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MODACCESS SUBPROJECT

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SECTION I – DELIVERABLE SUMMARY

Deliverable Title	
Deliverable ID , associated WP & Subproject	*DEL_MODACCESS_WP13_D47_V7_080528.doc MODACCESS / WP13*
Type of Deliverable	Report
Input / Starting stage	*WP13 Deliverables (D48, D49), MODURBAN partners input Others MODURBAN Subproject, WP13 members, Main Metros Systems Survey*
Output / Final stage	*Functional Interfaces Specification for Passenger Information System*

Lead partner(s)	
Achievement to date (%)	100 %
Expected date of achievement	T0+42
Type of exploitation	
Exploitation potential	
Expected budget	*See relevant table (wp13 costs)*
Actual costs	*See relevant table (WP13 costs)*
Expected costs to completion	
Protection	*Not Relevant*
Protection date	*Not Relevant*

IP's	***Partners, (type, identification, date)***
Pre-existing Know-How	Not Relevant
Exploitation Rights	Not Relevant

Associated Risk analysis	***Type, solution envisaged, action, actors***	***Actual Reduction***
Before start		
During task implementation		

Deliverable Title
Deliverable Abstract **The document focuses on the identification of the External & Internal PIS Interfaces for Urban Transport and the related General Functionalities. These will be analyzed and defined on the basis of the functionalities of PIS devices involved, with the aim of providing clearly comprehensible information in relation to the associated interfaces (acoustic, visual, tactile, others)** **This document also deals with the identification and analysis of the interface functionalities for the on-board and wayside PIS. In this case the functionalities will be defined on the basis of the different kinds of information, both dynamic and static, provided to the passenger.**
Associated Milestone (if relevant): M64. Selection of technologies to be used in the demonstration M30. Agreement on functions in emergency situations

Contribution to MODURBAN Objectives as mentioned in the Description of Work		
Objective Definition	***Comments***	***Quantification***
Objective 1 -		
Objective 2 –		
Objective 3 …		
Objective 4 …		

SECTION 2 – DELIVERABLE DETAILED DESCRIPTION

1. Scope of the Document

This document shall identify the external and internal interfaces for a PIS on a public transport and define the related general specifications. The PIS interfaces will be analyzed on the basis of the features of the different devices that provide information on board.
An analysis will also be carried out to identify the structure of the interfaces for a wayside PIS. However, the definition of the interface specifications will be based on the different kinds of information delivered to passengers.
The final target of the document is to provide a list of the main interface functionalities both for the on-board PIS and the wayside PIS, that could be taken into consideration as one of the starting points for the concept design of a European passenger information system that can give every European citizen the same perception of the information

The document does not deal with the type of transmitter to be used or the protocol, as within the European MODURBAN project it will be the subtask MODCOMM that will deal exhaustively with this problem. Nonetheless, the use of widely used techniques with proven reliability, such as the TCP/IP stack, is desirable.
The basic requirements that any communication system (wireless or wired) must satisfy are the following:

- Identification of default messages to be displayed in the event of loss of connection between the front end PIS devices and the information sources.
- Integrity of data forwarded so that the messages or information transmitted are in fact those to be transmitted, to avoid transmitting information with correct syntax but erroneous context (e.g. the PIS indicates the arrival in an existing station but it does not correspond to the train line).
- Guarantee correct addressing: one must always be certain that the information source and the device to be addressed are correct. For example, in the case of the wireless video surveillance one must always be sure that the image received is that coming from the selected camera and not from another, or in the case of data exchange via wireless between the OCC (Operational Control Centre) and a train there must be no cross-over interference with nearby trains.
- Protection of information transmitted: as far as possible error-free transmission must be guaranteed. To reduce the risk of error in reception every data sent must have the following characteristics:

    - Message authenticity
    - Message Integrity
    - Message Timeliness

2. Glossary

EAP	Emergency Alarm for Passenger
EEDe	Emergency Egress Device
Ext	External Teams
GOA	Grade Of Automation
OCC	Operations Control Centre
PA	Public Address
PIS	Passenger Information System
PRM	Person with Reduced Mobility
PTT	Push To Talk
SAS	Safety Alarm System
SNR	Signal Noise Ratio
TCMS	Train Control and Monitoring System
TCP/IP	Transmission Control Protocol / Internet Protocol

3. PIS Functionalities in Emergency Situations

The Passenger Information System (PIS) usually provides different kind of information on the base of the different travel positions, as: starting time, delay, line number & direction, terminal station, next stations, connections and information in emergency situations. In this last condition the functionalities of the PIS could be improved integrating the functionalities of SAS devices and Video Surveillance. Even if these devices are not a part of PIS, they are useful in emergency situation to give to the OCC personnel a complete vision of the situation both on board and on wayside. At the same time they are able to give to the passenger a feeling of security and a feeling of "somewhere someone knows my situation".
The devices that form a SAS & Video Surveillance basic set are list in the following:

- Emergency Passenger Call Unit
- Emergency Egress Device (EEDe)
- Emergency Alarm for Passenger (EAP)
- Manual Fire Extinguisher
- Emergency Lighting System
- Video Surveillance

