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TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

FG Distraction

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ITU-T Focus Group on Driver Distraction

Report on Use Cases

Focus Group Technical Report

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The procedures for establishment of focus groups are defined in Recommendation ITU-T A.7. The ITU-T Focus Group on Driver Distraction (FG Distraction) was established further to ITU-T TSAG agreement at its meeting in Geneva, 8-11 February 2011. ITU-T Study Group 12 is the parent group of FG Distraction.

Deliverables of focus groups can take the form of technical reports, specifications, etc. and aim to provide material for consideration by the parent group in its standardization activities. Deliverables of focus groups are not ITU-T Recommendations.

SERIES OF FG DISTRACTION TECHNICAL REPORTS

Final Report

Report on Use Cases

Report on User Interface Requirements for Automotive Applications

Report on Situational Awareness Management

Report on Vehicle-to-Applications Communications Interface

ABSTRACT

This document contains the report from FG Distraction on Use Cases. These use cases show why ITU-T Recommendations are needed to support safe interaction of external applications/services with drivers.

Table of Contents

Page

1. Scope

This report describes use cases that will be enabled by ITU-T Recommendations currently under development (i.e., P.UIA, G.SAM, G.V2A). They deal with enabling Information and Communications Technology (ICT) systems/applications that are external to the vehicle platform to safely interact with drivers. These use cases apply to non-commercial road vehicles. Some use cases also assume the presence of advanced vehicle technologies such as driver workload monitoring systems that are currently not universally available and for some classes of vehicles may never be universally provided. Advanced Driver Assistance Systems (ADAS) are considered out of scope.

2. References

[1] ITU-T FG Distraction P.UIA report, *FG Distraction report on User Interface requirements for Automotive applications (P.UIA).*

[2] ITU-T FG Distraction G.SAM report, *FG Distraction report on Situational Awareness Management (G.SAM).*

[3] ITU-T FG Distraction G.V2A report, *FG Distraction report on communications interface between external applications and a Vehicle Gateway Platform (G.V2A).*

3. Definitions

ADAS – Advanced Driver Assistance Systems are vehicle systems which have a primary function of helping the driver safely control the vehicle. Examples of such systems include lane departure warning systems and Adaptive Cruise Control (ACC).

Commercial road vehicle – a vehicle used by businesses or public transportation authorities which as a primary function other than personal transportation of individuals or small groups of individuals. Examples include tractor-trailers and buses. Such vehicles often require drivers to perform additional tasks while driving which may not have been adequately considered during the development of this report.

Driver profile – information at the DVI that describes static driver capabilities and other driver information (e.g., age, etc.). Exactly how the DVI acquires this knowledge is outside the scope of the ITU-T Recommendations being considered in this document.

Driver-Vehicle Interface (DVI) – the integrated user interface in the vehicle. It includes visual displays, loudspeakers, microphones, manual input controls, etc.

Driver-Vehicle Interface (DVI) capabilities – description of the type of communications that can be supported between the driver and vehicle. This includes both driver capabilities (e.g., hearing impairment, visual distraction, etc.) and vehicle capabilities (e.g., manual input controls, display characteristics, etc.).

Dynamically changing driver capabilities – short-term changes in the ability of the driver to receive or send information. These changes could be caused by the driving environment or internal physiological/psychological factors.

External application/service – applications/services that were not integrated into the vehicle at the time of manufacture. Such applications/services include those that reside on a nomadic device brought into the vehicle, roadside station, or cloud-based server. Applications/services that do reside on the vehicle platform, but were not integrated at the time of manufacture (e.g., downloaded applications), are also considered “external applications/services” since they might not be fully integrated into the DVI.

Static driver capabilities – inherent or slowly changing abilities of the driver to send or receive information. Examples include hearing impairment and baseline cognitive abilities.

4. Abbreviations

DVI	Driver Vehicle Interface
G.SAM	Draft new Recommendation ITU-T G.SAM
G.V2A	Draft new Recommendation ITU-T G.V2A

ICT	Information and Communications Technology
IT	Information Technology
P.UIA	Draft new Recommendation ITU-T P.UIA
QoS	Quality of Service

5. Introduction

Drivers will interact with the applications that are important to them despite laws forbidding use and their general knowledge that such interactions can be dangerous. This is partly due to underestimation of the true risks associated with such interactions. Very often the driver has no safer alternatives to interact with some application.

Moreover ICT systems/applications that try to communicate with drivers have the potential to distract and overload the driver if communications with the driver is not managed.

Technology standards have the potential to offer safer interaction and a better user experience. However, there are several issues with existing ICT applications/systems that need to be addressed:

- o Designers and developers of ICT applications/systems need to be aware of what is important for supporting safe interaction between a driver and ICT applications/systems
- o *When* ICT applications/systems interact with a driver needs to be controlled based on the driver's situational awareness, roadway situation, and vehicle state
- o *How* ICT applications/systems interact with a driver needs to be adapted based on the driver's capabilities, roadway situation, vehicle state, and Driver-Vehicle-Interface (DVI) capabilities
- o Transmission performance requirements for safe interaction are important (e.g., service availability, delay, information loss, etc.) and ICT applications/systems should be able to identify deficiencies in transmission performance and adjust system interfaces to the driver accordingly
- o Interoperability must exist between the subsystems (e.g., application, nomadic device, DVI, etc.) which make up the Drive-Application system

Educational campaigns and government regulation are important parts of the solution to the global problem of driver distraction and workload. However, technology standards that enables drivers to safely interact with ICT systems/applications are also an important part of the solution.

The ITU-T is working on technology standards that will enable safer Driver-Application interaction – regardless of where the application/service is located (e.g., nomadic device, cloud-based server, etc.). The purpose of this report is to document the use cases that should be addressed by the ITU-T Recommendations under development (i.e., P.UIA, G.SAM, G.V2A). It is hoped that they will guide the development of these standards.

6. Use cases addressed by ITU-T Recommendations

This section provides a high level description of the use cases addressed by driver distraction related ITU-T Recommendations currently under development (i.e., P.UIA, G.SAM, G.V2A). They are:

1) **Interaction with external application/service**
2) **Arbitration and integration of external message**
3) **Negotiation of network Quality of Service (QoS)**
4) **Management of multiple dialogues**
5) **Adaptation of DVI and external applications/services to driver capabilities**
6) **Adaptation of DVI and external applications/services to roadway situation**

7) **Adaptation of DVI and external applications/services to vehicle state**
8) **Adaptation of DVI and external applications/services to Information Technology (IT) policy**

For each use case, detailed user scenarios are given showing the interactions between the driver and applications for different exemplars of the use case. These examples illustrate the need for technology standards to enable safe interactions with external applications. It is worth noting that these user scenarios avoid specifying a particular technology or implementation – except in cases where is judged that doing so significantly improves comprehension of the user scenario to the reader.

Each user scenario is explained with a figure and associated written description. White numbers on the figures correspond to the step number in the written description. The figures follow a common format which is described next (see Figure 1a for reference).

Each figure shows the communications that takes place between the objects involved in the example. Objects are shown across the top of the figure. They are:

- **Driving situation** – represents the driving environment and its effect on Situational Awareness (SA). Events that impact the driver are shown as lines between the “Driver situation” object and “Driver” object.
- **Driver** – represents the person that is operating the vehicle.
- **Driver-Vehicle Interface (DVI)** – represents the integrated user interface in the vehicle. It includes visual displays, loudspeakers, microphones, manual input controls, etc.
- **Network** – represents the communications network used to connect other objects. This could be either a wired (e.g., USB, MOST, etc.) or wireless network (e.g., WiFi, LTE, etc.).
- **Nomadic device** – represents device carried into the vehicle (e.g., mobile phone, Personal Navigation Device, etc.) which has a system or application that interacts with the driver.
- **Other vehicle** – represents a vehicle which has a system or application that allows interaction with the driver of a different vehicle.
- **Roadside station** – represents roadside equipment which has a system or application that needs to interact with the driver.
- **Cloud-based server** – represents a network server which has a system or application that needs to interact with the driver.
- **Application** – represents an application that needs to interact with the driver.

The thick grey bars, which start just below the objects and extend straight downward, represent the objects they are beneath over time. Communications is shown using lines between these objects. If the grey bars are partially transparent this indicates that the associated object is not involved in the communications being shown in the current figure.

The type of communications is indicated by the characteristics of the line, as shown in the legend:

- **Dialogue/App** – Line shadowing is used to distinguish the communications of multiple dialogues with different applications. Figure 1a shows communications with a single application so no line shadowing is needed for this example.
- **Interface modality** – Line color is used to show modality of communications. Orange represents light (i.e., vision). Blue represents sound transmission. Brown represents mechanical coupling.
- **Communications type** – Line type is used to distinguish the various types of communication within a mode.
- **Amount of information** – Line thickness is used to show the amount of information transmitted per unit time. Thin lines represent small amounts of information. Medium thickness represents medium amounts of information. Thick lines represent large amounts of information.

Call-outs (i.e., blue comment boxes) are used to highlight where and how ITU-T Recommendations are used to enable safe interactions between drivers and external applications.

Each of the following sub-sections describes a different use case and corresponding examples.

6.1 *Use Case 1*: Interaction with external application/service

This use case refers to the ability for drivers to safely interact with “external application/services” (see definition in Section 3) through the vehicle’s Driver-Vehicle Interface (DVI) – regardless of where they are located.

The ability to interact with external applications/services through the DVI is important for a couple of reasons. First, the DVI is designed for safe interaction with the driver. For example, visual displays are located within the vehicle to minimize driver distraction and integrated microphones are positioned to optimize speech pick-up and noise rejection. Second, having all communications with the driver go through the DVI allows the vehicle to control the timing and format of <u>all</u> communications with the driver. This prevents external applications/services from distracting the driver at critical moments or causing elevated workload. It also allows message format of external applications/services to be optimized based on the driving situation.

Five detailed user scenarios of Use Case 1 are given in the following sub-subsections:

1. *Scenario 1a*: Application on nomadic device
2. *Scenario 1b*: Application on cloud-based server
3. *Scenario 1c*: Downloaded Application
4. *Scenario 1d*: Broadcast of roadway information
5. *Scenario 1e*: Tethering

6.1.1 *Scenario 1a*: Application on nomadic device

In this scenario the driver decides to interact with an application on her mobile phone. The particular application is not important, at least for Use Case 1, since it is intended to apply to all applications that follow the guidance provided in the ITU-T (i.e., P.UIA, G.SAM, and G.V2A) and referenced standards. The ability to safely interact with an application on a nomadic device is what is being shown.

The sequence of events and communications between objects for Scenario 1a are illustrated in Figure 1a and described below:

1) User Scenario 1a starts with the driver outside of her parked car.
2) The driver enters her car, starts it, and docks her carried-in device.
3) Upon docking, the DVI automatically connects to the device. The physical connection could be either wired (e.g., USB, etc.) or wireless (e.g., WiFi, etc.). P.UIA recommends automatic docking of the nomadic device subsystem. G.SAM defines the mechanisms that enable automatic connection.
4) The device then activates all applications that are standards-compliant.
5) Upon activation, applications use mechanisms defined in G.SAM to negotiate network QoS and query DVI capabilities. These mechanisms ensure sufficient communications QoS and optimization of message modality, respectively. The authority of the application to interact with the driver is also verified using G.SAM mechanisms.
6) Applications then communicate with the DVI. G.V2A defines a communications interface that enables the application to communicate with the vehicle. In this scenario, a visual message is sent by the application to indicate that it is available. P.UIA recommends characteristics of visual messages to optimize situational awareness.
7) The DVI presents the visual message indicating that the application is available to the driver.
8) The driver starts driving.
9) The driver manually activates the speech interface on the DVI. P.UIA recommends characteristics of manual control input.

10) The DVI speech interface verbally prompts the driver for speech input. P.UIA provides guidance on the characteristics of speech interfaces.

11) The driver interacts with the application using speech.

12) The application responds to the driver's input using an auditory message. P.UIA recommends characteristics of auditory messages.

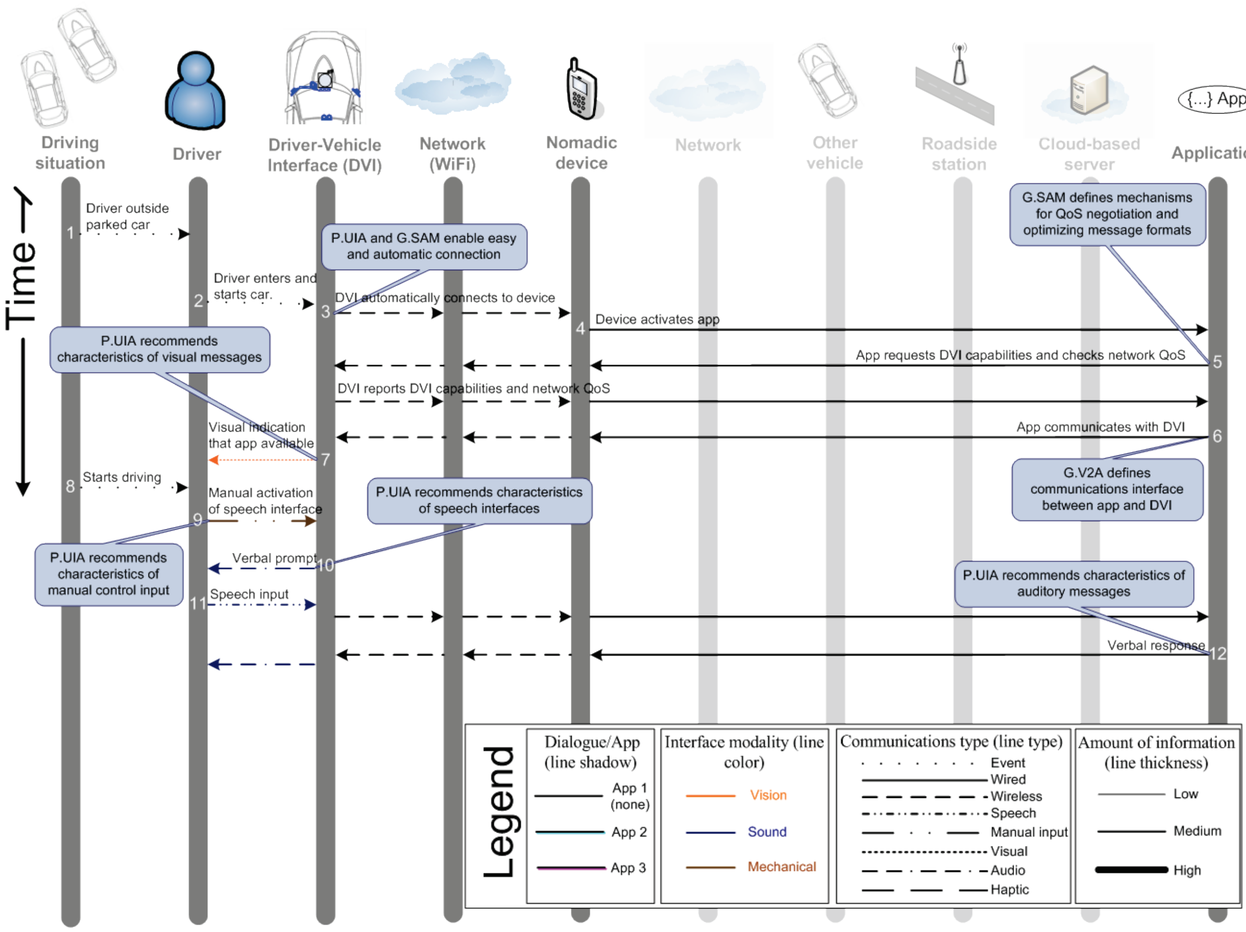

Figure 1a. Detailed example of Use Case 1 showing safe interaction of driver with application on nomadic device.

6.1.2 *Scenario 1b*: Application on cloud-based server

In this scenario the driver decides to interact with a cloud-based application. The ability to safely interact with an application running on a network server (a.k.a., cloud-based server) is what is being shown.

The sequence of events and communications between objects for Scenario 1b are illustrated in Figure 1b and described below:

1) User Scenario 1b starts with the driver outside of his parked car.

2) The driver enters his car and starts it.

3) Upon starting the car, the DVI automatically connects to a cloud-based server through an LTE connection. P.UIA recommends automatically establishing the connection and G.SAM defines the mechanisms that enable the automatic connection to the cloud-based server.

4) The cloud-based server then activates the application.

5) Upon activation, the application uses mechanisms defined in G.SAM to negotiate network QoS and query DVI capabilities. These mechanisms ensure sufficient communications QoS and optimization of message formants, respectively. The authority of the application to interact with the driver is also verified using G.SAM mechanisms.

6) The application then communicates with the DVI. G.V2A defines a communications interface that enables the application to communicate with the vehicle. In this scenario, a visual message is sent by the application to indicate that it is available. P.UIA recommends characteristics of visual messages to optimize situational awareness.
7) The DVI presents the visual message indicating that the application is available to the driver.
8) The driver starts driving.
9) The driver manually activates the speech interface on the DVI. P.UIA recommends characteristics of manual control input.
10) The DVI speech interface verbally prompts the driver for speech input. P.UIA provides guidance on the characteristics of speech interfaces.
11) The driver interacts with the application using speech.
12) The application responds to the driver's input using an auditory message. P.UIA recommends characteristics of auditory messages.

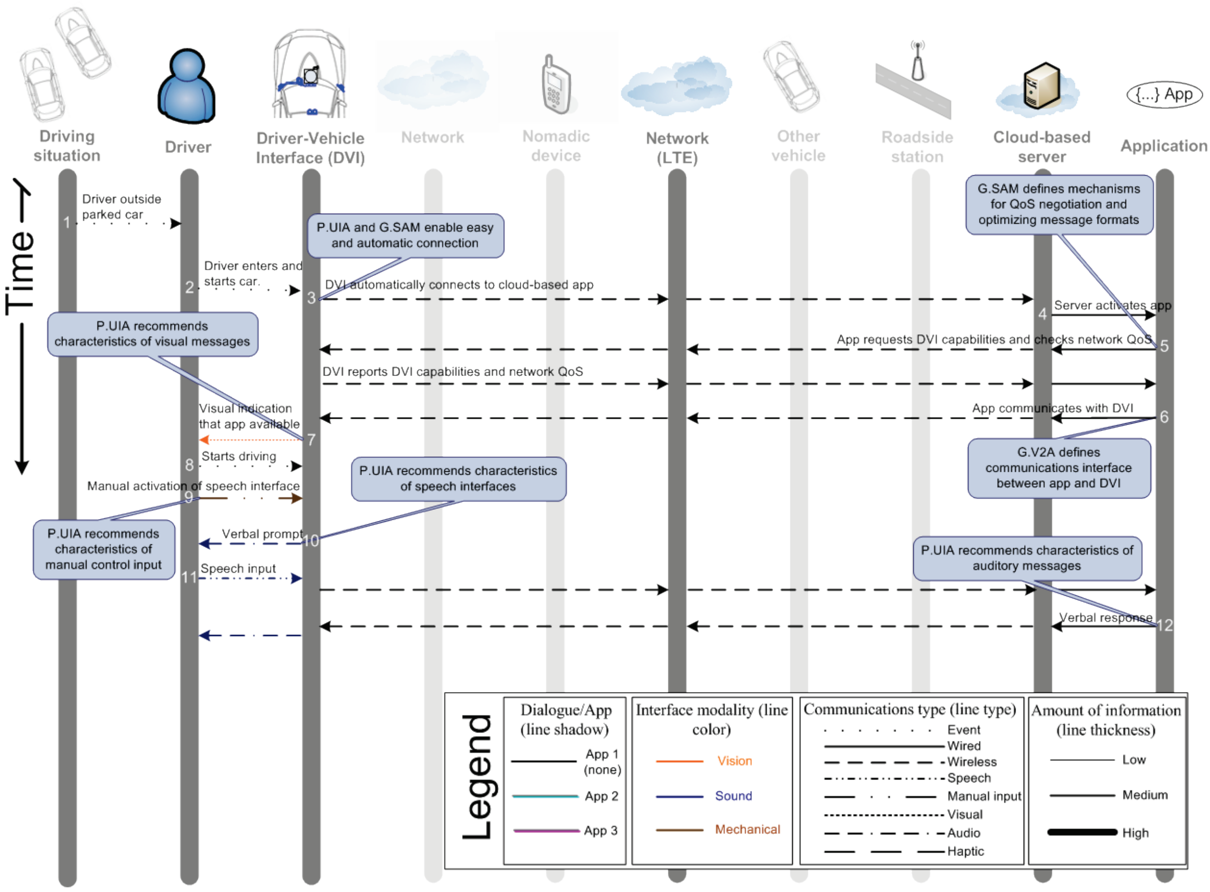

Figure 1b. Detailed example of Use Case 1 showing safe interaction of driver with cloud-based application.

6.1.3 *Scenario 1c*: Downloaded Application

In this scenario the driver decides to interact with a downloaded application running on the vehicle. The ability to safely interact with a downloaded application, which was not known at the time of vehicle manufacture, is what is being shown.

