2 - Safety Margin concept [2] and in D4.2.3 - Use case and typical accident situation [3]. The related functional specifications have been detailed in D4.3.2 - SP4 Applications Functional Specifications [4].

1.1.1. Frontal Collision Warning

The General Use Case for the Frontal Collision Warning application provides assistance for general scenarios such as the one showed in the pictogram below. Recommendations are provided to the driver of the ego vehicle (actor 1 in the Figure 1) in order to prevent the risk of frontal collisions due to static obstacles or unexpected queueing in front.

![Figure 1: FCW – General Use Case.](image-url)
1.1.2. Road Condition Status – Slippery Road

The General Use Case for the Road Condition Status – Slippery Road is a generalisation of the two basic Use Cases, where the needed information about the slippery condition of the road segment is considered independently if the information source is from the infrastructure or direct from another vehicle.

![Figure 2: RCS – General Use Case.](image)

1.1.3. Vulnerable Road User Warning

The general use case for the Vulnerable Road User application is coincident with the use case 10a: Vulnerable road user crossing a road, based on on-board detection system.

![Figure 3: VRU – General Use Case.](image)
1.2. Vehicles

Volvo implemented the SAFESPOT system in three normal productions trucks: a Volvo FH-520 6x2 tractor, a Volvo FH-520 6x2 rigid, and a Renault Premium Distribution Truck as shown in figure 4.

They are three typical trucks for long, mid and short distances and are representative hosts for the communication based applications implemented by Volvo.

Figure 4: Volvo demonstrators: a Volvo FH-520 6x2 rigid, a Volvo FH-520 6x2 tractor and a Renault Premium Distribution Truck.
1.3. Equipment

Each vehicle is equipped in order to integrate SAFESPOT and CVIS systems on a common reference platform, according to Figure 5 below.

![Figure 5: SAFESPOT and CVIS common architecture – VOLVO implementation.](image)

Then the Volvo trucks have a connection to the in-vehicle data using a gateway as shown in Figure 6.

![Figure 6: SAFESPOT and CVIS common architecture – Connection to the in-vehicle data for the VOLVO trucks.](image)
Eventually, the Volvo FH-520 6x2 tractor, which is used as probe vehicle, is equipped a Road Eye sensor and Laser Scanners.

The SAFESPOT vehicle equipment present in the Volvo demonstrator trucks has been described in detail in D1.4.2 [1].

### 1.3.1. Installation layout

The SAFESPOT equipment is installed in the Volvo FH-520 6x2 tractor and the Volvo FH-520 6x2 rigid according to Figure 8. The Renault Premium Distribution Truck is smaller and cannot follow the same installation layout as the Volvo trucks. For the Renault Premium Distribution Truck the SAFESPOT components are mainly installed behind the seats inside the driver cabin in a dedicated compartment.
Most of the control units are located in the SAFESPOT PC compartment on the left side of the Volvo truck cabin, as illustrated in Figure 9.

An exception is the positioning PC, which needs to be placed close to the positioning camera, in the upper part of the windscreen, due to limited length of the FireWire cable. This detail can be observed in Figure 10.
Figure 10: AGLAIA positioning camera location in upper part of windscreen.

Other sensors are placed according to providers specifications; the three IBEO laser scanners are mounted in the front under-run protection (FUP) and the Road Eye surface estimation sensor is viewing the ground just under the FUP.

Figure 11: 2 out of the 3 IBEO laser scanners installed on Volvo FH-520 6x2 tractor.

Antennas are mounted on the antenna rack on the top of the cabin.

In order to ensure stable power supply, extra batteries and charging equipment are installed. The battery box is mounted on the chassis just behind the driver cabin.
The results of the SP4 application analysis, in the form of warning messages, are delivered to the driver using a human machine interface (HMI). All applications provide information to the driver using the secondary display shown in Figure 12.

![Image of HMI of Volvo Demonstrators](image_url)

Figure 12: HMI of Volvo Demonstrators (here the Renault truck).
1.3.2. Executed demonstration activities

Two relevant demonstration events happened in the last year of activity of the SAFESPOT project: the demonstration, during the 16th World Congress for ITS Systems and Services in Stockholm, on September 2009:

http://www.itsworldcongress.com/

and the demonstration during the Cooperative Mobility Showcase 2010 - smart vehicles on intelligent roads, held in Amsterdam, on March 2010:


Following pictures report some of the activities carried out during the above demonstration events.

Figure 13: ITS Stockholm event – Execution of the Use Case.

Figure 14: ITS Stockholm event – Presentation of the vehicles.
Figure 15: Cooperative Mobility Showcase 2010 - A guest is received by the driver.

Figure 16: Cooperative Mobility Showcase 2010 – A guest is informed about the Safespot system and the use case he will see.
Figure 17: Cooperative Mobility Showcase 2010 – Vehicles are in position for the next demo.

Figure 18: Cooperative Mobility Showcase 2010 – The use cases demonstrated include CRF & Volvo vehicles.
Conclusions

Three demonstrator trucks have been equipped by Volvo with SAFESPOT components and subsystems to develop, evaluate and demonstrate the different applications of the SCOVA SP.

In this document the equipped trucks integrating the Safety Margin Assistance and compliant with the SAFESPOT system have been presented. The Volvo test vehicles will mainly be used to support the Swedish TS SP with the vehicle based applications whose Volvo is application Leader, namely FCW – Frontal Collision Warning, RCS – Road Condition Status and VRUAA – Vulnerable Road User Detection and Accident Avoidance.

As it has been shortly outlined, SAFESPOT applications have the task to process the collected information in order to analyze the surrounding scenario and warn the driver through human user interfaces.

The vehicles have been built based on the same common architecture as described in D7.3.1 – Global System Reference Architecture [5].

2. References

[1] C. Zott, P. Lytrivis “SAFESPOT D1.4.2 - HW and SW specifications of prototype and test bed components”.


[3] G. Vivo, “SAFESPOT D4.2.3 - Use case and typical accident situation”.