4. Passenger Information System Interfaces for Urban Public Transport

The information sources for the on-board PIS are both inside and outside the vehicle itself. The interface system of a PIS on a public transport vehicle can, therefore, be divided into two classes: internal interface and external interface (Figure 1).
The external interfaces regulate the possible relations, in communication terms, that the on-board PIS can have with the OCC (Operational Control Centre) and the ExT (External Teams).
The common functional characteristic of these two external interfaces is the possibility of a wireless connection between the vehicle PIS and the OCC and Platform (Optional with the ExT). This connection, in the case of a driverless or unmanned vehicle, is essential, especially for live video surveillance which is fundamental for the safety of passengers during the entire journey.
The internal interfaces manage the information flow between the devices that form part of the PIS (displays, loudspeakers, luminous panels) and the on-board information sources, which can be both the on-board computer supervisor (possibly a unit dedicated exclusively to the PIS or part of the TCMS) or the actual DRIVER who can send voice messages to the PASSENGERS or, if necessary, automatically interrupt or modify the information flow generated by the on-board supervisor. The computer supervisor is the only information source in the case of unmanned systems and, therefore, any interruption or modification of the information broadcast to passengers falls within the sphere of the external interfaces (i.e. OCC).
However, when there is a train crew (even on driverless systems) the main functional requirements consist of the possibility for the DRIVER to intervene in real time on the pre-recorded messages of the PIS and the possibility for PASSENGERS to activate a voice communication with the DRIVER. In this case the voice communication function is an essential requirement to guarantee a feeling of security during the journey. The Driver speaking directly with a passenger can have, in emergency situations, a description of what is happening even in the absence of on-board video surveillance.
This last function introduces another aspect of on-board communication systems that is complementary to the PIS and is the SAS (Safety Alarm Security System). The devices of the PIS to safeguard journey and passenger safety form part of this system. Hence all the emergency devices such as Emergency Egress Handle, Emergency Alarm Handle, Intercom and Video Surveillance are part of the SAS.

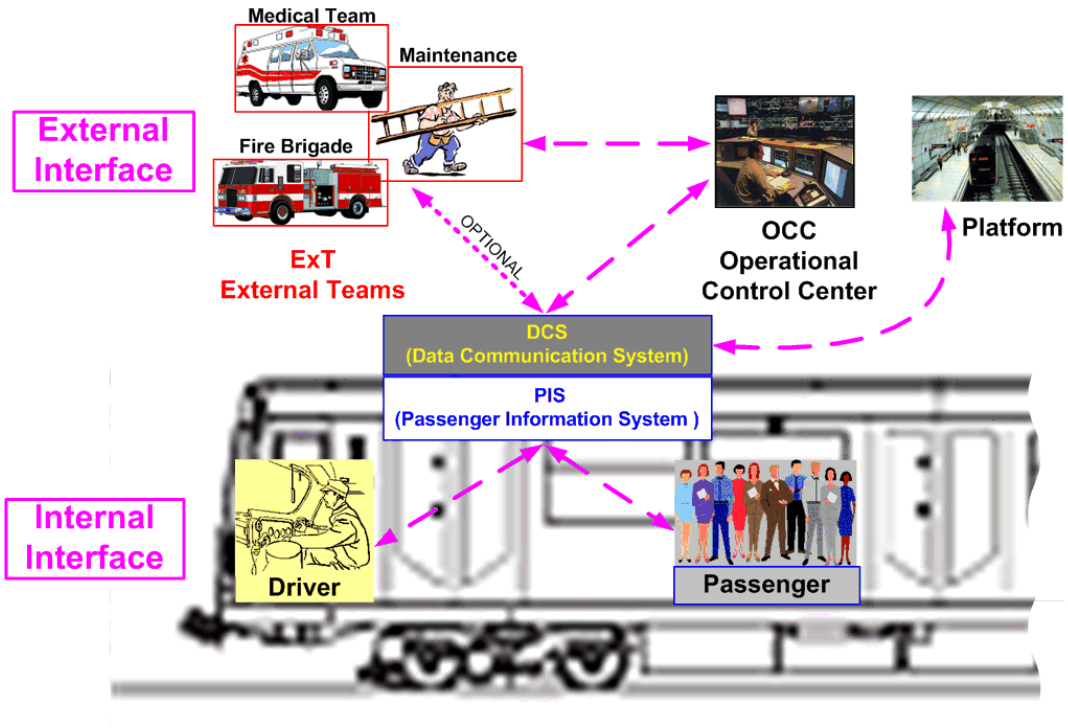

Figure 1 – Block Diagram of the Internal and External Interfaces of a PIS

4.1. External Interfaces

The external interfaces of the PIS are the OCC (Operational Control Centre) and only as optional the ExT (External Teams) which, although they have in common the wireless communication function, have different functions related to the different connection requirements of the OCC and the ExT (only as optional).