The sequence of events and communications between objects for Scenario 1c are illustrated in Figure 1c and described below:

1) User Scenario 1c starts with the driver outside of her parked car.
2) The driver enters her car and starts it.
3) Upon starting the car, the DVI automatically connects to an application that has been downloaded to the vehicle. P.UIA recommends automatically establishing the connection and G.SAM defines the mechanisms that enable the automatic connection to the application.
4) Upon activation, the application uses mechanisms defined in G.SAM to check local network QoS (e.g., MOST, etc.) and query DVI capabilities. These mechanisms ensure sufficient communications QoS and optimization of message modality, respectively. The authority of the application to interact with the driver is also verified using G.SAM mechanisms.
5) The application then communicates with the DVI. G.V2A defines a communications interface that enables the application to communicate with the DVI. In this scenario, a visual message is sent by the application to indicate that it is available. P.UIA recommends characteristics of visual messages to optimize situational awareness.
6) The DVI presents the visual message indicating that the application is available to the driver.
7) The driver starts driving.
8) The driver manually activates the speech interface on the DVI. P.UIA recommends characteristics of manual control input.
9) The DVI speech interface verbally prompts the driver for speech input. P.UIA provides guidance on the characteristics of speech interfaces.
10) The driver interacts with the application using speech.
11) The application responds to the driver's input using an auditory message. P.UIA recommends characteristics of auditory messages.

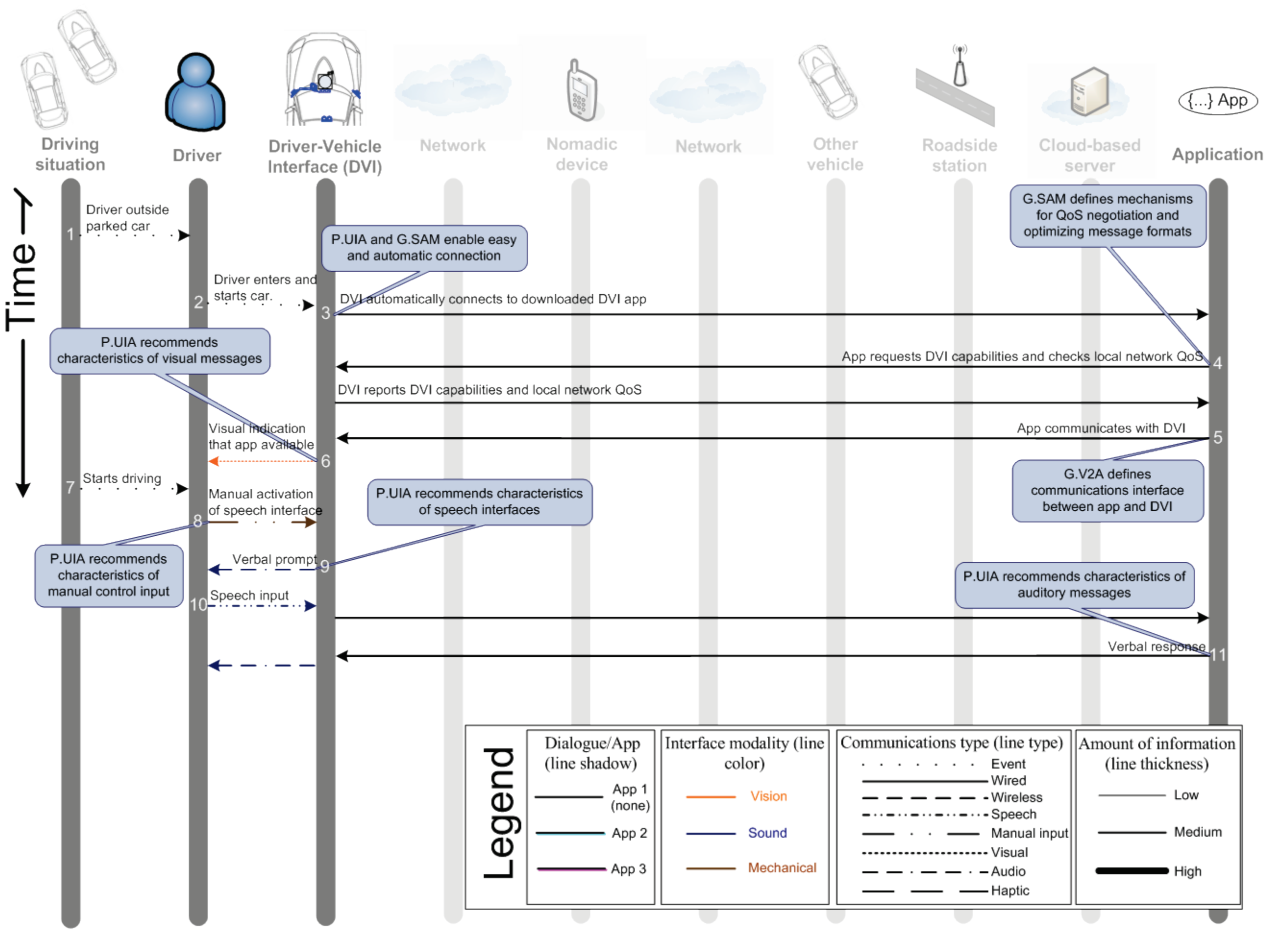

Figure 1c. Detailed example of Use Case 1 showing safe interaction of driver with application on vehicle platform.

6.1.4 *Scenario 1d*: Broadcast of roadway information

In this scenario roadway information is broadcast to the driver. This is an example of Infrastructure-to-Vehicle (I2V) communications. Such information could include weather conditions, traffic information (e.g., congestion, stopped traffic, etc.), or roadway hazards (e.g., presence of animals, construction workers, etc.). The application/service generating these messages is shown to be on both a cloud-based server and a roadside station. The ability to safely broadcast this information to the driver is what is being shown.

The sequence of events and communications between objects for Scenario 1d are illustrated in Figure 1d and described below:

1) User Scenario 1d starts with the driver already driving and connected to the cloud.
2) A cloud-based application determines it should send a roadway information message to a vehicle based on the vehicle's current location. The application uses mechanisms defined in G.SAM to check network QoS and query DVI capabilities. These mechanisms ensure sufficient communications QoS and optimization of message formants, respectively. The authority of the application to interact with the driver is also verified using G.SAM mechanisms.
3) The application sends a roadway information message to the DVI. G.V2A defines a communications interface that enables the application to communicate with the DVI.
4) The DVI provides a visual indication of road state. Additional information about the road state could be requested by the driver, but is not in this example. A visual message is given instead of an auditory message based on recommendations in P.UIA. In this case, the roadway hazard is not urgent. The characteristics of visual messages to optimize situational awareness are also provided by P.UIA. An acknowledgement that the message has been presented to the driver is also sent from the DVI to the application.
5) An application running on a roadside station determines it should send a roadway information message to a vehicle based on the vehicle's current location. The application uses mechanisms defined in G.SAM to check network QoS and query DVI capabilities. These mechanisms ensure sufficient communications QoS and optimization of message formants, respectively. The authority of the application to interact with the driver is also verified using G.SAM mechanisms.
6) The application sends a roadway information message to the DVI. G.V2A defines a communications interface that enables the application to communicate with the DVI.
7) The DVI provides an auditory indication of road state. An auditory message is given instead of a visual message based on recommendations in P.UIA. In this case, the roadway hazard is urgent and spatial relation of the hazard relative to the driver is known. The characteristics of auditory messages to optimize situational awareness are also provided by P.UIA. An acknowledgement that the message has been presented to the driver is also sent from the DVI to the application.

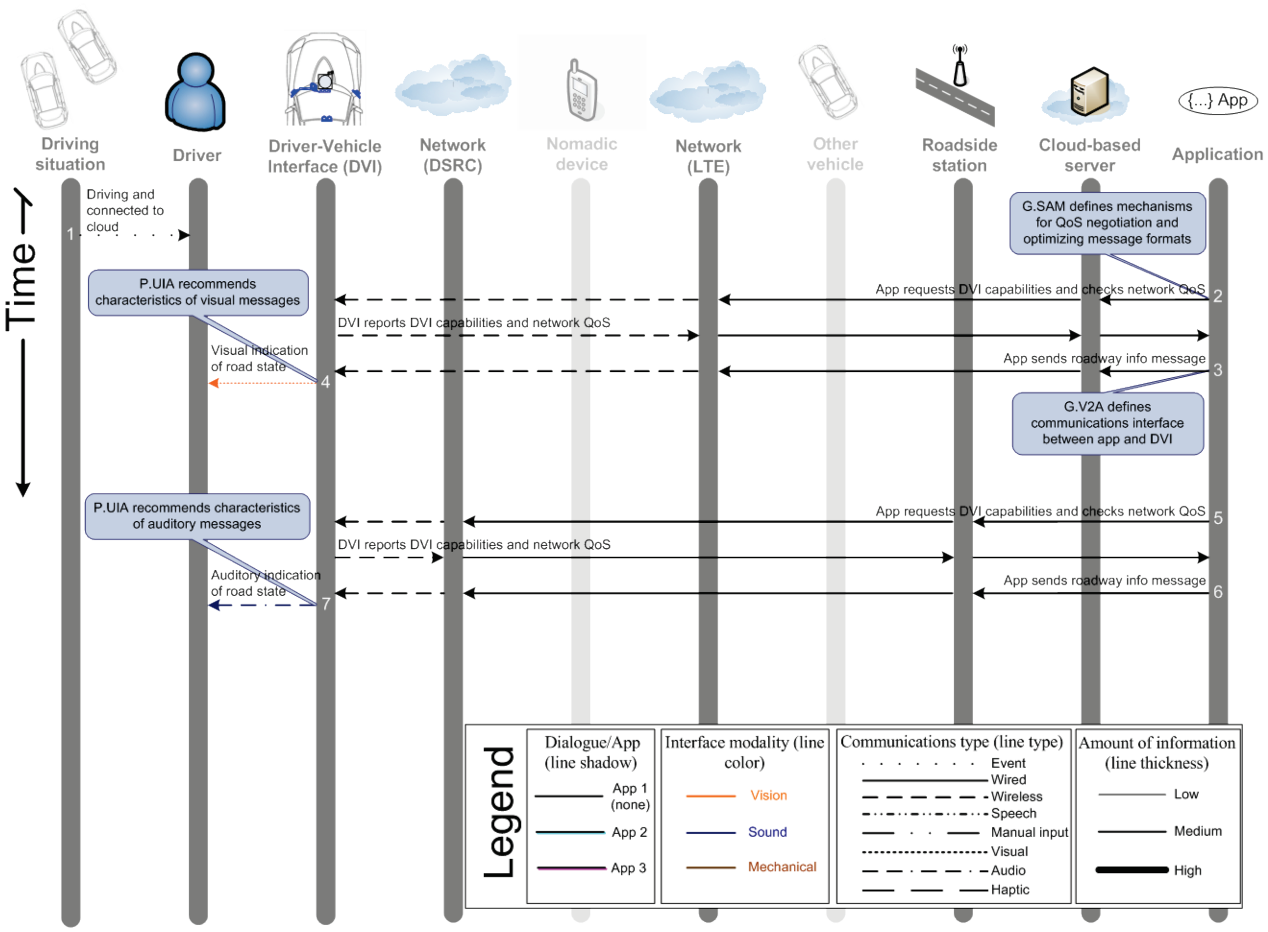

Figure 1d. Detailed example of Use Case 1 showing the I2V broadcasting of roadway situation.

6.1.5 *Scenario 1e*: Tethering

In this scenario tethering is used to access cloud-based services. Tethering uses the nomadic device (e.g., mobile phone) as a data conduit only. The application is running on the DVI, but it is accessing data and services in the cloud. The ability to safely access cloud-based services via tethering is what is being shown.

The sequence of events and communications between objects for Scenario 1e are illustrated in Figure 1e and described below:

1) User Scenario 1e starts with the driver outside of her parked car.
2) The driver enters her car and starts it.
3) Upon starting the car, the DVI automatically connects to a nomadic device in the vehicle. P.UIA recommends automatically establishing the connection and G.SAM defines the mechanisms that enable the automatic connection to the nomadic device.
4) The nomadic device notifies the DVI that tethering is available.
5) The DVI notifies local applications that tethering is available
6) A DVI application which uses tethering checks network QoS to cloud-based services using mechanisms defined in G.SAM.
7) Network QoS is confirmed.
8) The application notifies the DVI that it is available.
9) The DVI presents the visual message indicating that the application is available to the driver.

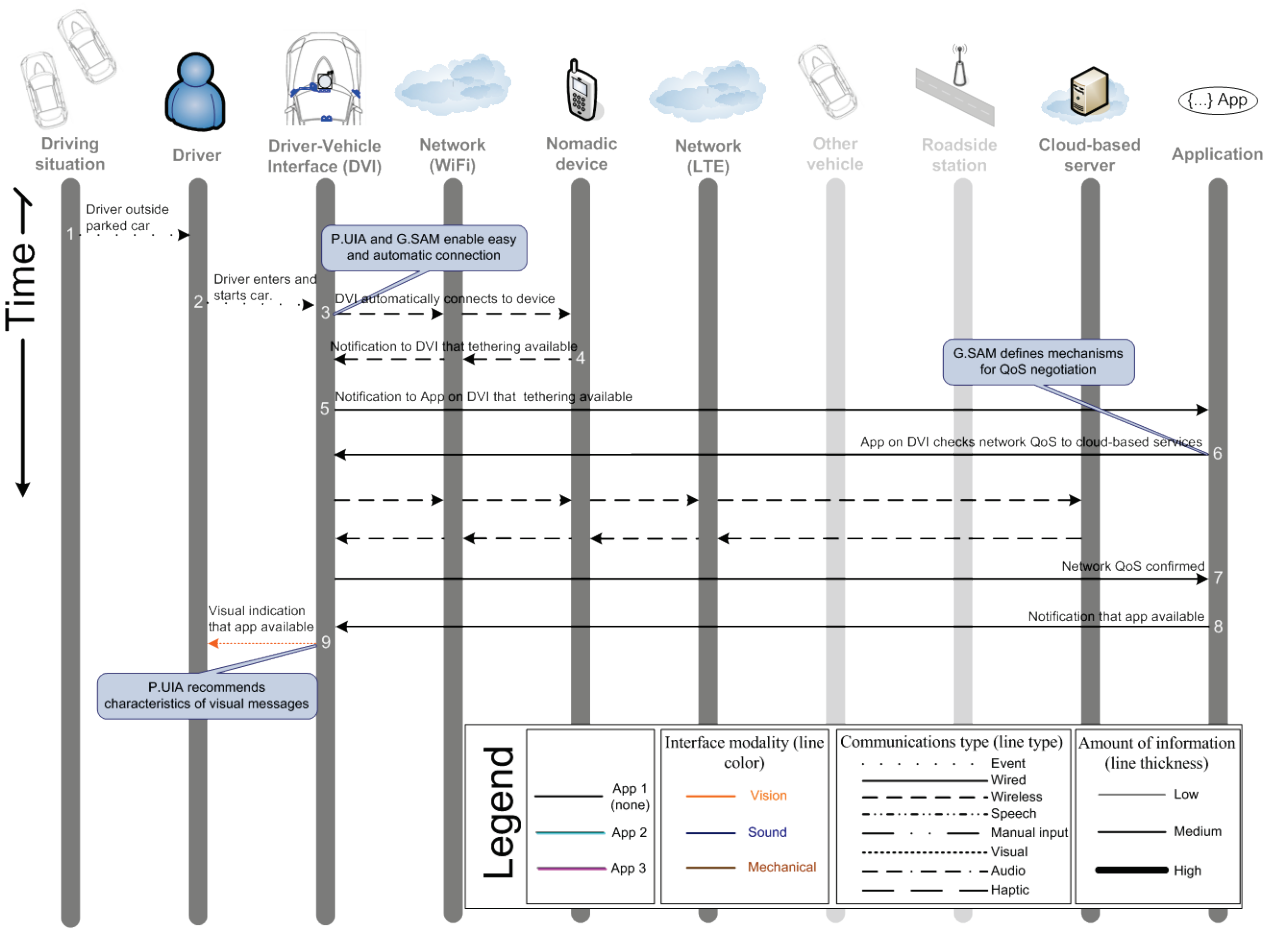

Figure 1e. Detailed example of Use Case 1 showing tethering.

6.2 *Use Case 2*: Arbitration and integration of external message

This use case refers to the ability for drivers to safely interact with a diverse set of external applications and services through the vehicle's DVI.

The DVI needs to be able to manage the priorities and needs of different types of external applications/services with the demands of driving. To do this, it must be able to differentiate messages coming from different applications/services and be able to prioritize them. It may also need to set message format (e.g., amount of visual information, sound localization, etc.), adjust timing, or integrate messages.

Four detailed user scenarios of Use Case 2 are given in the following sub-subsections:

1. *Scenario 2a*: Arbitration of messages
2. *Scenario 2b*: Integration of messages
3. *Scenario 2c*: Both arbitration and integration of messages
4. *Scenario 2d*: E-call

6.2.1 *Scenario 2a*: Arbitration of messages

In this scenario two messages arrive around the same time. One is a high priority route navigation manoeuvre message and the other is a low priority social media status update message. The ability to prioritize playback of messages is what is being shown.

The sequence of events and communications between objects for Scenario 2a are illustrated in Figure 2a and described below:

1) User Scenario 2a starts with the driver already driving and connected to the cloud.
2) A cloud-based social media application sends a status update message.
3) A cloud-based navigation application sends a route manoeuvre. This message is received before the social media message is played.
4) The DVI is able to defer playback of the lower priority social media message using mechanisms defined in G.SAM. This prevents distraction and workload caused by the social media message from interfering with successful execution of the navigation manoeuvre or safe operation of the vehicle.
5) The social media message is played after navigation manoeuvre has been processed by the driver.

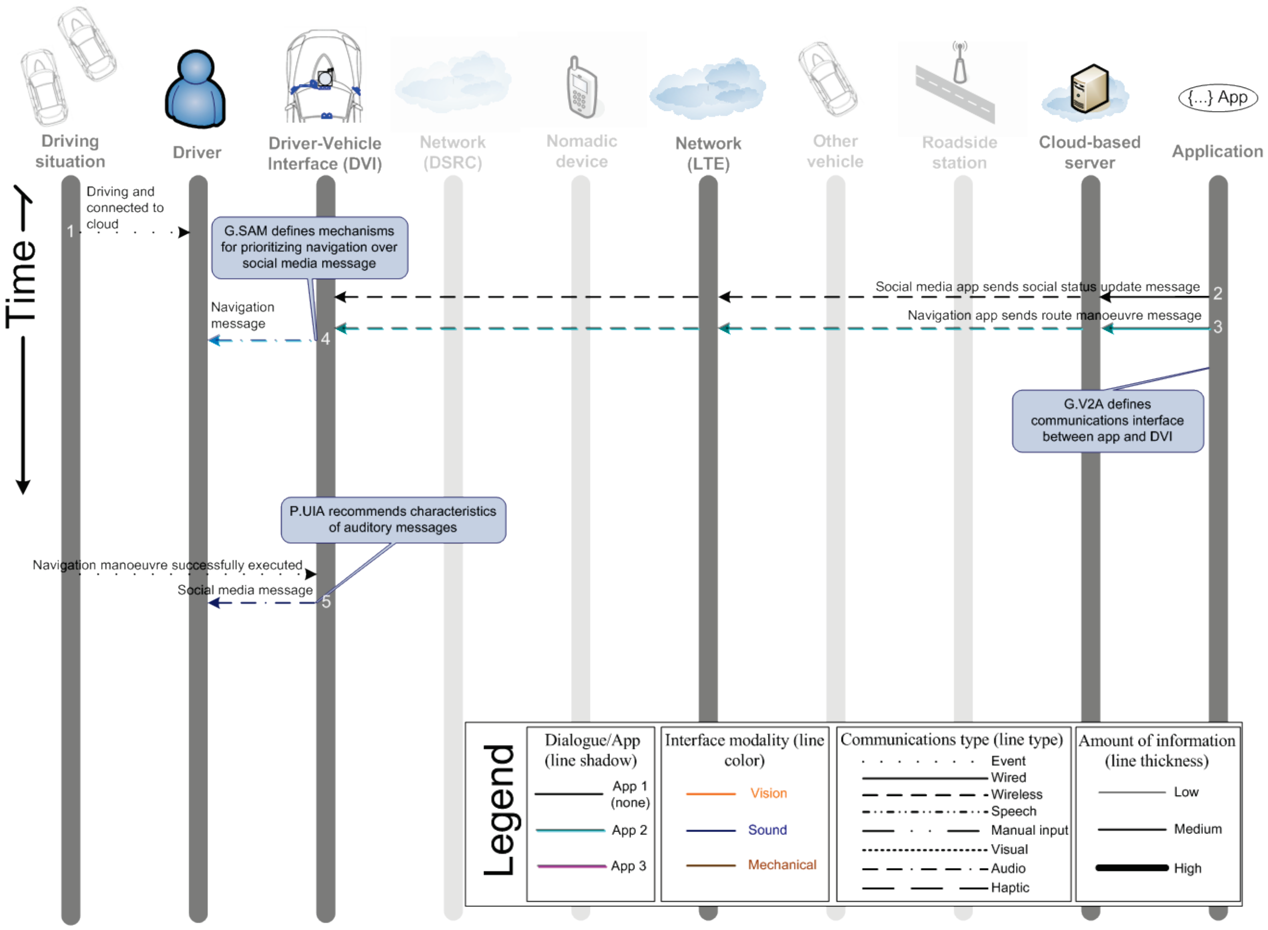

Figure 2a. Detailed example of Use Case 2 showing arbitration of a Route Navigation Manoeuvre message and Social Media Status Update message.

6.2.2 *Scenario 2b*: Integration of messages

In this scenario a route navigation manoeuvre message arrives while the driver is engaged in a telephone call. The navigation manoeuvre message is integrated into the phone audio stream by spatially rendering it from a different location than the phone audio. This allows the driver to easily switch attention as required. The ability to integrate messages without reducing situational awareness of the driver is what is being shown.

The sequence of events and communications between objects for Scenario 2b are illustrated in Figure 2b and described below:

1) User Scenario 2b starts with the driver already driving and connected to the cloud.
2) A phone call is established between the driver and someone connected to the telephone network. The far end of telephone connection is not shown in the figure.
3) A cloud-based navigation application sends a route manoeuvre message.

4) The DVI is able to intelligently integrate the navigation message into the phone call audio using mechanisms defined in G.SAM. The navigation message is rendered such that it is perceived as coming from a different spatial location than phone audio. This helps the driver switch attention between navigation and phone applications as needed.

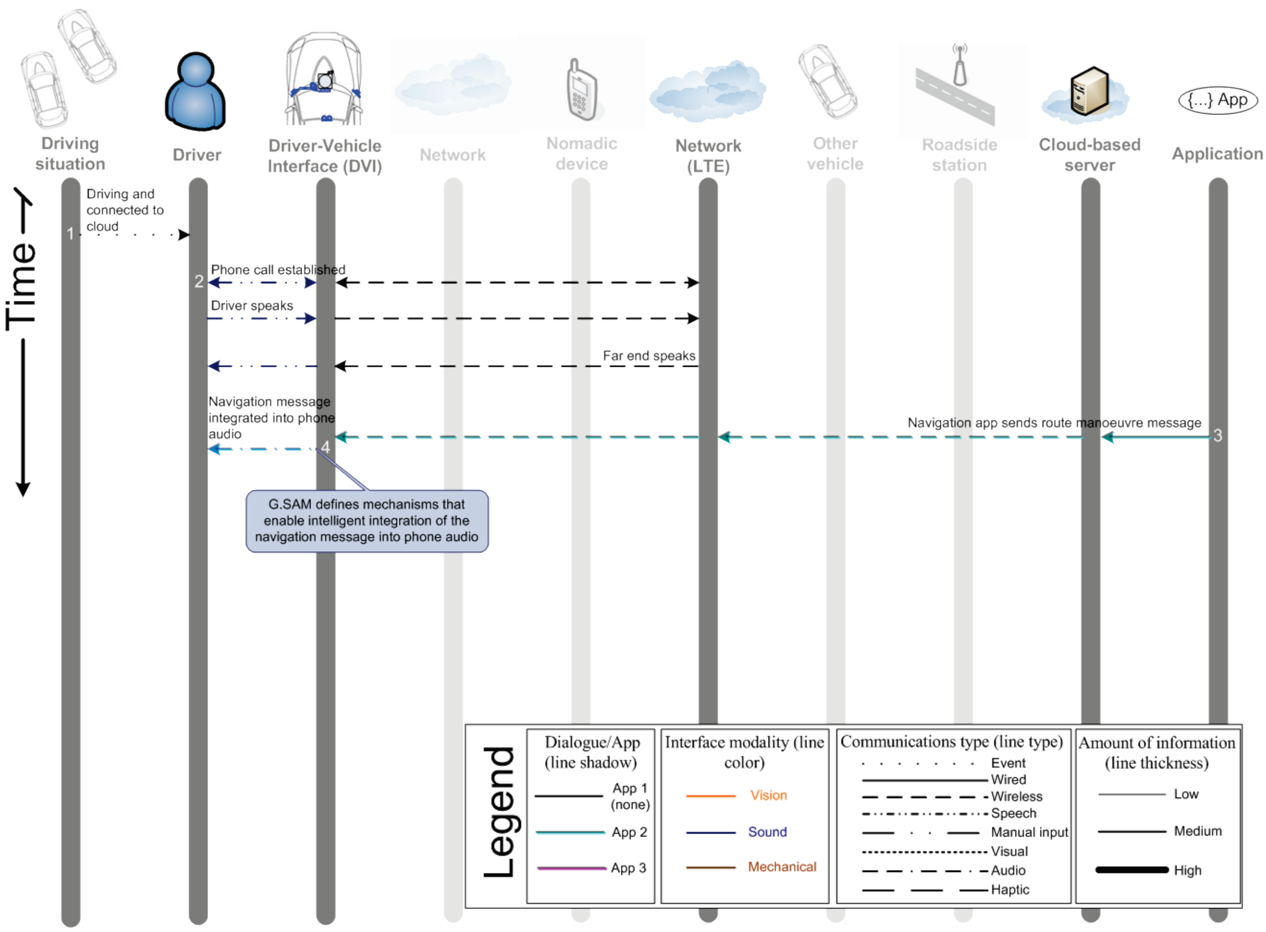

Figure 2b. Detailed example of Use Case 2 showing integration of a Route Navigation Manoeuvre message during an active phone call.

6.2.3 *Scenario 2c*: Both arbitration and integration of messages

In this scenario a meeting appointment message arrives while the driver is busy. The message is first delayed because of a competing collision avoidance warning message. This example also demonstrates the use of Vehicle-to-Vehicle (V2V) communications. It is then integrated, but with reduced visual information. The ability to arbitrate and integrate external messages to better manage situational awareness of the driver is what is being shown.

The sequence of events and communications between objects for Scenario 2c are illustrated in Figure 2c and described below:

1) User Scenario 2c starts with the driver already driving and connected to the cloud.

2) A "Here I am" safety message is received from a nearby vehicle. It is used by the DVI to predict an escalating crash situation.

3) A cloud-based calendar application sends a meeting appointment message.

4) Message arbitration occurs at this point. Delivery of the meeting appointment message is postponed by the DVI due to the escalating crash situation. This is achieved using mechanisms defined in G.SAM.

5) Message integration occurs at this point. The meeting appointment message is delivered. However, the amount of visual information presented to the driver is reduced because of high visual demands of the roadway. This is achieved using mechanisms defined in G.SAM.

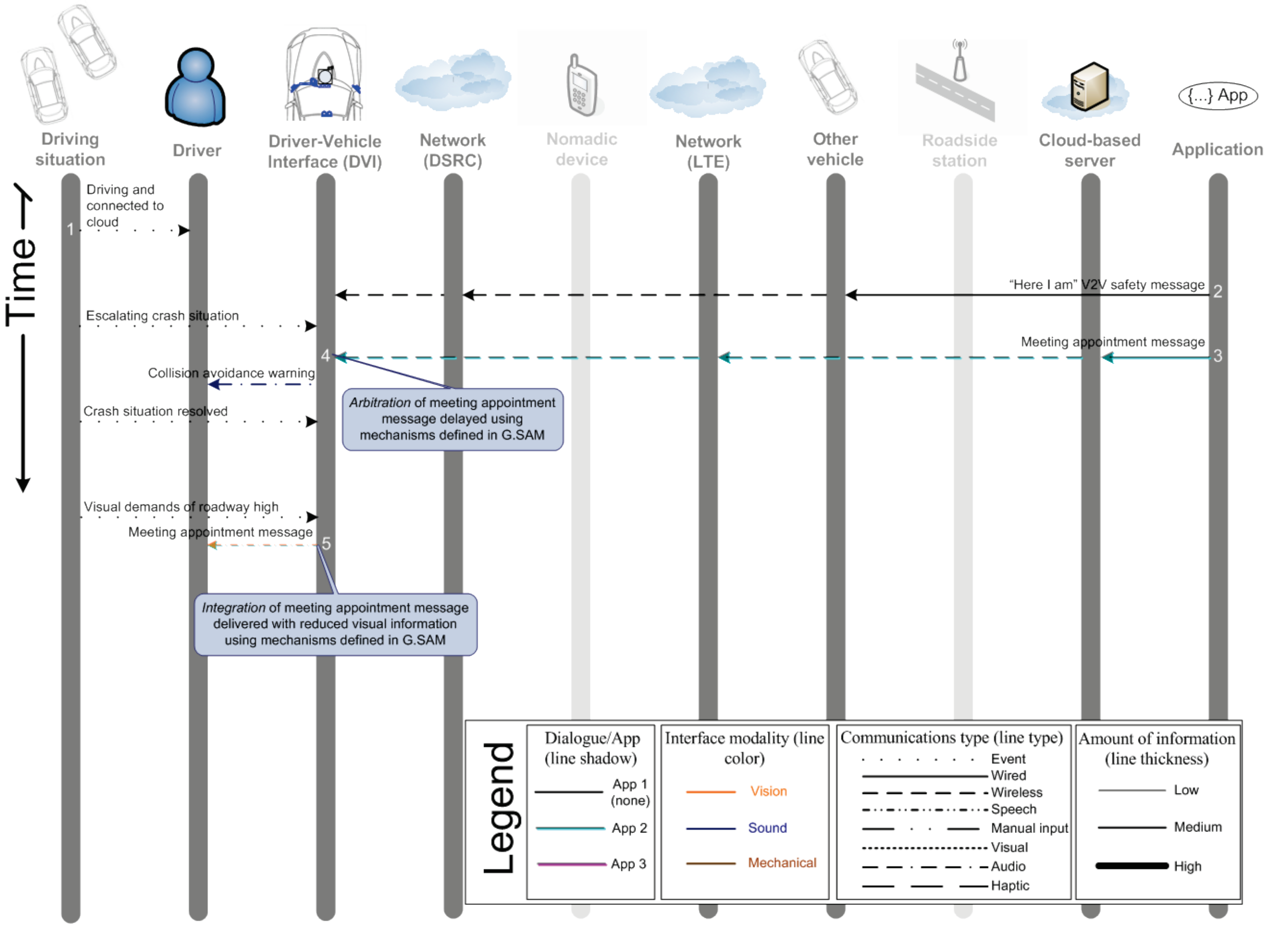

Figure 2c. Detailed example of Use Case 2 showing arbitration and integration of a meeting appointment message.

6.2.4 *Scenario 2d*: E-call

In this scenario the driver gets in a crash and e-call is started automatically. The ability to suppress non-emergency communications during an e-call is what is being shown.

The sequence of events and communications between objects for Scenario 2d are illustrated in Figure 2d and described below:

1) User Scenario 2d starts with the driver already driving and connected to the cloud.
2) The vehicle crashes. Onboard sensors automatically trigger an E-Call.
3) Crash incident data (e.g., location data) is sent to an emergency response center. The emergency response center not shown in the figure, but is connected to the LTE network.
4) A phone call is established with the emergency response center. A conversation between the Operator and driver begins.
5) A cloud-based calendar application sends a meeting appointment message.
6) The DVI is able to suppress the meeting appointment message using mechanisms defined in G.SAM. This prevents external applications from interfering with communications between the driver and emergency response center.

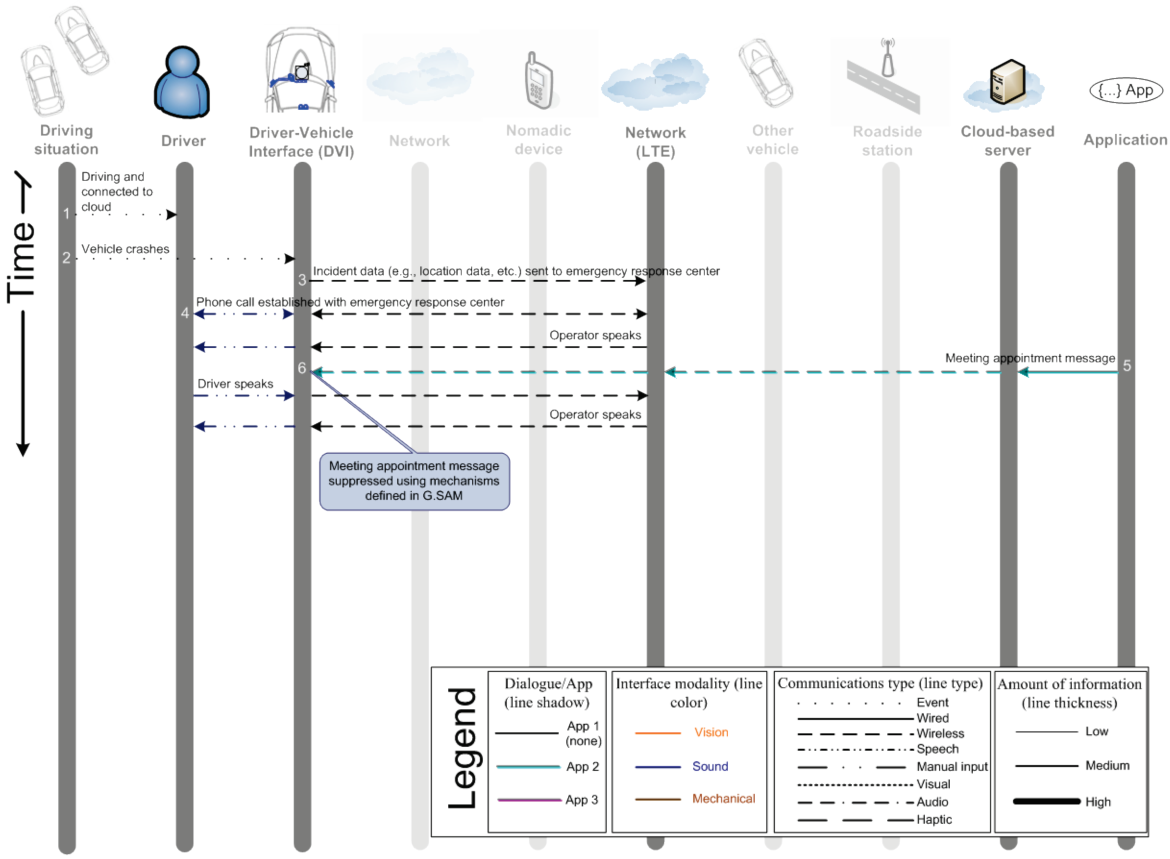

Figure 2d. Detailed example of Use Case 2 showing suppression of external messages during an E-call.

6.3 *Use Case 3*: Negotiation of network Quality of Service (QoS)

This use case refers to the ability for applications/services to negotiate the guaranteed network QoS between the application/service and the vehicle's DVI.

Some applications/services have stringent requirements on network performance to ensure safe interaction with drivers (e.g., low latency, high availability, etc.). Therefore, there needs to be a mechanism for applications/services to determine and select the network QoS that will be realized during interaction with the driver.

Three detailed user scenarios of Use Case 3 are given in the following sub-subsections:

1. *Scenario 3a*: Application selects network
2. *Scenario 3b*: Application suspends interaction
3. *Scenario 3c*: Application switches network due to roaming

6.3.1 *Scenario 3a*: Application selects network

In this scenario the application checks network QoS of two networks and then selects the network that meets the application's requirements. The ability to determine and select a network which can support safe interaction with the driver is what is being shown.

The sequence of events and communications between objects for Scenario 3a are illustrated in Figure 3a and described below:

1) User Scenario 3a starts with the driver already driving and connected to the cloud.

2) A cloud-based roadway hazard application checks network QoS of the LTE connection of the vehicle. G.SAM defines the mechanisms that enable network QoS negotiation.

3) The application also check network QoS of the DSRC connection to the vehicle.

4) The application then selects the DSRC connection and sends a roadway hazard message. G.SAM defines mechanisms that enable the application to select the network.

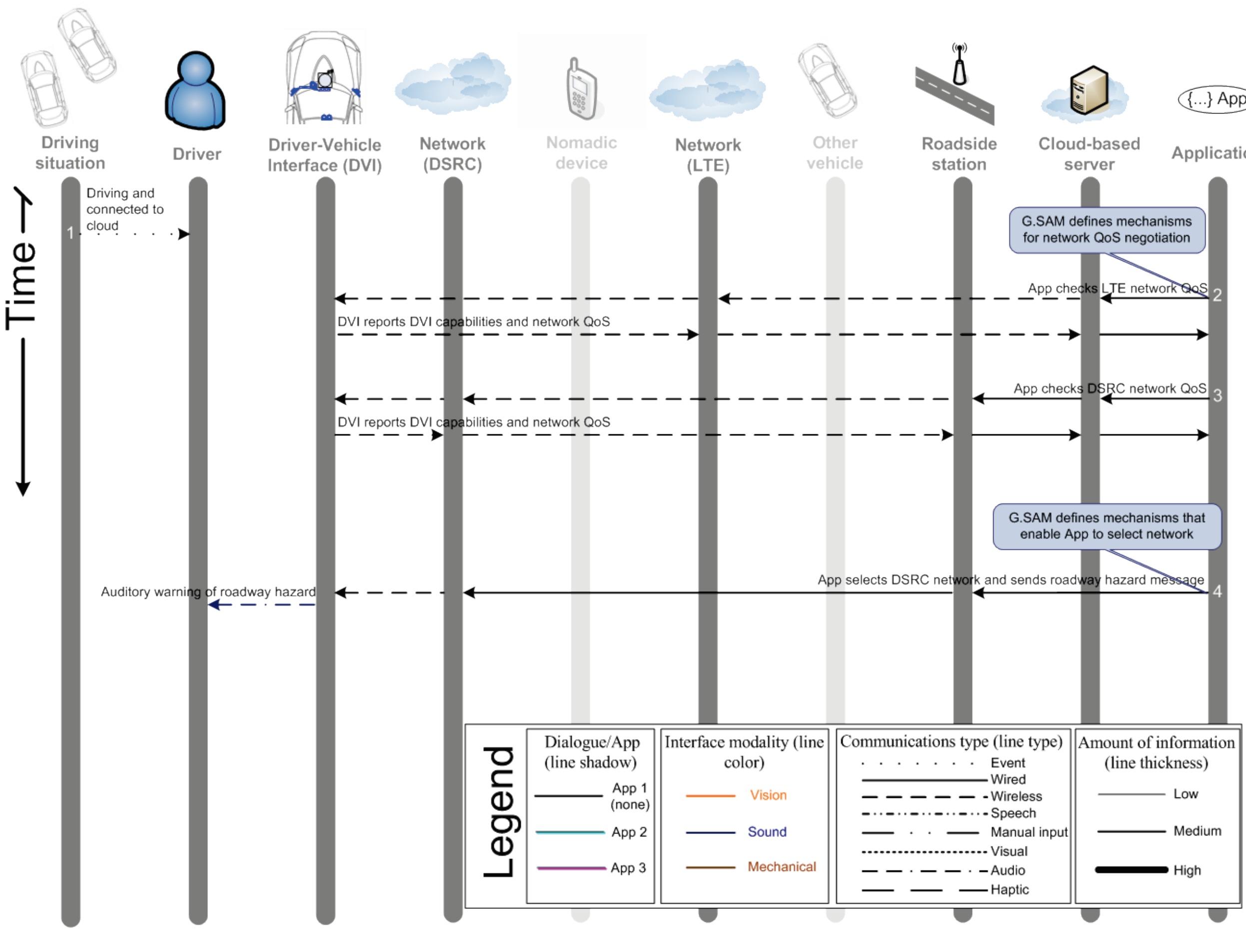

Figure 3a. Detailed example of Use Case 3 showing selection of network based on network QoS.

6.3.2 *Scenario 3b*: Application suspends interaction

In this scenario the application suspends its interaction with the driver due to poor network performance. The ability to automatically disengage from an interaction before it becomes distracting is what is being shown.

The sequence of events and communications between objects for Scenario 3b are illustrated in Figure 3b and described below:

1) User Scenario 3b starts with the driver already driving and connected to the cloud.

2) The driver selects an application. At the time of selection, network QoS was sufficient to support safe interaction.

3) The DVI brings the application into focus. However, an unpredicted drop in network QoS happens at about the same time.

4) The application checks network QoS before beginning the dialogue.

5) The application suspends interaction because it cannot safely interact with the driver. A notification message is sent to the DVI.

6) An audio-visual message is given to the driver indicating that the application has been suspended due to network QoS.

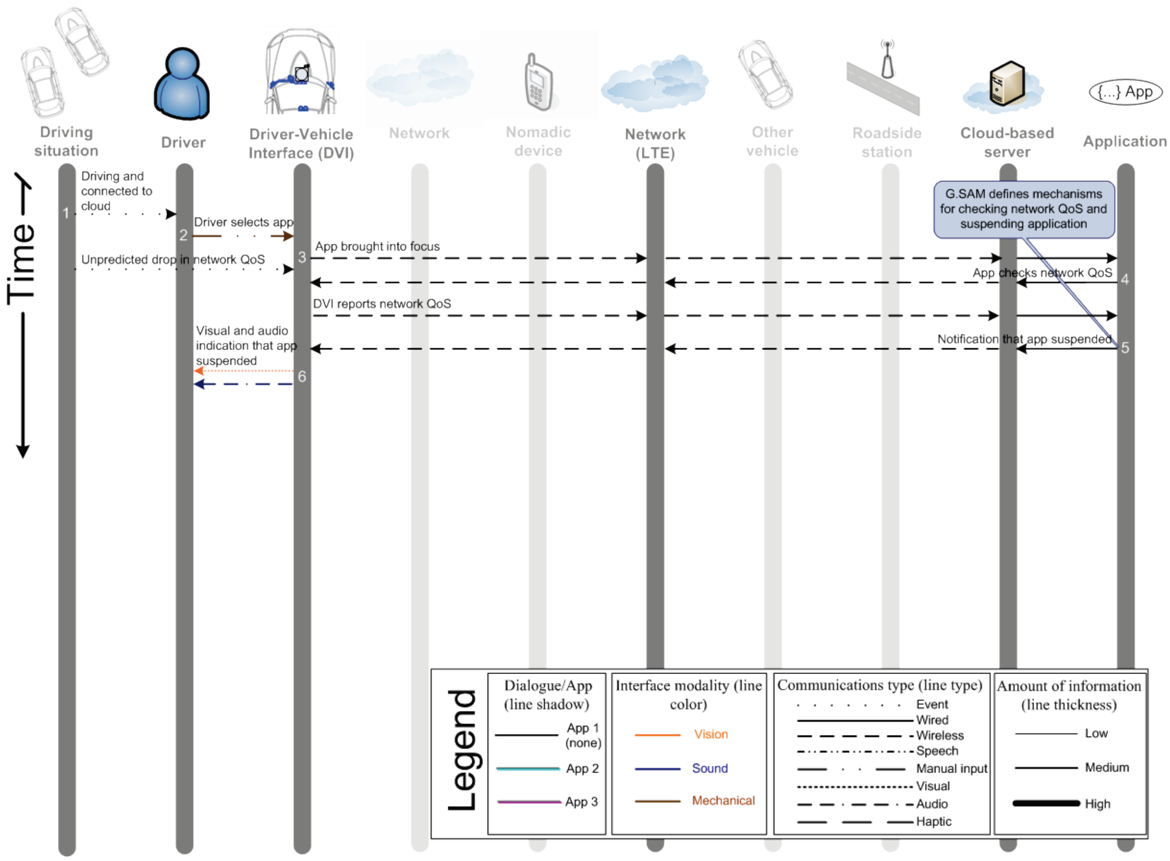

Figure 3b. Detailed example of Use Case 3 showing suspension of interaction with an application based due to poor network QoS.

6.3.3 *Scenario 3c*: Application availability due to roaming

In this scenario an application becomes available when switching from one network carrier (3G) to another (LTE). The ability to automatically check network QoS and only make applications available when the network supports safe interaction is what is being shown.

The sequence of events and communications between objects for Scenario 3c are illustrated in Figure 3c and described below:

1) User Scenario 3c starts with the driver outside of his parked car.

2) The driver enters his car and starts it.

3) Upon starting the car, the DVI automatically connects to a cloud-based server through an LTE connection. P.UIA recommends automatically establishing the connection and G.SAM defines the mechanisms that enable the automatic connection to the cloud-based server.

4) The cloud-based server then activates the application.

5) Upon activation, the application uses mechanisms defined in G.SAM to negotiate network QoS and query DVI capabilities. These mechanisms ensure sufficient communications QoS and optimization of message formants, respectively. The authority of the application to interact with the driver is also verified using G.SAM mechanisms.

6) The application determines that the current network QoS does not support safe interaction with the driver. It then notifies the DVI that the application is not available due to network QoS. G.V2A defines a communications interface that enables the application to communicate with the vehicle.

7) The DVI presents a visual message to the driver indicating that the application is NOT available due to network QoS. P.UIA recommends characteristics of visual messages to optimize situational awareness.

8) The driver starts driving.

9) The vehicle crosses a network boundary and begins roaming on a network with higher network QoS.

10) The DVI notifies the cloud-based application of the new network connection.

11) The application checks network QoS of the new connection.

12) The application determines that the new connection is capable of supporting safe interaction with the driver and sends a notification to the DVI.

13) The DVI presents a visual message to the driver indicating that the application is now available.

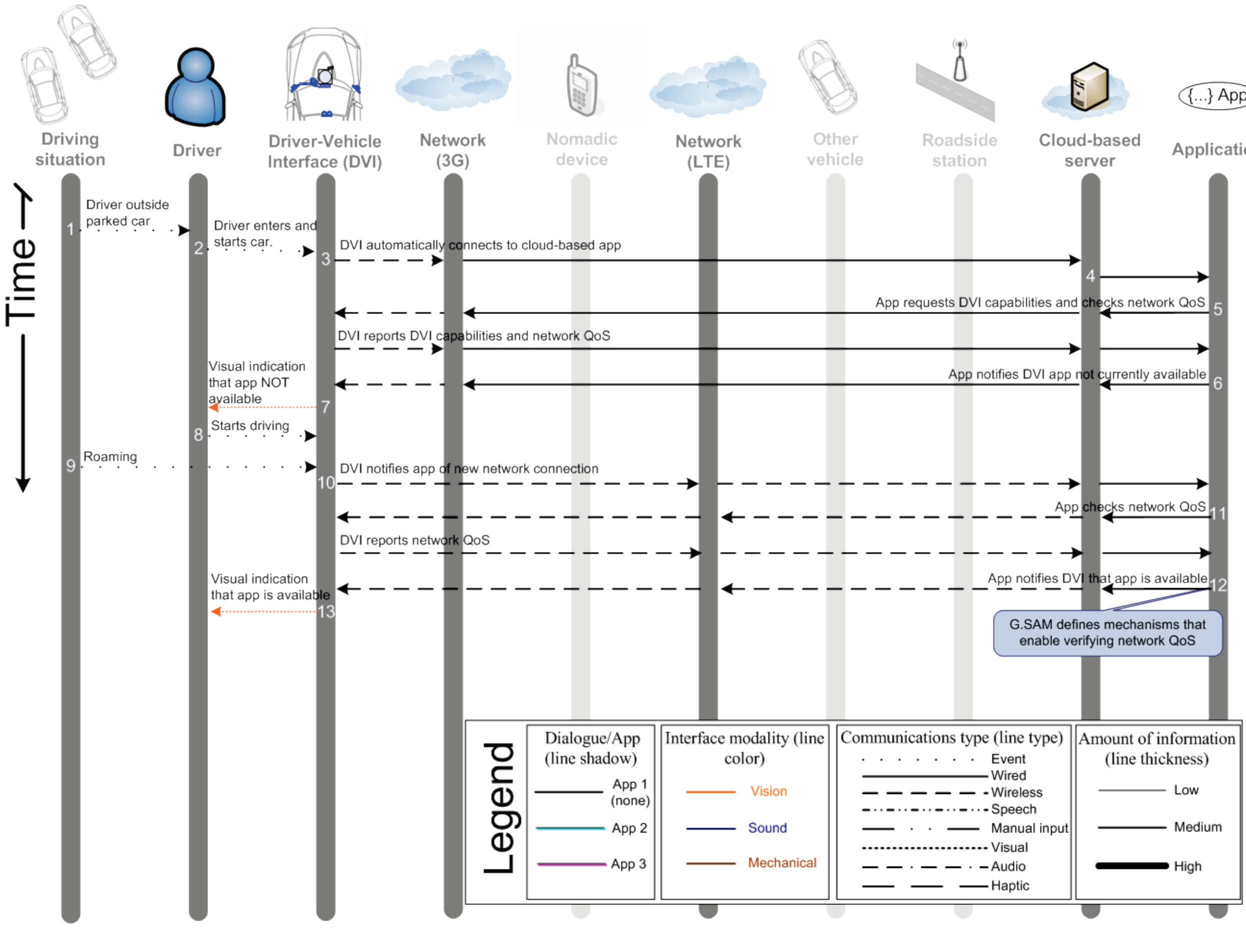

Figure 3c. Detailed example of Use Case 3 showing application availability due to roaming.

6.4 *Use Case 4*: Management of multiple dialogues

This use case refers to the ability for the driver to easily navigate to, and interact with, one of multiple dialogues that may be simultaneously active.

Simultaneous dialogues with multiple applications/services can cause significant distraction and workload. Therefore, there needs to be a mechanism by which drivers can safely manage interaction with multiple applications/services.

Three detailed user scenarios of Use Case 4 are given in the following sub-subsections:

1. *Scenario 4a*: Opening/closing an application
2. *Scenario 4b*: Switching between applications
3. *Scenario 4c*: Interaction with background application

6.4.1 *Scenario 4a*: Opening/closing an application

In this scenario an application is opened and then closed. The ability to safely begin and end interaction with an application is what is being shown.

The sequence of events and communications between objects for Scenario 4a are illustrated in Figure 4a and described below:

1) User Scenario 4a starts with the driver driving and connected to the cloud.
2) The driver manually activates the speech interface.
3) The speech interface responds with a prompt indicating it is ready for speech input.
4) The driver gives a speech command such as "Open app" to indicate she wants to open an application. G.SAM defines the mechanisms for application management.
5) The DVI responds with an auditory prompt and visual list of available applications.
6) The driver selects an application listed on the visual display using speech.
7) The DVI then activates the application.
8) The application requests DVI capabilities and checks network QoS.
9) The application determines the network can support the required QoS, adjusts output based on DVI capabilities, and communicates with the DVI.
10) The DVI brings the newly opened app into focus.
11) The driver decides to close the application in focus by giving a speech command.

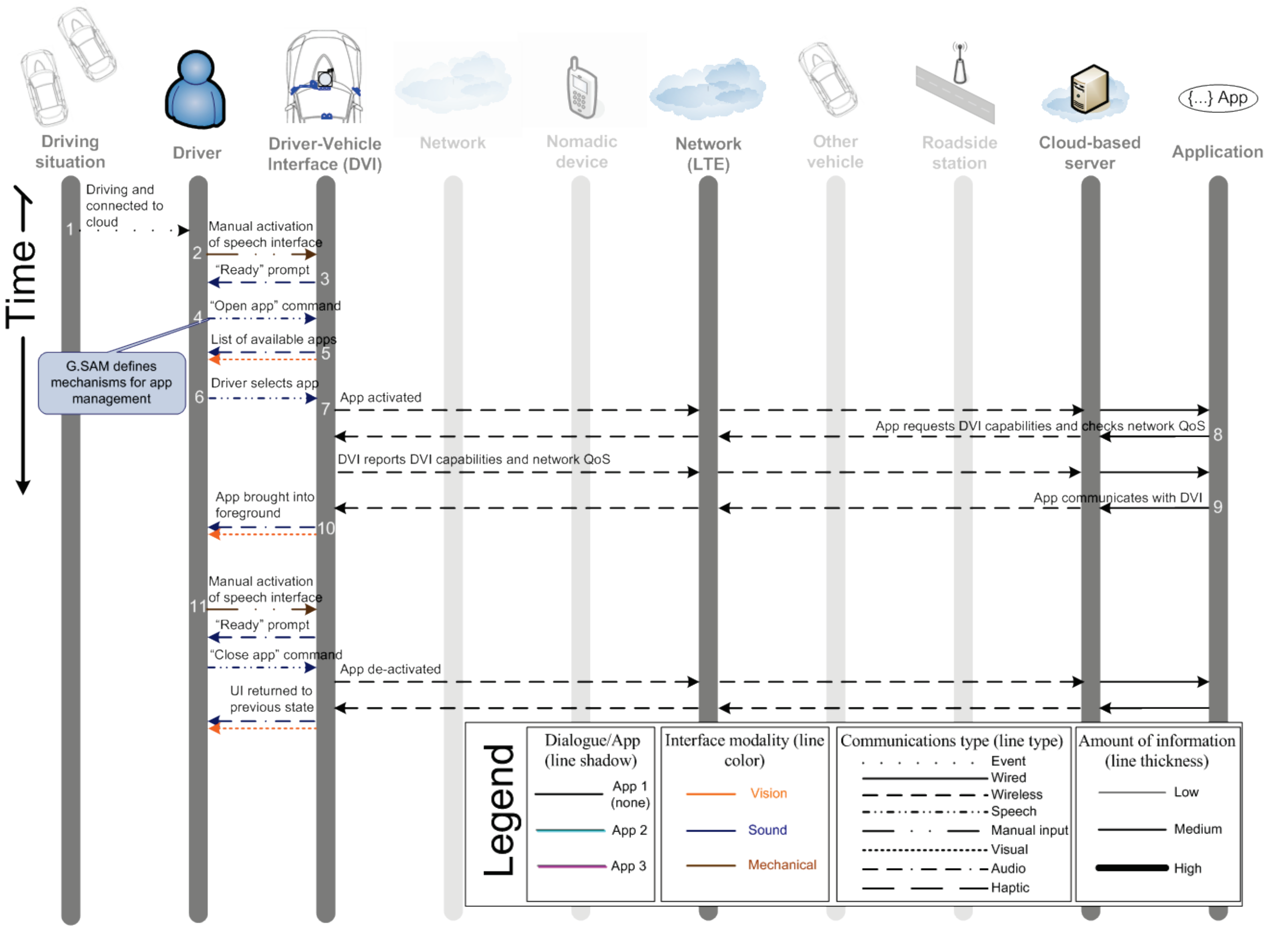

Figure 4a. Detailed example of Use Case 4 showing an application being opened and closed.

6.4.2 *Scenario 4b*: Switching between applications

In this scenario the driver switches between multiple applications that are open at the same time. The ability to minimize the distraction and workload associated with interacting with multiple applications is what is being shown.

The sequence of events and communications between objects for Scenario 4b are illustrated in Figure 4b and described below:

1) User Scenario 4b starts with the driver driving and 3 applications open. Application #1 is currently in focus and happens to be running locally on the DVI itself.
2) The driver scrolls to the next open application. In this particular example, a simple manual control is used to scroll among the open applications.
3) Upon switching, Application #1 is suspended and loses focus while Application #2 is resumed and gets focus. Application #2 happens to be running on a nomadic device. G.SAM defines mechanisms for application management.
4) Application #2 is displayed on the DVI.
5) The driver scrolls to the next open application.
6) Upon switching, Application #2 is suspended and loses focus while Application #3 is resumed and gets focus.
7) Application #3 is displayed on the DVI.
8) The driver scrolls to the next open application.
9) Upon switching, Application #3 is suspended and loses focus while Application #1 is resumed and gets focus.
10) Application #1 is displayed on the DVI.

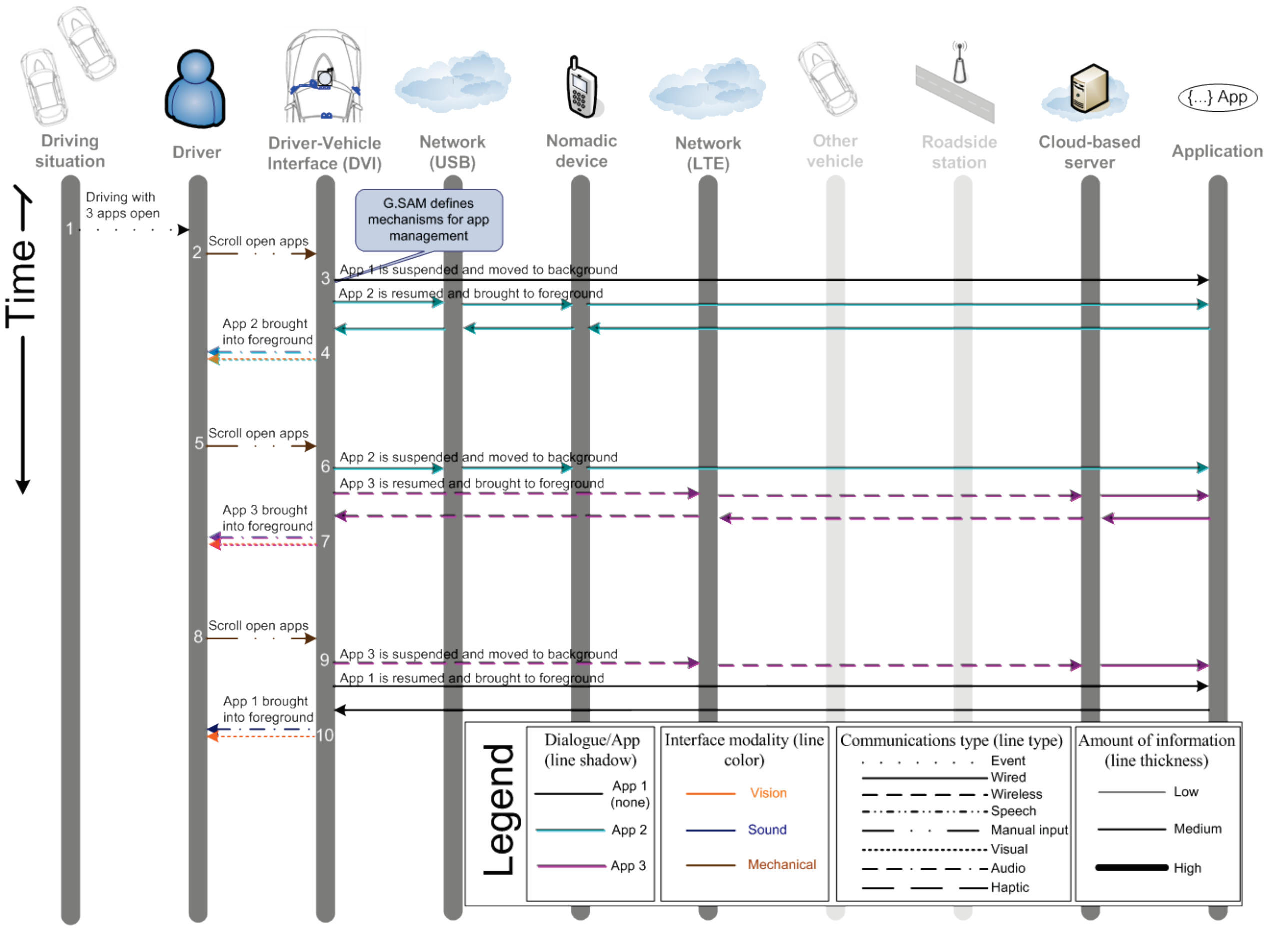

Figure 4b. Detailed example of Use Case 4 showing switching between applications.

6.4.3 *Scenario 4c*: Interaction with background application

In this scenario an application running in the background comes to the foreground and requests user input. It then retreats to the background again. The ability to minimize the distraction and workload associated with interacting with multiple applications is what is being shown.

The sequence of events and communications between objects for Scenario 4c are illustrated in Figure 4c and described below:

1) User Scenario 4c starts with the driver driving and a radio application in focus.
2) A navigation applications then requests input from the driver. In this case, the driver is near the destination and the navigation application asks if the driver would like assistance finding a parking spot.
3) The DVI communicates with the radio application to suspend it, and moves the radio application to the background on the DVI. This is achieved using mechanisms defined in G.SAM.
4) The navigation application is brought into the foreground on the DVI and asks the driver if she would like assistance finding parking near the destination.
5) The driver declines the request using speech input.
6) The navigation application provides feedback to the driver and returns foreground to the radio application.
7) The radio application is brought back to the foreground again on the DVI.

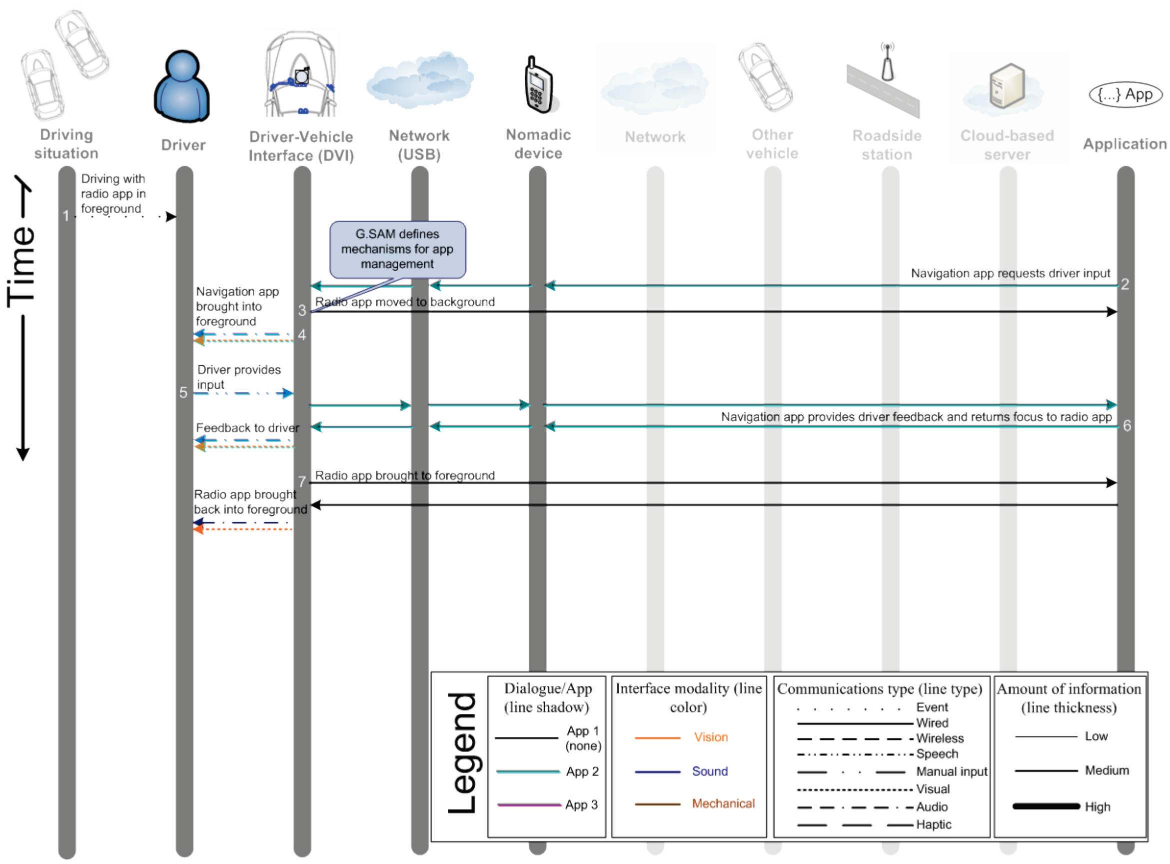

Figure 4c. Detailed example of Use Case 4 showing interaction with a background application.

6.5 *Use Case 5*: Adaptation of DVI and external applications/services to driver abilities

This use case refers to the ability for the DVI and external applications/services to adapt their inputs and outputs based on driver capabilities.

External applications/services need to adapt the way they interact with drivers based on the current capabilities of the driver to ensure safe interaction. This requires the DVI to monitor the state of the driver, adapt its user interface, and communicate any needed changes in interaction style (e.g., message format, pause/resume interaction, etc.) to external applications/services.

Three detailed user scenarios of Use Case 5 are given in the following sub-subsections:

1. *Scenario 5a*: Driver with disability
2. *Scenario 5b*: Dynamically changing driver capabilities
3. *Scenario 5c*: Detection of impaired driver state

6.5.1 ***Scenario 5a*: Driver with disability**

In this scenario, assuming the vehicle is equipped with functionality to alter DVI capabilities to address drivers with certain disabilities, the DVI and external application change configuration/behaviour based on the static capabilities of a deaf driver (i.e., cannot receive auditory messages). The ability to adapt the DVI and external applications to improve SA when long-term driver capabilities are known is what is being shown.

The sequence of events and communications between objects for Scenario 5a are illustrated in Figure 5a and described below:

1) User Scenario 5a starts with a deaf driver outside of her parked car.
2) The driver enters her car and starts it.
3) Upon starting the car, the DVI adapts based on the driver profile. This profile includes the fact that the driver is deaf and cannot receive auditory messages. It should be possible for the driver to modify profile settings when it is safe to do so. The DVI also automatically connects to a cloud-based social media application. G.SAM defines the mechanisms that enable adaptation of the DVI based on static driver capabilities.
4) The social media application is activated on the cloud-based server.
5) Upon activation, the application requests DVI capabilities and checks network QoS.
6) The DVI reports that auditory communications with the driver is not available, as well as network QoS. G.SAM defines the mechanisms that enable static driver capabilities (e.g., cannot receive auditory messages) to be communicated to external applications.
7) The driver starts driving.
8) The application sends a social media status update message to the driver. However, the output format is visual instead of auditory because of the mechanisms defined in G.SAM. It is worth noting that switching to “visual mode” for deaf drivers does not exempt the system from P.UIA recommendations, and in some cases this may result in reduced functionality.

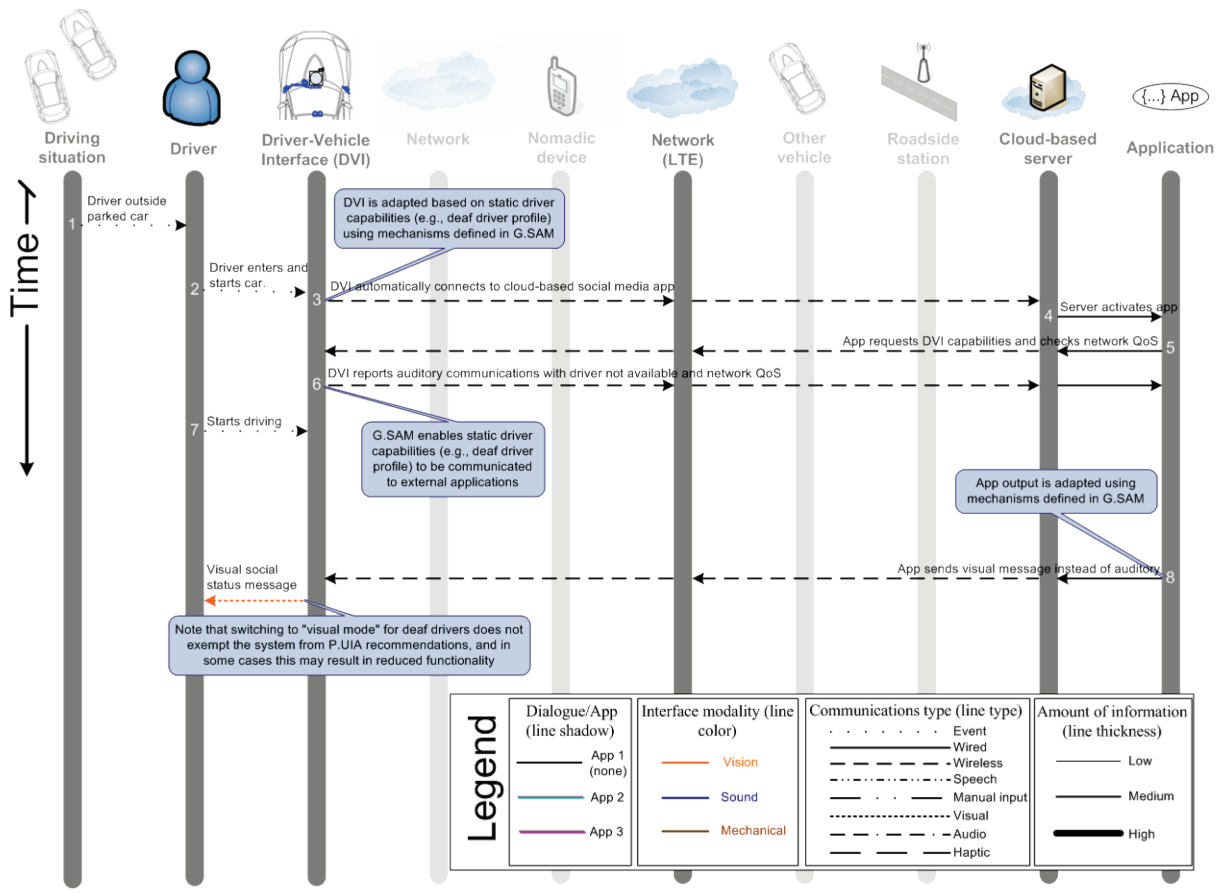

Figure 5a. Detailed example of Use Case 5 showing adaptation of the DVI and external application based on static driver disabilities.

6.5.2 *Scenario 5b*: Dynamically changing driver capabilities

In this scenario the DVI and external application change configuration/behaviour based on dynamic changes in driver capabilities (i.e., cannot receive visual messages due to high visual workload). The ability to improve SA by adapting the DVI and external applications according to short-term changes in driver capabilities is what is being shown.

The sequence of events and communications between objects for Scenario 5b are illustrated in Figure 5b and described below:

1) User Scenario 5b starts with the driver driving and connected to the cloud.
2) An application sends a visual message to the driver based on previously established configuration settings.
3) The driver begins glancing at the center-stack display excessively.
4) The DVI determines that the driver cannot receive visual messages because of high visual workload. In this particular case, it is also determined that auditory messages are acceptable. However, it should be noted that there may be other cases where it would be better to defer delivery of the message. This status is locally stored pushed to external applications.
5) Under normal conditions, the application would send a visual message. However, due to inability of driver to accept visual messages the output is adapted to an auditory message. G.SAM defines the mechanisms that make this possible.
6) Glance behaviour returns to normal.
7) The DVI updates local status to indicate that driver can now receive visual messages and notifies external application.
8) The next message from the application is a visual message due to the change in driver capabilities.

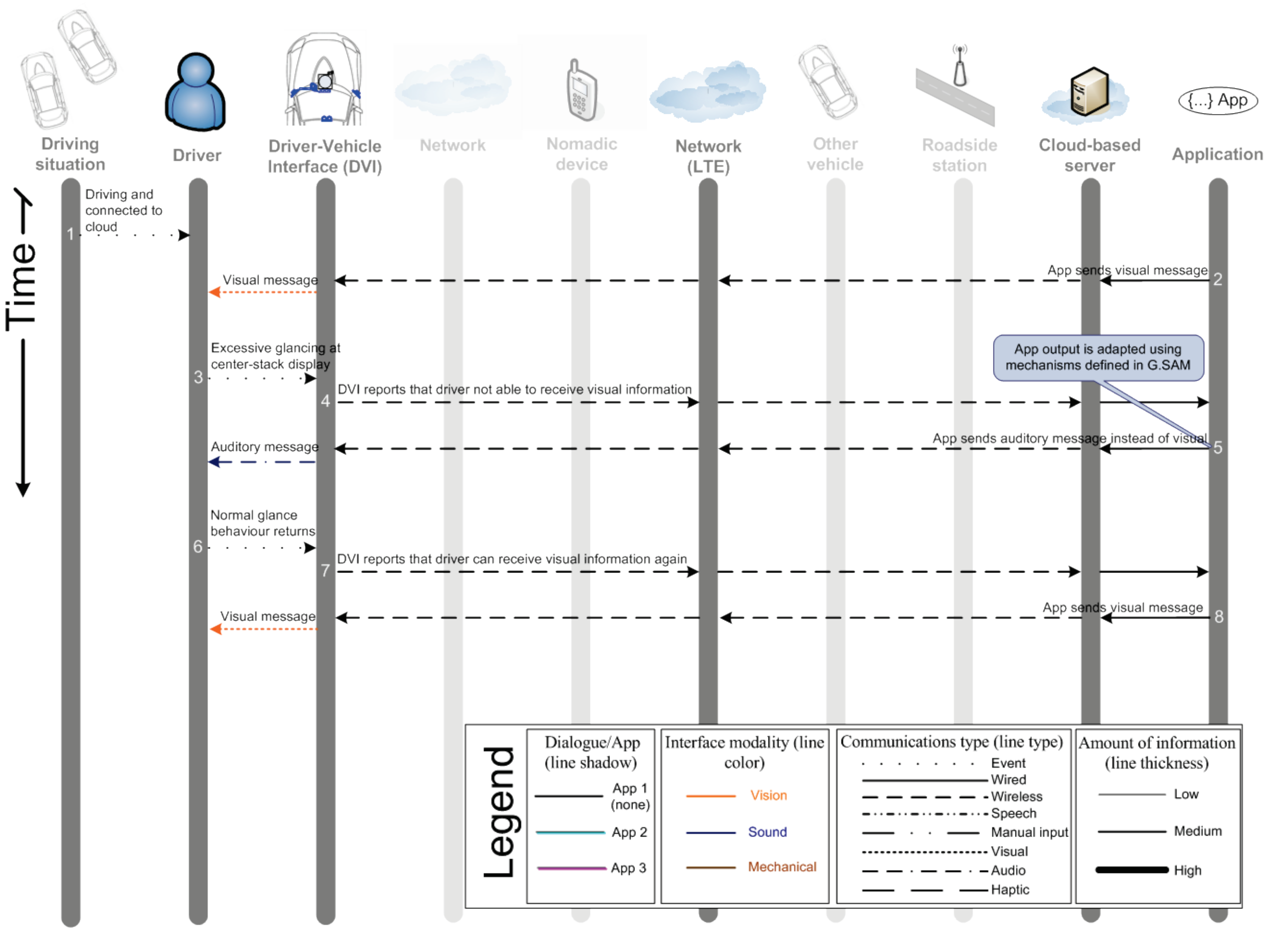

Figure 5b. Detailed example of Use Case 5 showing adaptation of the DVI and external application based on short-term changes in driver capabilities.

6.5.3 *Scenario 5c*: Detection of impaired driver state

In this scenario the DVI detects that the driver is slightly drowsy and adapts the behaviour of an external application. It should also be noted that in more extreme cases of drowsiness the best option would be to encourage the driver to get some rest. The ability to improve SA by making applications aware of certain driver states is what is being shown.

The sequence of events and communications between objects for Scenario 5c are illustrated in Figure 5c and described below:

1) User Scenario 5c starts with the driver driving and connected to an internet radio application.
2) The internet radio application is playing a relaxing genre (e.g., smooth jazz).
3) The driver starts getting drowsy, and the relaxing music is not helping.
4) The DVI determines the driver is slightly drowsy, and reports this to the internet radio application.
5) The internet radio application offers to change the genre to something more stimulating. Application output is adapted using mechanisms defined in G.SAM.
6) The driver selects a more stimulating genre.
7) The internet radio application starts playing modern rock.
8) The driver becomes less drowsy.

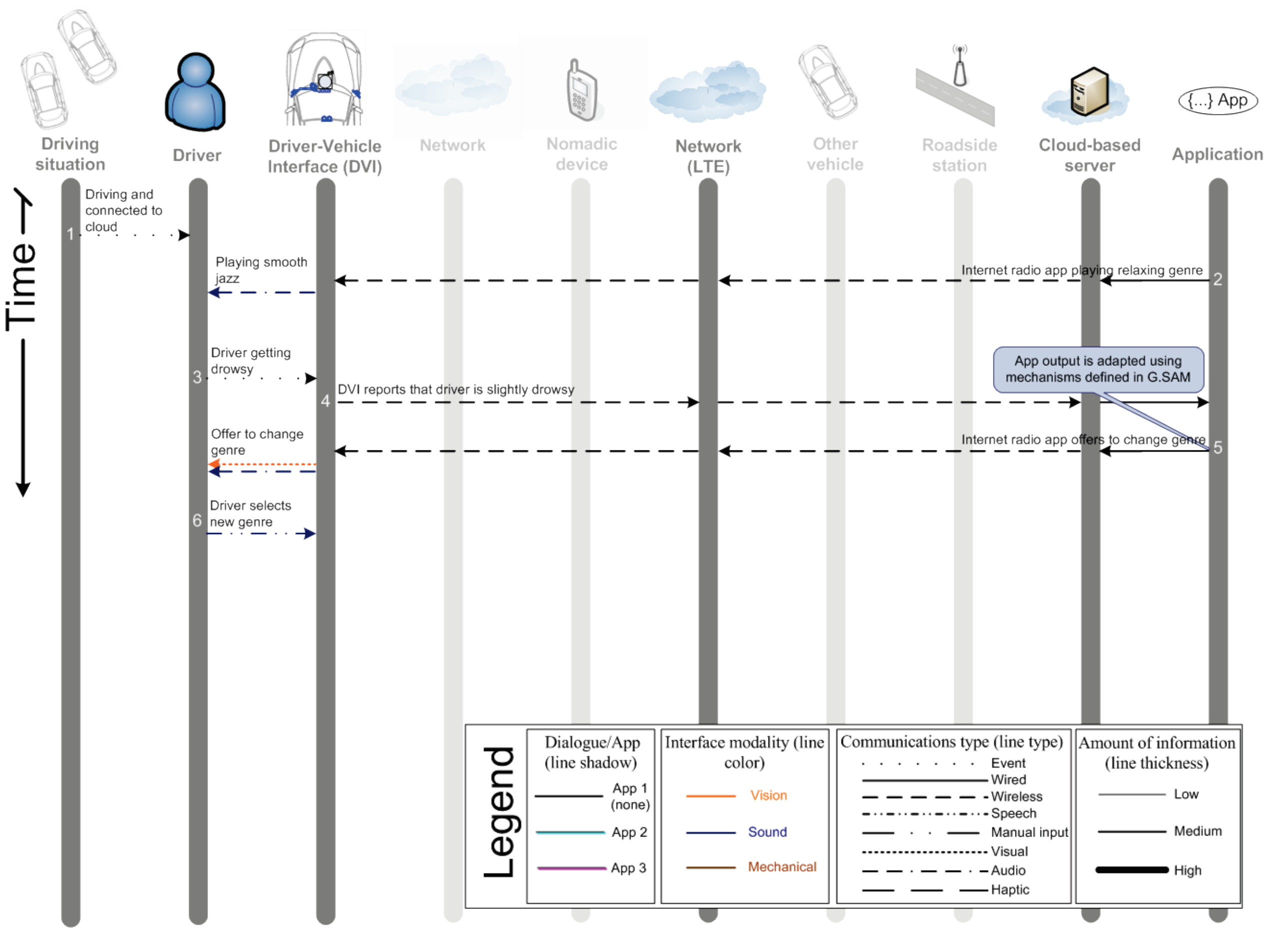

Figure 5c. Detailed example of Use Case 5 showing adaptation of external application based on driver state.

6.6 *Use Case 6*: Adaptation of DVI and external applications/services to roadway situation

This use case refers to the ability for the DVI and external applications/services to adapt their inputs and outputs based on the roadway situation.

External applications/services need to adapt the way they interact with drivers based on the current driving situation to ensure safe interaction. This requires the DVI to monitor the roadway, adapt its user interface, and communicate any needed changes in interaction style (e.g., message format, pause/resume interaction, etc.) to external applications/services.

Three detailed user scenarios of Use Case 6 are given in the following sub-subsections:

1. *Scenario 6a*: Driver busy notification
2. *Scenario 6b*: Delay of message delivery in demanding driving situation
3. *Scenario 6c*: Change message format based on road conditions
4. *Scenario 6d*: Interruption of driver interaction

6.6.1 *Scenario 6a*: Driver busy notification

In this scenario the DVI determines the driver workload caused by the driving situation is too high for the driver to receive non-essential communications. It then blocks two separate communications, a phone call and text message, and automatically notifies the sender that the driver is too busy to receive the communications at this time. The ability to manage SA by deferring communications with the driver is what is being shown.

The sequence of events and communications between objects for Scenario 6a are illustrated in Figure 6a and described below:

1) User scenario 6a starts with the vehicle under normal driving condition and connected to the cloud. The DVI is continuously monitoring the roadway conditions. This is accomplished using on-board sensors and communications with other vehicles, roadside infrastructure, and cloud-based servers.

2) The driving situation is increasing the load on the driver. This is detected by the DVI who sets the driver state to "overloaded".

3a) An incoming phone call is received from the far end.

4a) The DVI and G.SAM enables the blocking of the incoming phone call because of the driver state. The information message "The driver cannot accept your call at this time" is sent to the far end and a visual indication that an incoming call has been rejected is displayed to the driver.

3b) An incoming text (e.g. SMS) is received from the far end.

4b) The DVI and G.SAM enables the blocking of the incoming text message because of the driver state. A negative acknowledgement is sent to the far end indicating delivery of the text message will be delayed and a visual indication that the text message has been blocked is displayed to the driver.

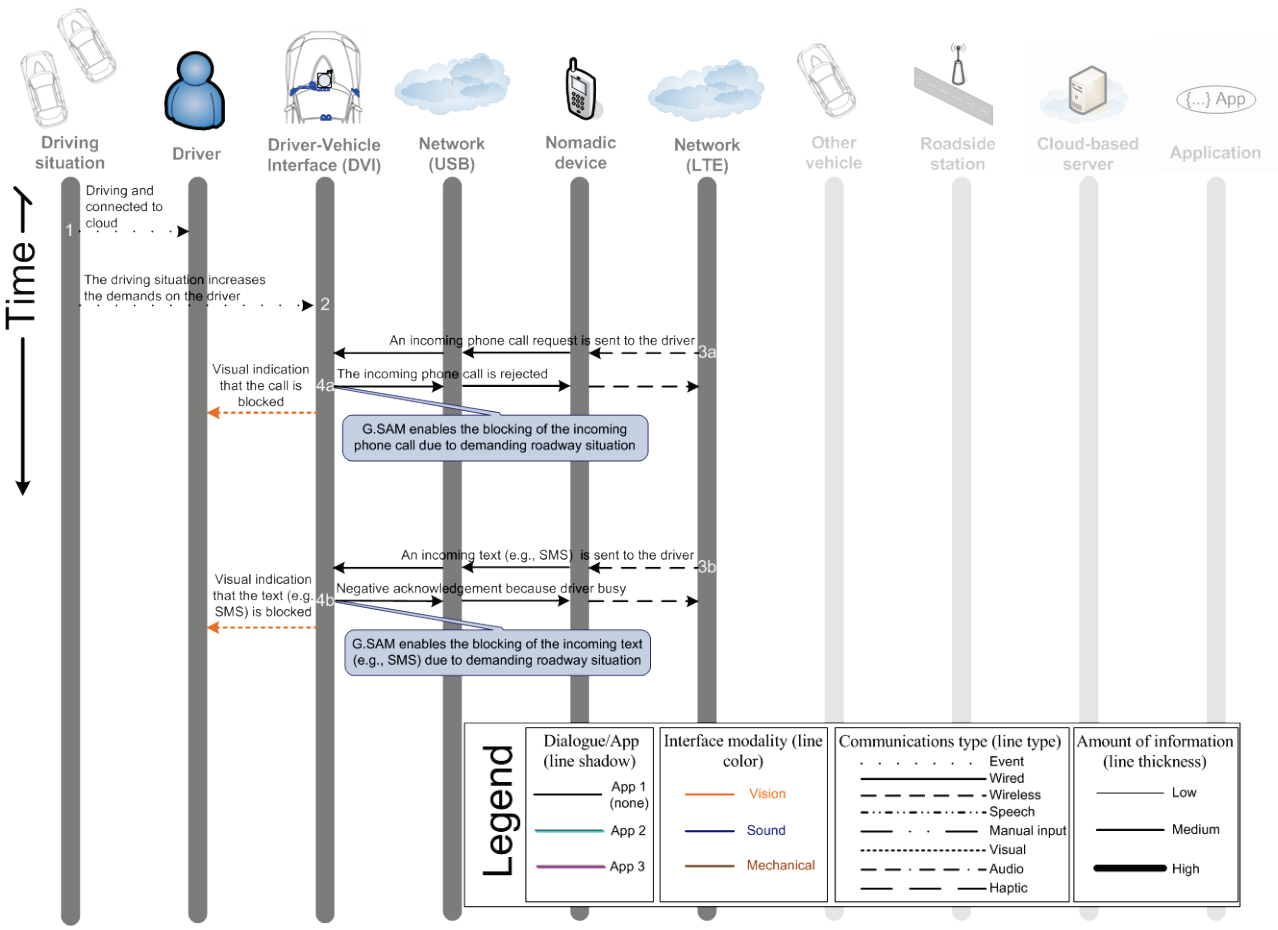

Figure 6a. Detailed example of Use Case 6 showing the notification of a busy driver.

6.6.2 *Scenario 6b*: Delay of message delivery in demanding driving situation

In this scenario the delivery of a social media status update message is delayed due to a roadway situation causing high driver workload. The ability to improve SA by deferring non-essential communications under conditions of high driver workload is what is being shown.

The sequence of events and communications between objects for Scenario 6b are illustrated in Figure 6b and described below:

1) User scenario 6b starts with the vehicle under normal driving condition and connected to the cloud. The DVI is continuously monitoring the roadway conditions either toward the roadside station or toward the cloud application.
2) The driving situation is increasing the load on the driver. This is detected by the DVI who set the driver in an overloaded state.
3) A social media status message is sent from the cloud-based application to the driver.
4) The DVI delays the handling of the social status message. This is done using mechanisms defined in G.SAM.
5) The driving situation demands have decreased. This is detected by the DVI and the driver returns in a normal condition state.
6) G.SAM enables the delivery of the content of the social media status message to the driver because of better driving condition. The content is displayed to the driver.

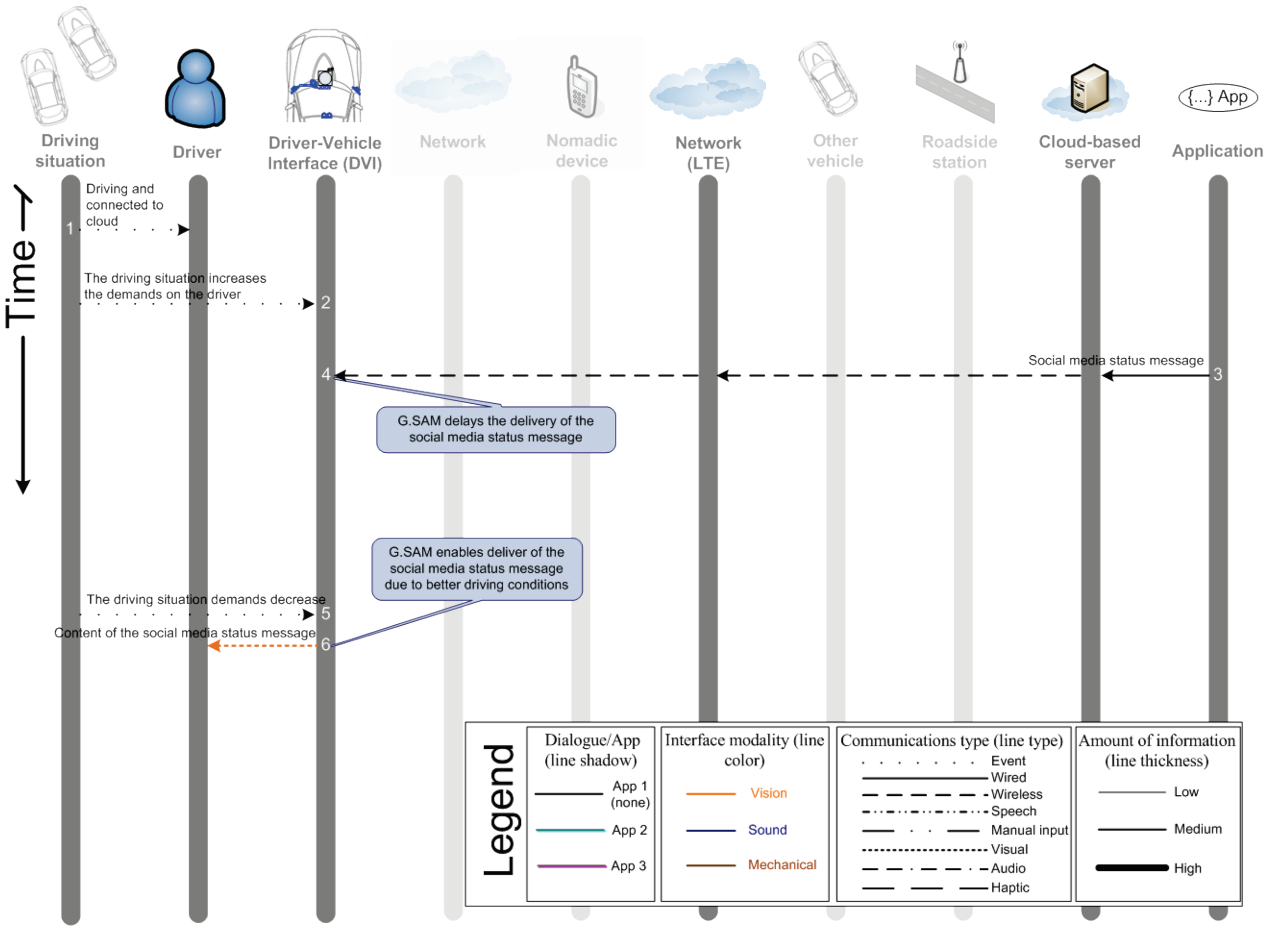

Figure 6b. Detailed example of Use Case 6 showing the delay of message delivery in demanding driving situation.

6.6.3 *Scenario 6c*: Change message format based on road conditions

In this scenario the DVI predicts high visual workload for the driver by monitoring the roadway situation and adapts the modality of a roadway hazard message from visual to auditory. The ability to better manage SA by adapting behaviour of the DVI and external applications based on roadway conditions is what is being shown.

The sequence of events and communications between objects for Scenario 6c are illustrated in Figure 6c and described below:

1) User Scenario 6c starts with the driver driving and connected to the cloud.
2) Visually demanding driving conditions are starting to occur.

3) This is detected by the DVI which then decides that it is unsafe for the driver to receive visual information. The DVI notifies the connected application of this change using the communications interface defined in G.V2A. G.SAM defines the mechanisms that allow the application to adapt its output from visual to auditory messages.

4) The Roadway Hazard application would normally send a visual message to inform the driver, but because the driver cannot receive visual messages an auditory message is sent instead.

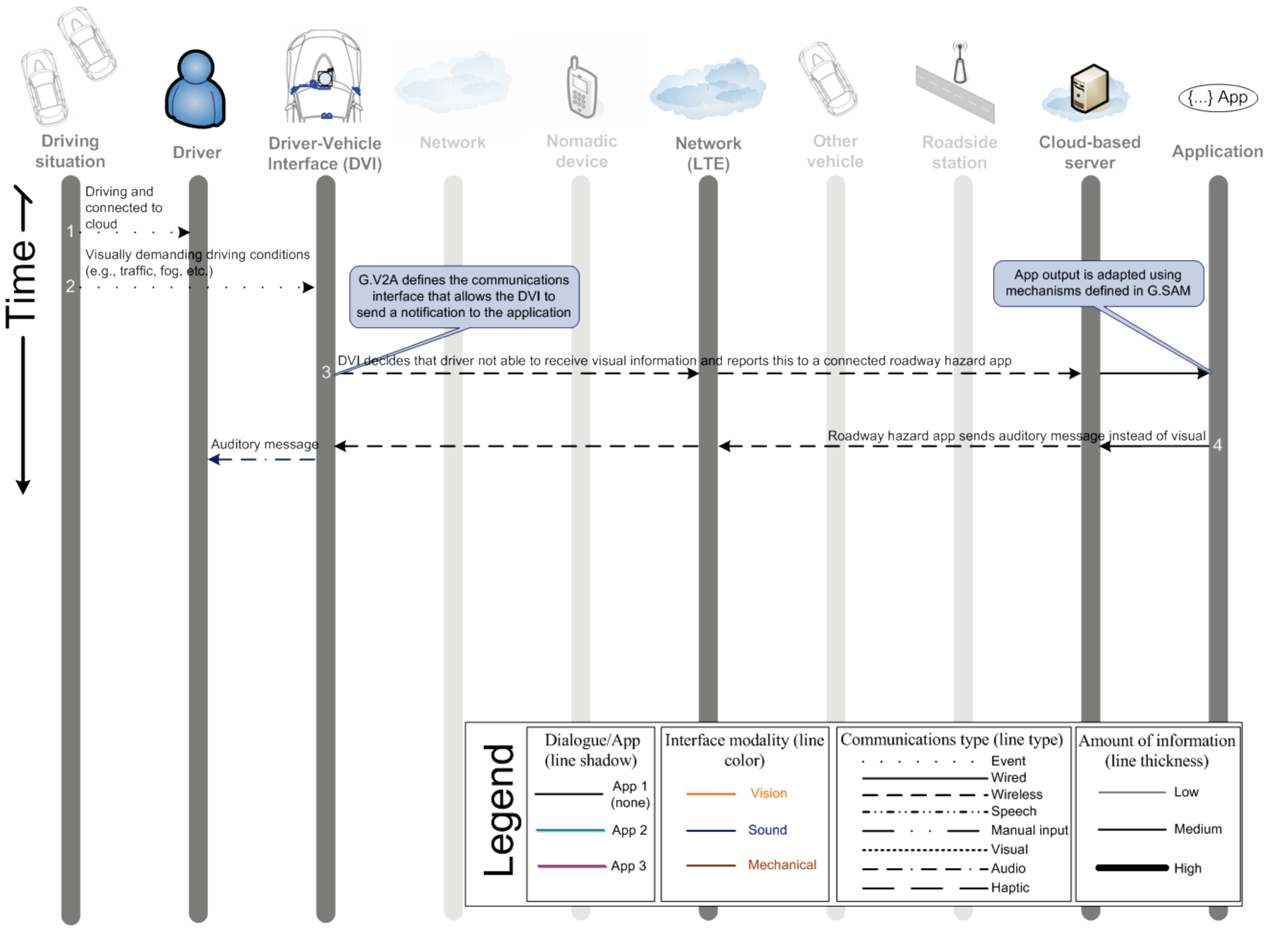

Figure 6c. Detailed example of Use Case 6 showing the change of message format based on road conditions.

6.6.4 *Scenario 6d*: Interruption of driver interaction

In this scenario the DVI determines the driver workload, due to the driving situation, becomes too high after driver interaction with applications not related to driving have already begun. It then suspends this interaction so the driver can focus on driving. Two separate driver interactions are shown as being suspended: dialogue with a speech recognition system and a phone call. The ability to better manage SA by suspending non-essential communications is what is being shown.

The sequence of events and communications between objects for Scenario 6d are illustrated in Figure 6d and described below:

1) User Scenario 6d starts with the driver driving and connected to the cloud.

2) A cloud-based application initiates a dialogue with the driver by requesting speech input.

3) The DVI detects an escalating crash situation.

4) The DVI issues a collision avoidance warning to the driver and suspends interaction with the application using mechanisms defined in G.SAM.

5) The crash situation is resolved and the DVI resumes interaction with the application using mechanisms defined in G.SAM.

6) The application resumes the dialogue with driver beginning at a point that is logical to the user and does require unnecessary re-entry of input. P.UIA provides guidance on how applications should suspend and resume interactions.

7) The driver provides the requested input and receives confirmation from the application that the information was understood.

8) The driver then initiates a phone call.

9) However, after the call is established the DVI detects that there is another escalating crash situation.

10) A crash avoidance warning is issued to the driver and the phone call is suspended by muting audio to the driver and sending a message to the far end that the phone call has been temporarily suspended.

11) The crash situation is resolved and the DVI sends a message to the far end indicating that the call is being resumed.

12) The phone call is resumed. Mechanisms defined in G.SAM are used to both notify the far end and resume suspend/resume the phone call.

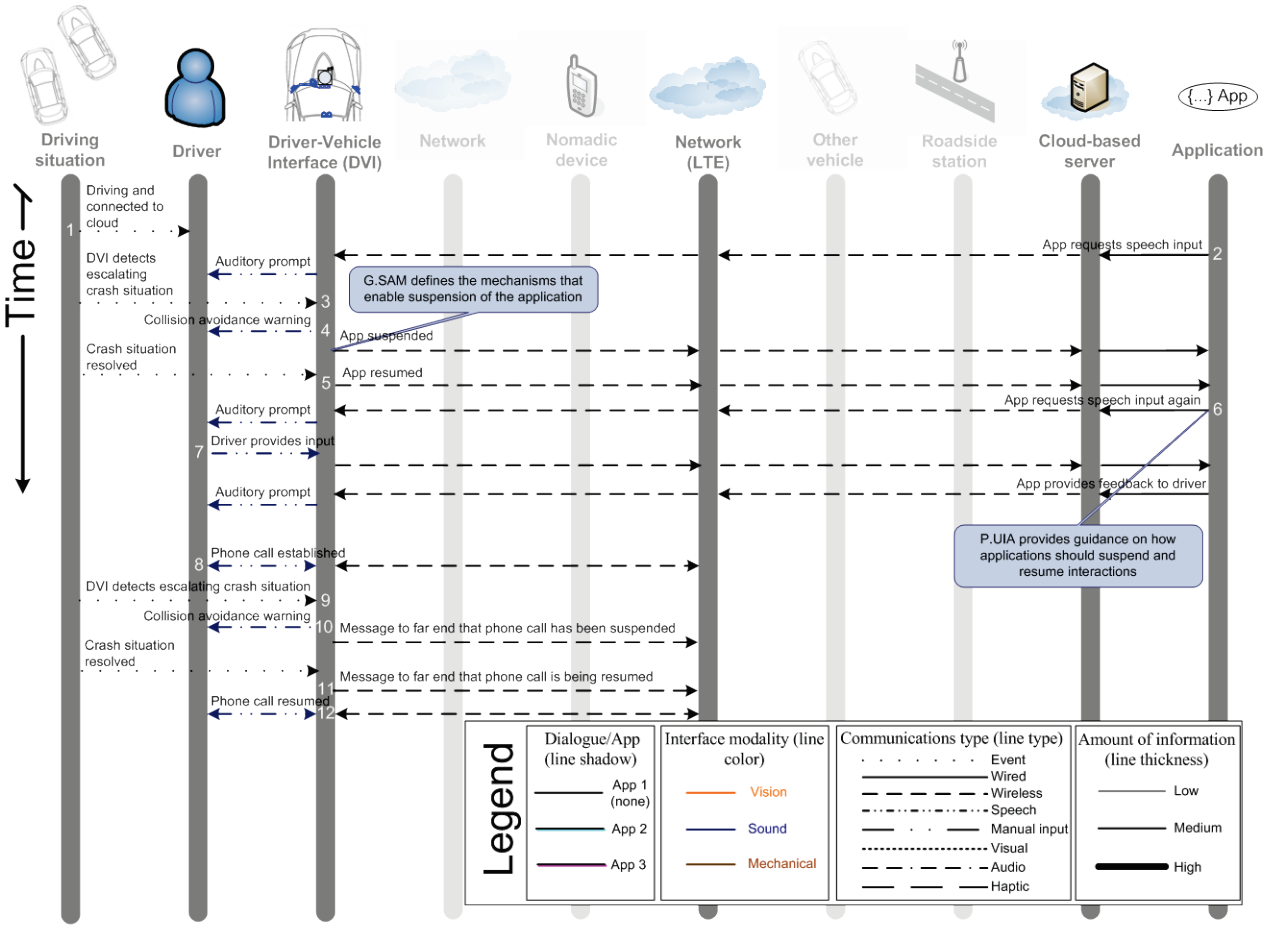

Figure 6d. Detailed example of Use Case 6 showing the interruption of driver distraction.

6.7 *Use Case 7*: Adaptation of DVI and external applications/services to vehicle status

Three detailed user scenarios of Use Case 7 are given in the following sub-subsections:

1. *Scenario 7a*: Vehicle enters safe operating condition (e.g., park gear, < 5 m.p.h., etc.)
2. *Scenario 7b*: Driver adjusts vehicle controls *(*e.g., climate control, etc.*)*
3. *Scenario 7c*: Suppression of hazard alert due to safe speed

6.7.1 *Scenario 7a*: Vehicle enters safe operating condition (e.g., park gear, < 5 m.p.h., etc.)

In this scenario the vehicle enters into an operating condition where it is safe to perform non-driving tasks and switches message modality from auditory to visual. The ability to manage SA by monitoring vehicle state information and controlling the modality and amount of information presented to the driver is what is being shown.

The sequence of events and communications between objects for Scenario 7a are illustrated in Figure 7a and described below:

1) User Scenario 7a starts with the driver driving and connected to the cloud.
2) A Social Network Service (SNS) application sends an auditory message because of the demanding driving situation.
3) Having arrived at the destination, the driver parks the vehicle. The DVI detects that the vehicle has entered an operating condition where it is safe to perform non-driving tasks (e.g., park gear, < 5 m.p.h., etc.). The algorithms that define a safe operating condition from vehicle parameters are the out of scope of the ITU-T Recommendations being considered here.
4) The safe operating state of the vehicle is reported to the cloud-based SNS application by the DVI. G.SAM mechanisms are used to enable auditory messages to be switched to visual messages.
5) The SNS application responds by switching message modality from auditory to visual.
6) The DVI starts displaying a high amount of visual information from the main page of the SNS application.

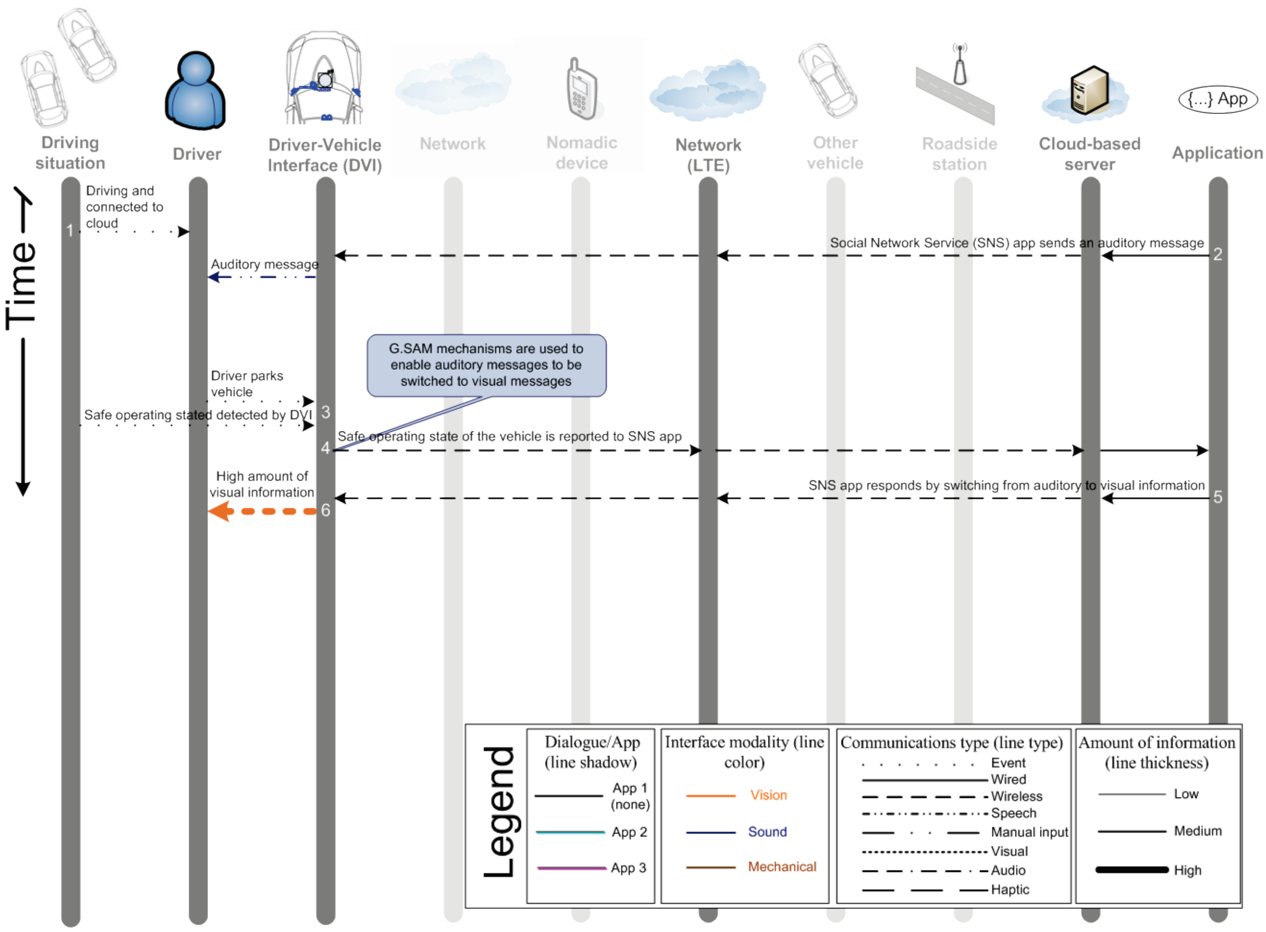

Figure 7a. Detailed example of Use Case7 showing increase in visual information when vehicle enters safe operating condition *(e.g., park gear, < 5 m.p.h., etc.).*

6.7.2 *Scenario 7b*: Driver adjusts vehicle controls (e.g., climate control, etc.)

In this scenario an incoming message from an external application is delayed because the DVI detects the driver is adjusting the climate control system which is already adding a high amount of distraction and workload. The ability to better manage SA by monitoring vehicle state information and controlling when external applications communicate with the driver is what is being shown.

The sequence of events and communications between objects for Scenario 7b are illustrated in Figure 7b and described below:

1) User scenario 7b starts with the driver driving and connected to the cloud.
2) When the driver uses the climate control panel, the DVI detects this operation.
3) A cloud-based navigation application sends navigation information to the DVI.
4) At reception of the navigation information, the DVI delays delivery of the navigation information message because the driver is engaged in a vehicle control operation. G.SAM defines the mechanisms that make this possible.
5) The DVI detects that manual operation of the climate control panel has ended.
6) The navigation information message is then displayed to the driver.

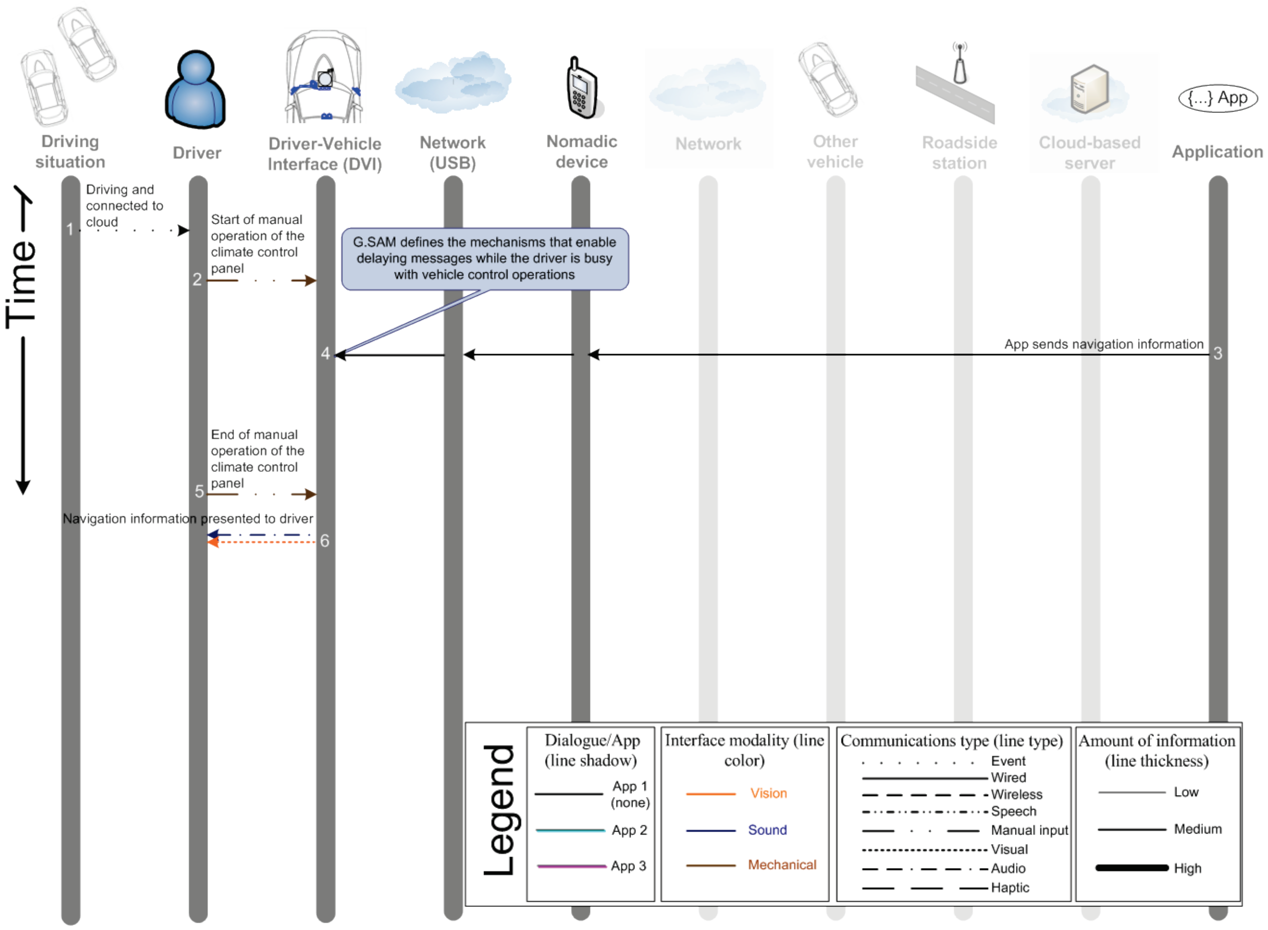

Figure 7b. Detailed example of Use Case7 showing driver adjusting vehicle controls (e.g., climate control, etc.).

6.7.3 *Scenario 7c*: Suppression of hazard alert due to safe speed

In this scenario an incoming auditory hazard alert message from a cloud-based ITS application is suppressed because the DVI determines the current vehicle speed is low enough that the hazard is not currently a threat. The ability to better manage SA by monitoring vehicle state information and controlling the modality of messages is what is being shown.

The sequence of events and communications between objects for Scenario 7c are illustrated in Figure 7c and described below:

1) User scenario 7c starts with the vehicle under normal driving conditions.
2) By observing the speed of the vehicle, DVI detects that the vehicle is in slow-going status. The algorithms that define the slow-going status from vehicle parameters are the out of scope of the ITU-T Recommendations being considered here.
3) The roadway information application sends an auditory alert message for bad road state (e.g., wet pavement) to DVI.
4) G.SAM defines the types and format of the messages between roadway information applications and DVI. The DVI suppresses the auditory part of the alert because the vehicle is under slow-going status and only presents a visual indication to the driver.

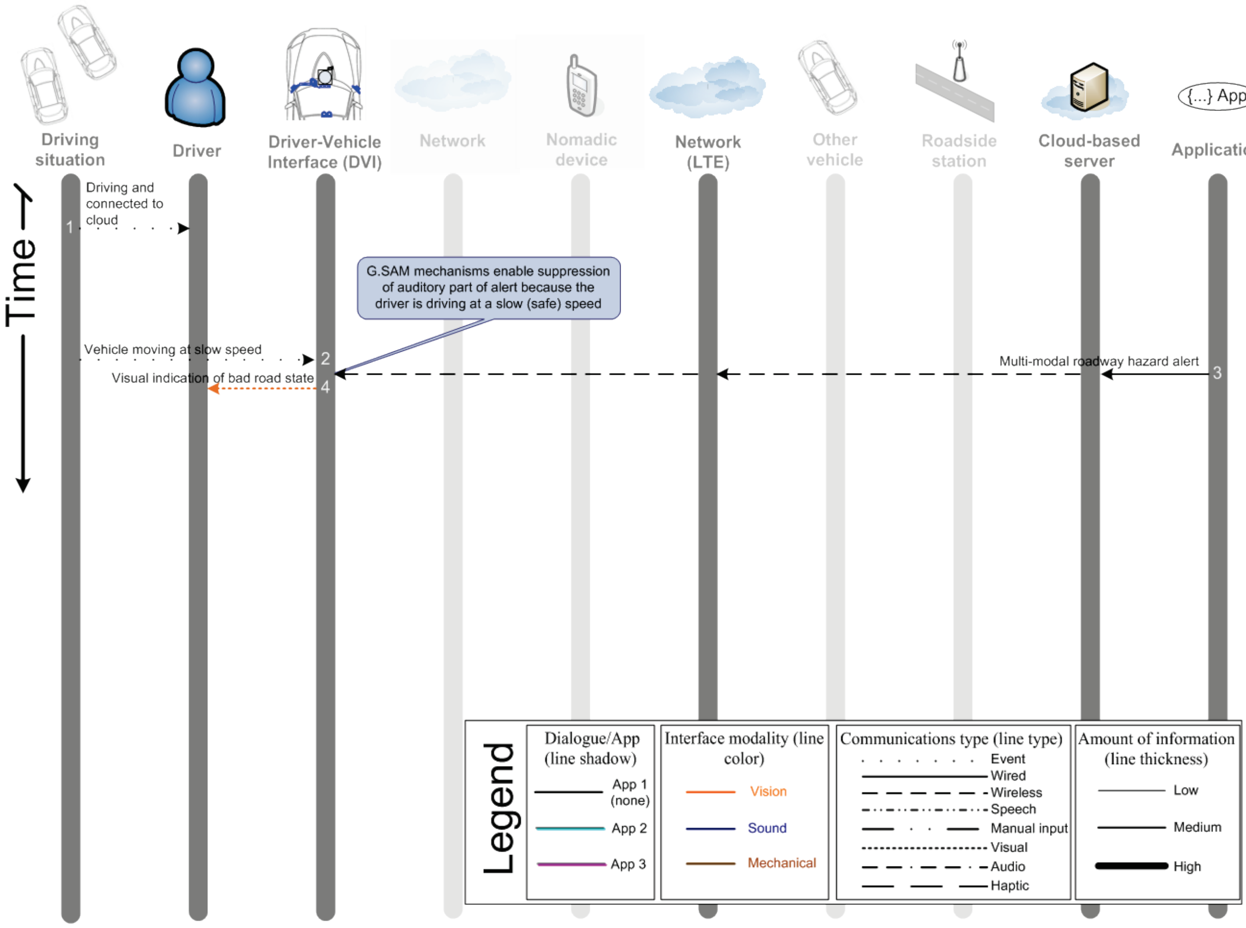

Figure 7c. Detailed example of Use Case7 showing the suppression of an auditory hazard alert due to vehicle status.

6.8 *Use Case 8*: Adaptation of DVI and external applications/services to local regulations

This use case refers to the ability for the DVI and external applications/services to adapt their inputs and outputs based on local regulations (e.g., manual texting, talking/listening, etc.). It is predicated on the development of appropriate real-time infrastructure capabilities that would provide location-specific regulatory information to the vehicle. This infrastructure is outside the scope of draft new Recommendations ITU-T P.UIA, G.SAM, and G.V2A. However, the mechanisms to execute the IT policy once it is known is considered in scope.

External applications/services need to adapt the way they interact with drivers based on local regulations to be compliant with laws. This requires the DVI to determine local regulations (e.g., based on geographic location), adapt its user interface, and communicate any needed changes in interaction style (e.g., message format, pause/resume interaction, etc.) to external applications/services.

Five detailed user scenarios of Use Case 8 are given in the following sub-subsections:

1. *Scenario 8a*: Application blocked
2. *Scenario 8b*: Application suspended
3. *Scenario 8c*: Interface modality disabled
4. *Scenario 8d*: Age restriction
5. *Scenario 8e*: Contents blocked

6.8.1 *Scenario 8a*: Application blocked

In this scenario an application initially shown as available becomes unavailable (i.e., blocked from starting) when the vehicle is driven into a state/country where the application is illegal. The ability to prevent starting interaction with an application based on local IT policy is what is being shown.

The sequence of events and communications between objects for Scenario 8a are illustrated in Figure 8a and described below:

1) User Scenario 8a starts with the driver outside of his parked car.
2) The driver enters his car, starts it, and docks his carried-in device.
3) Upon docking, the DVI automatically connects to the device. The physical connection wireless in this example.
4) The device then activates the application.
5) Upon activation, the application checks network QoS and queries DVI capabilities. The authority of the application to interact with the driver is also verified.
6) Applications then communicate with the DVI notifying it that it is available for use.
7) The DVI presents the visual message indicating that the application is available to the driver.
8) The driver starts driving.
9) The DVI determines that the application should be blocked because the vehicle is moving and local IT policy. Location of the vehicle is determined through GPS sensors or some other means. Mechanisms defined in G.SAM enable blocking the application based on IT policy. However, the backend infrastructure for determining what the IT policy is for the current location is outside the scope of G.SAM.

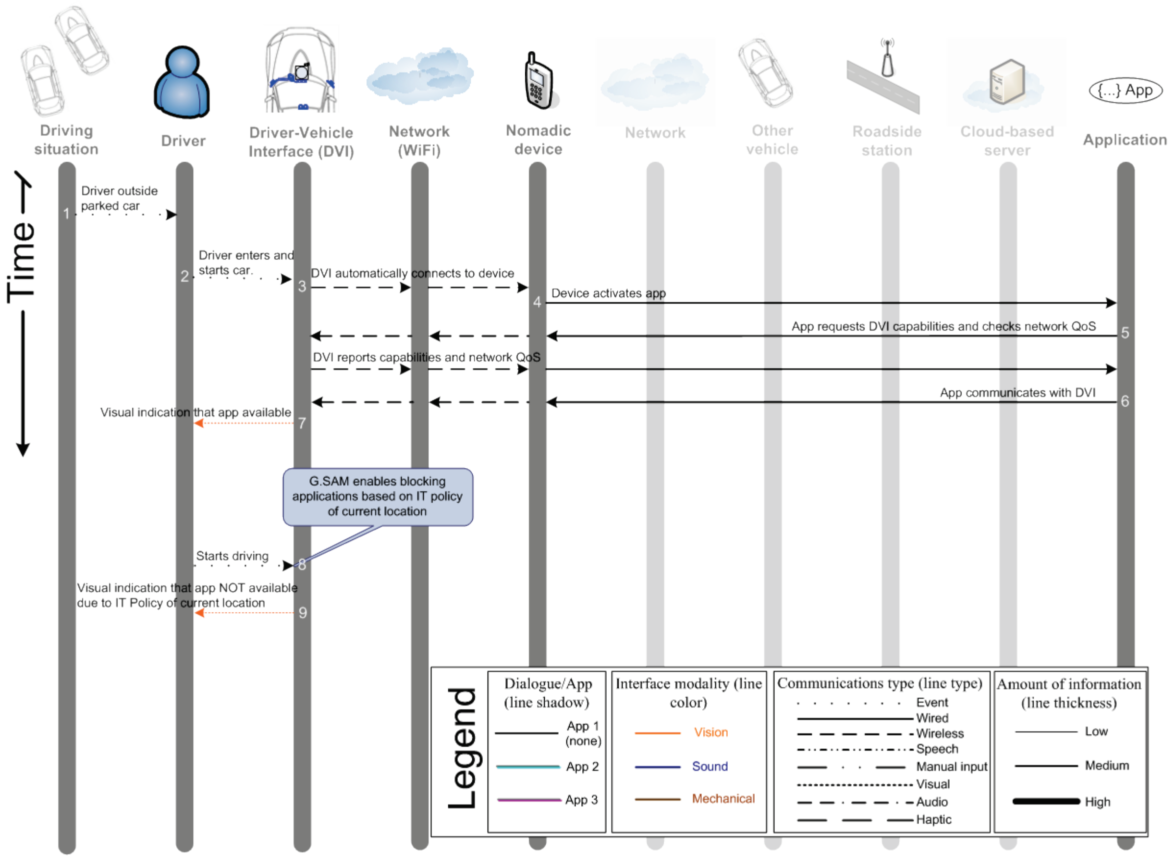

Figure 8a. Detailed example of Use Case 8 showing an application being blocked due to IT policy of current location.

6.8.2 *Scenario 8b*: Application suspended

In this scenario an opened application gets suspended when a national border is crossed where the application is illegal. The ability to suspend an application based on local IT policy is what is being shown.

The sequence of events and communications between objects for Scenario 8b are illustrated in Figure 8b and described below:

1) User Scenario 8b starts with the driver driving and connected to the cloud.
2) The driver manually activates the speech interface of the DVI.
3) The speech interface provides feedback that it is ready for speech input.
4) The driver issues the speech command to open an application
5) The DVI provides list of available applications.
6) The driver selects a Social Networking Service (SNS) application.
7) The SNS application is activated.
8) Upon activation, the application requests DVI capabilities and checks network QoS.
9) The application confirms that the DVI and network will support interaction with the driver.
10) The SNS application is brought into focus on the DVI.
11) A national border is crossed where the SNS application is illegal. The DVI detects that the application is illegal based on local IT policy. Location of the vehicle is determined through GPS sensors or some other means. It then suspends the SNS application and provides the driver with feedback that this action has taken place.

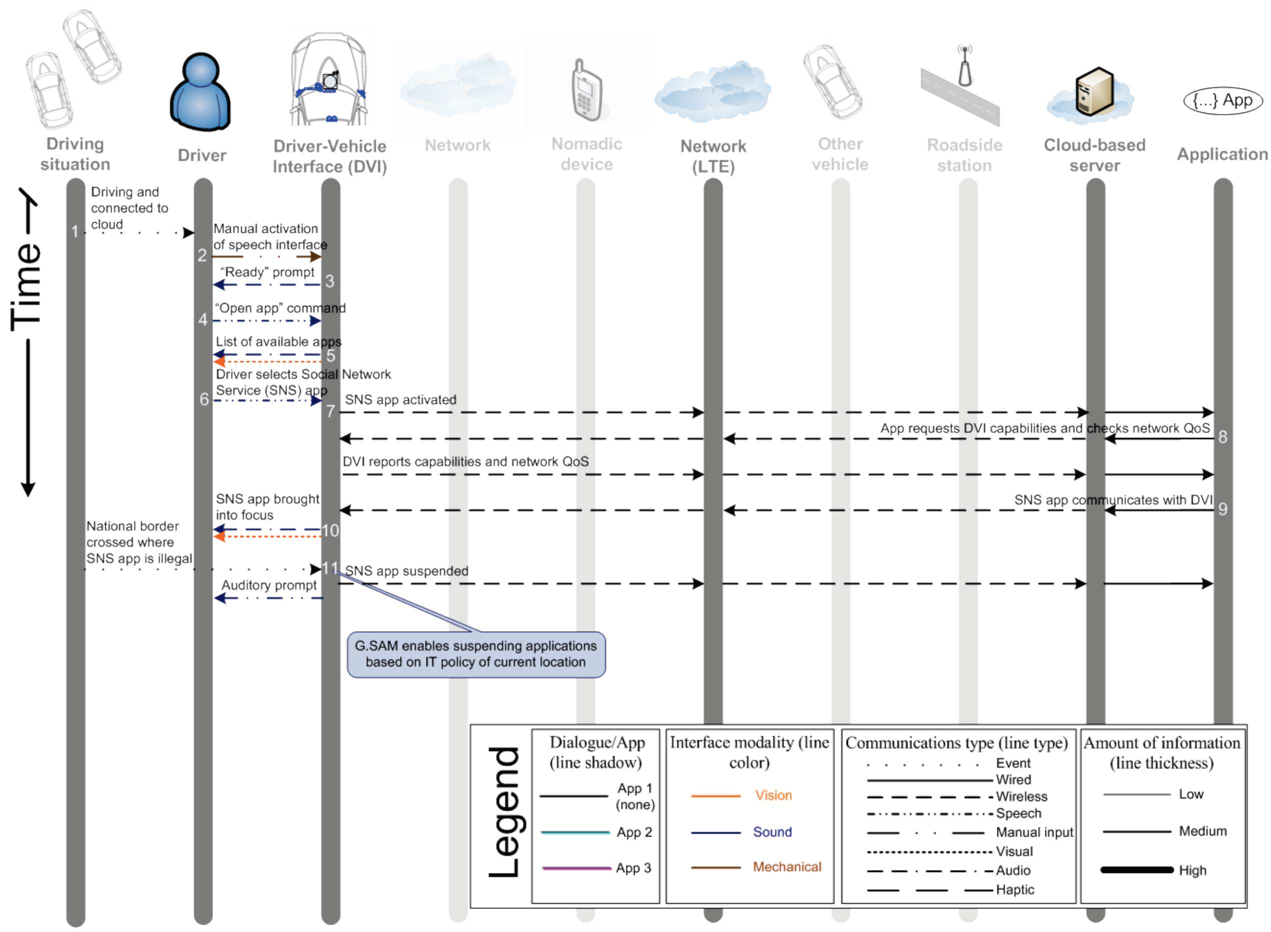

Figure 8b. Detailed example of Use Case 8 showing an application being suspended due to IT policy of current location.

6.8.3 *Scenario 8c*: Interface modality disabled

In this scenario an interface modality is disabled when a national border is crossed where using the modality is illegal (e.g., manual entry of destination for a navigation application). The ability to disable an interface modality based on local IT policy is what is being shown.

The sequence of events and communications between objects for Scenario 8c are illustrated in Figure 8c and described below:

1) User Scenario 8c starts with the driver driving and connected to a cloud-based navigation application.

2) The navigation applications requests manual input of a Point-Of-Interest (POI).

3) A national border is crossed where manual destination entry (i.e., POI entry) is illegal. The DVI detects that manual destination entry is illegal based on IT policy for the current location of the vehicle. Location of the vehicle is determined through GPS sensors or some other means. The DVI reports the change in interface capabilities based on IT policy. G.SAM defines the mechanisms for updating interface modes due to IT policy of current position.

4) The navigation application then sends a message to the DVI to update the user interface to only allow speech input.

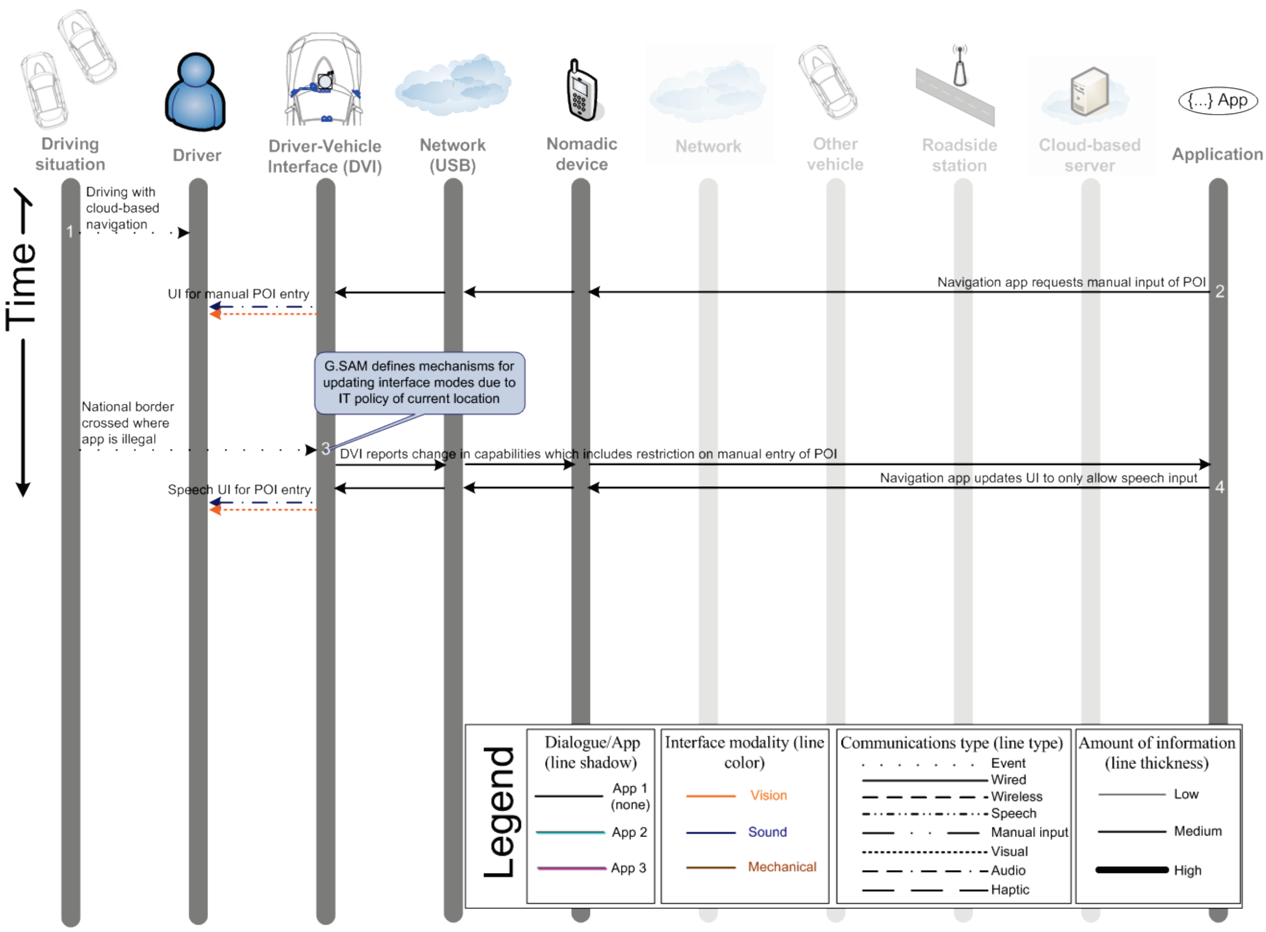

Figure 8c. Detailed example of Use Case 8 showing an interface modality disabled due to IT policy of current location.

6.8.4 *Scenario 8d*: Age restriction

In this scenario the DVI restricts access to an application based on identifying the driver as being under age and local laws prohibiting certain types of interactions for under age drivers. The ability to restrict access to applications based on the driver profile and local IT policy is what is being shown.

The sequence of events and communications between objects for Scenario 8d are illustrated in Figure 8d and described below:

1) User Scenario 8d starts with the driver outside of her parked car.
2) The driver enters her car and starts it.
3) Upon starting, the DVI automatically determines the driver is under age based on a driver profile and connects to the cloud-based server.
4) The cloud-based server then activates the application.
5) Upon activation, the application checks network QoS and queries DVI capabilities. The authority of the application to interact with the driver is also verified.
6) The application then communicates with the DVI notifying it that it is available for use.
7) The DVI presents the visual indication that the application is available to the driver.
8) The driver starts driving and the DVI suspends the application based on local IT policy and the fact the driver is under age. Visual feedback is given to the driver indicating that the application has been suspended. Mechanisms defined in G.SAM enable these age restrictions based on the driver profile and local IT policy.

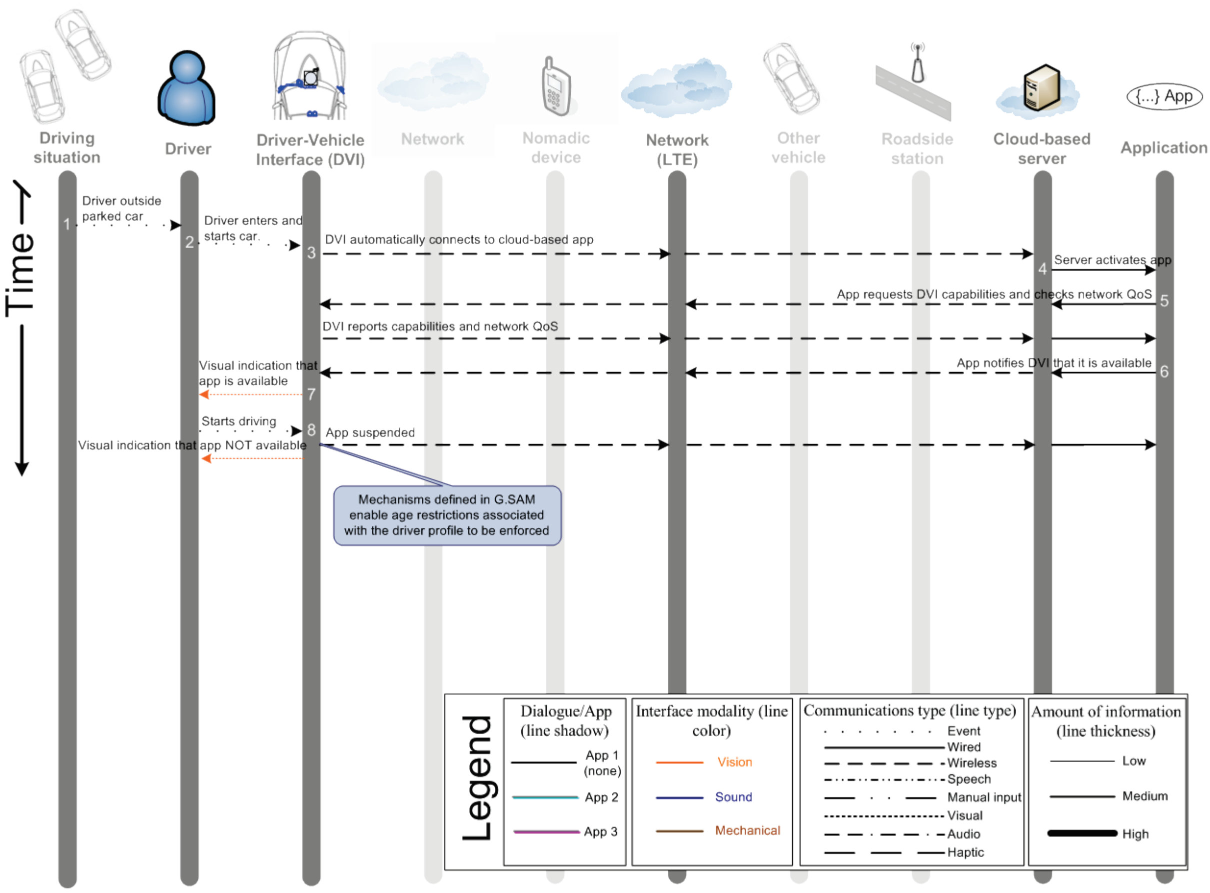

Figure 8d. Detailed example of Use Case 8 showing enforcement of age restrictions based on local IT policy.

6.8.5 *Scenario 8e*: Content restriction

In this scenario the DVI restricts still images (i.e., album art) coming from an internet radio application. Note that this report is not advocating the banning of still images, rather it is just using this as an example of how content could be restricted. The ability to restrict content based on local IT policy is what is being shown.

The sequence of events and communications between objects for Scenario 8e are illustrated in Figure 8e and described below:

1) User Scenario 8e starts with the driver driving and connected to an internet radio application.
2) The application plays the next song and updates visual information including album art.
3) A national border is crossed where still images (i.e., album art) is illegal while driving.
4) The DVI detects that still images are now illegal and reports the restriction to the internet radio application. G.SAM defines the mechanisms that enable album art to be restricted based on local IT policy.
5) The application updates its visual user interface to exclude album art.

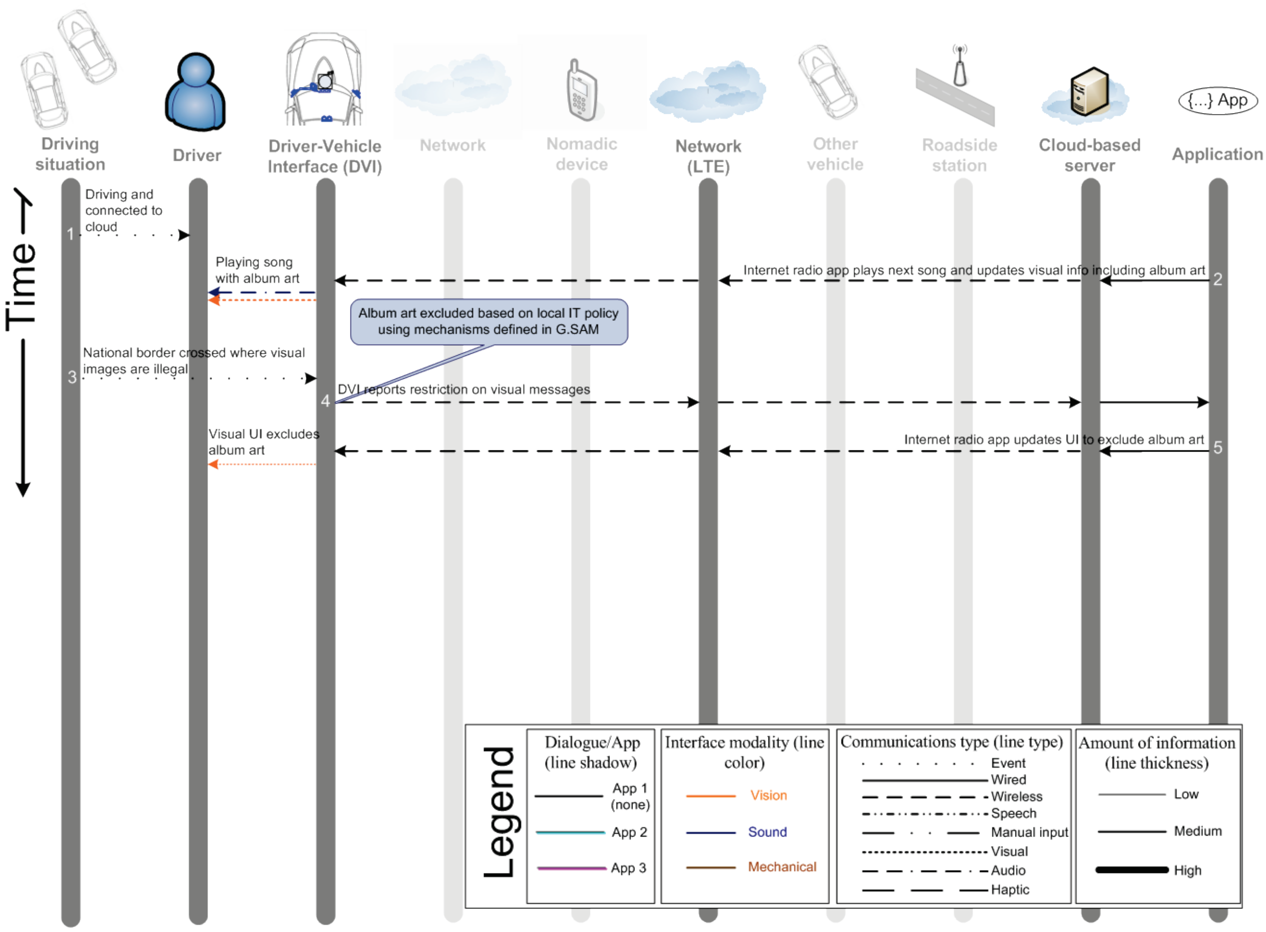

Figure 8e. Detailed example of Use Case 8 showing enforcement of content restrictions based on local IT policy.

7. Description of ITU-T Recommendations being developed

ITU Council Resolution 1318 defined the ITU's role in ICTs and improving Road Safety. Draft new Recommendations ITU-T P.UIA, G.SAM, and G.V2A have been approved as work items. They are a direct response to this Resolution and a concrete example of how the ITU-T is addressing the global problem of driver distraction.

The following subsections each describe an ITU-T Recommendation being developed (P.UIA, G.SAM, or G.V2A) and explain how they will address the use cases in this report.

It is worth noting that there is a logical order, or hierarchy, to the current document (Use Cases report), P.UIA, G.SAM, and G.V2A. The Use Cases report drives the scope and requirements of the 3 ITU-T Recommendations. P.UIA specifies functionality and performance, and imposes requirements on G.SAM mechanisms and the G.V2A communications interface. G.SAM mechanisms may also impose some requirements on G.V2A, which is the underlying communications interface between the DVI and application.

7.1 Draft new Recommendation ITU-T P.UIA (User Interface requirements for Automotive applications)

There is a growing need to provide designers and developers of ICTs systems and applications with guidance on requirements for safely interacting with drivers.

Draft new Recommendation ITU-T P.UIA will give design and performance guidance for ICT systems that need to interact with drivers. It is expected that eventually this Recommendation will address all modalities (visual, auditory, tactile, manual input, speech input) and apply to all device types (e.g., vehicle, nomadic-paired, nomadic-not paired).

However, device-specific guidance will also be given to optimize performance of each device type.

It is likely that P.UIA will not only address the end-to-end requirements (i.e., application-to-user), but also subsystem requirements (e.g., vehicle cockpit, network, nomadic device, application).

References to existing standards and guidelines will be made whenever possible.

Recommendation ITU-T P.UIA will help enable the use cases in this report by providing design and performance guidance to designers and developers of ICT systems/applications. P.UIA has been referenced in the user scenarios above to help provide a mapping between the use cases and P.UIA.

ITU-T FG Distraction has created a report [1] that is intended to help get this work started.

7.2 Draft new Recommendation ITU-T G.SAM (Mechanisms for managing the situational awareness of drivers)

The automotive cockpit is fundamentally changing. ICTs are finding their way into road vehicles and drivers are increasing interacting with these vehicle-installed, nomadic, and cloud-based ICT systems. This has the potential of causing a significant increase in technology-related driver distraction and workload.

There is a growing need to define mechanisms that can be used to manage the timing and modality of information exchanged between the driver and applications; which compete for the driver's attention. Of course, a pre-requisite for managing all applications is to have a centralized point of intelligence and control – such as the Driver-Vehicle Interface (DVI). Such integration of all applications will also require a communications interface between the DVI and external applications. This is beyond the scope of G.SAM, but is dealt with in another draft new ITU-T Recommendation (G.V2A) described in Section 4.3.

Draft new Recommendation ITU-T G.SAM will define the functional requirements (i.e., mechanisms) of ICT applications/systems needed to manage and improve Situational Awareness (SA) of drivers. An example of such a mechanism is a functional entity that could handle arbitration/integration of messages to the driver. Another example is a functional entity which could handle easily suspending/resuming interaction with an application.

The mechanisms to be defined G.SAM will improve SA in a couple of ways. First, they will reduce technology-related driver distraction and workload. Second, they will increase the effectiveness of safety-related applications such as Advanced Driver Assistance Systems (ADAS). Effectiveness is improved by making safety-related communications more salient while simultaneously reducing the driver distraction and workload created by other applications.

Recommendation ITU-T G.SAM will help enable the use cases in this report by defining the functional requirements of mechanisms used to manage situational awareness. G.SAM has been referenced in the user scenarios above to help provide a mapping between the use cases and G.SAM.

ITU-T FG Distraction has created a report [2] that is intended to help get this work started. It describes the high-level capabilities that should be supported by the G.SAM mechanisms that will be developed.

7.3 Draft new Recommendation ITU-T G.V2A (Communications interface between external applications and a Vehicle Gateway Platform)

Nomadic ICT devices (e.g., mobile phones, portable navigation units, etc.) are currently being used within the automotive cockpit by drivers while operating their vehicle. Their small size, manual interface, unsecured/uncontrolled/arbitrary position within the vehicle, and uncontrolled interaction with the driver has the potential to decrease SA. It is unlikely that regulation and education alone will prevent usage of these devices within the cockpit. Therefore, technology-based solutions for safer interaction with these devices should also be pursued.

There is also a need to enable safe interaction with cloud-based applications that are hosted outside of the vehicle. Intelligent Transport Systems (ITS) applications are just one example.

What do cloud-based and nomadic device-based applications have in common? They are both “external” to the vehicle platform, which is the best place to safely manage interactions with the driver.

Draft new Recommendation ITU-T G.V2A will define a communications interface between external applications and a Vehicle Gateway Platform (VGP) in non-commercial road vehicles. The DVI can be considered part of the VGP. The objective of this Recommendation is to enable applications running on nomadic devices (e.g., mobile phones, portable music players, etc.) and in the cloud (e.g., ITS systems, navigation servers, etc.) to interact with drivers in a safer manner. The communications interface will allow external applications to leverage the DVI. It will also enable the vehicle platform to control the timing and modality of all application messages to the driver.

Recommendation ITU-T G.V2A will help enable the use cases in this report by defining the interface that allows the DVI and external applications to communicate. G.V2A has been referenced in the user scenarios above to help provide a mapping between the use cases and G.V2A.

ITU-T FG Distraction has created a report [3] that is intended to help get this work started.

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