4.1.1. Functionalities of the OCC External Interface

The interface between the on-board PIS and the OCC has 4 main functions (Figure 2):

- Voice Communication with Passenger
- Voice Communication with the DRIVER
- Wireless Link for Video Surveillance Transmission
- Remote Diagnostic of MODACCESS Devices (i.e. PIS, doors, others)

The peculiarities of this interface are represented by the dual functions of the audio communication depending on the type of vehicle. In fact, while on vehicles with drivers the communication is activated between the OCC and the DRIVER, on driverless vehicles or unmanned vehicles it is necessary instead to have a direct audio communication with Passengers. In this case also the video surveillance takes on an important role not only in guaranteeing the safety of passengers but also in monitoring the integrity of the vehicle, (e.g. doors or lighting out of order).

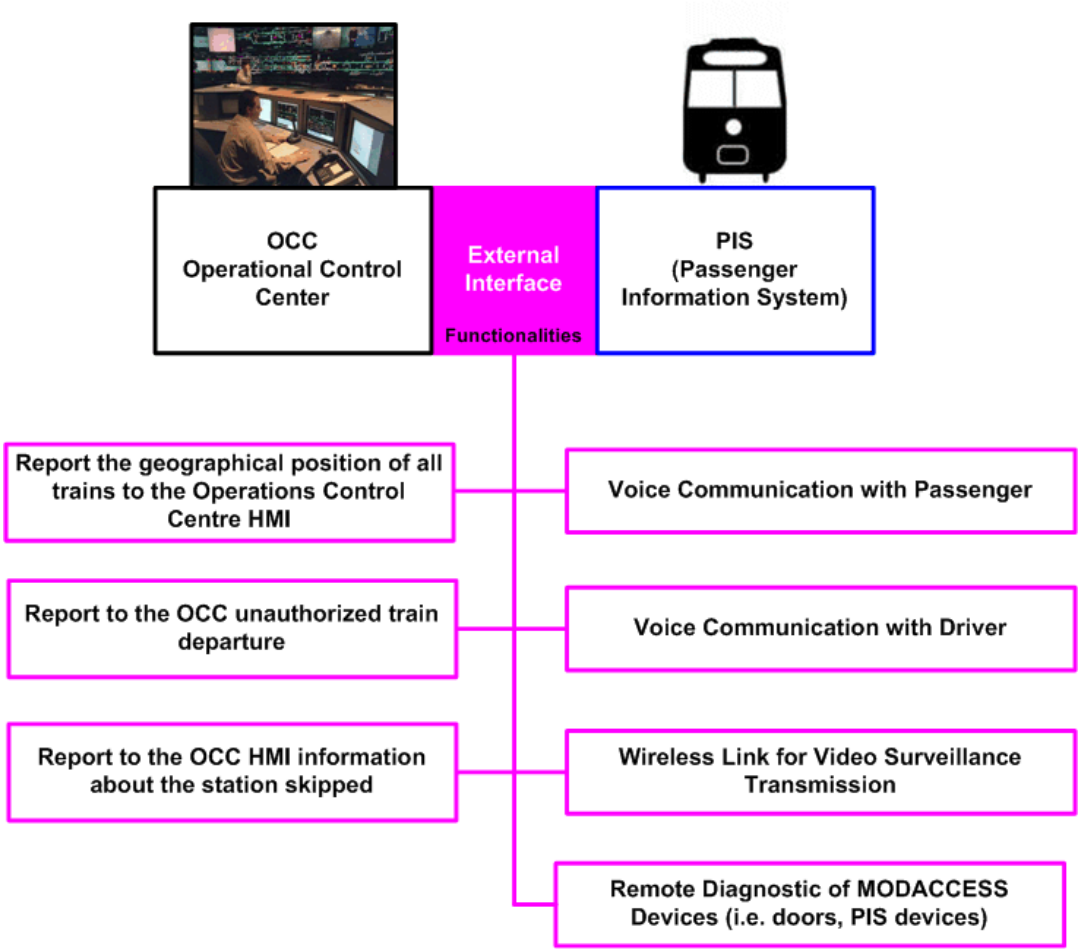

Figure 2 – Block Diagram of the External Interfaces between GCC and PIS and SAS of a Public Transport vehicle

4.1.2. Functionalities of the ExT External Interface (only as optional)

The interface between the on-board PIS and the ExT has 3 functionalities (Figure 3):

- Emergency Access into the Vehicle (in collaboration with WP14)
- Wireless Link for Video Surveillance Transmission
- Voice communication with the Passenger or DRIVER inside

The functionality of a wireless connection for the transmission of voice and images with any rescue teams or more simply a maintenance team, through portable terminals, could be very useful especially in the case of failures that interrupt the running of driverless vehicles or seriously effect service while passengers are on board. This audio and video connection between external personnel and passengers would be essential also from a psychological point of view to tranquilize the latter but it would also be useful to ground personnel to be able to obtain a general idea of the condition of the vehicle and improve risk management performances.

Another important function, which however will have to be developed together with the WP14 partners, is the possibility for an external rescue team to have access to the inside of the vehicle through devices external to the train that permit the opening of doors or hatches in the event that the normal door opening system is out of order.

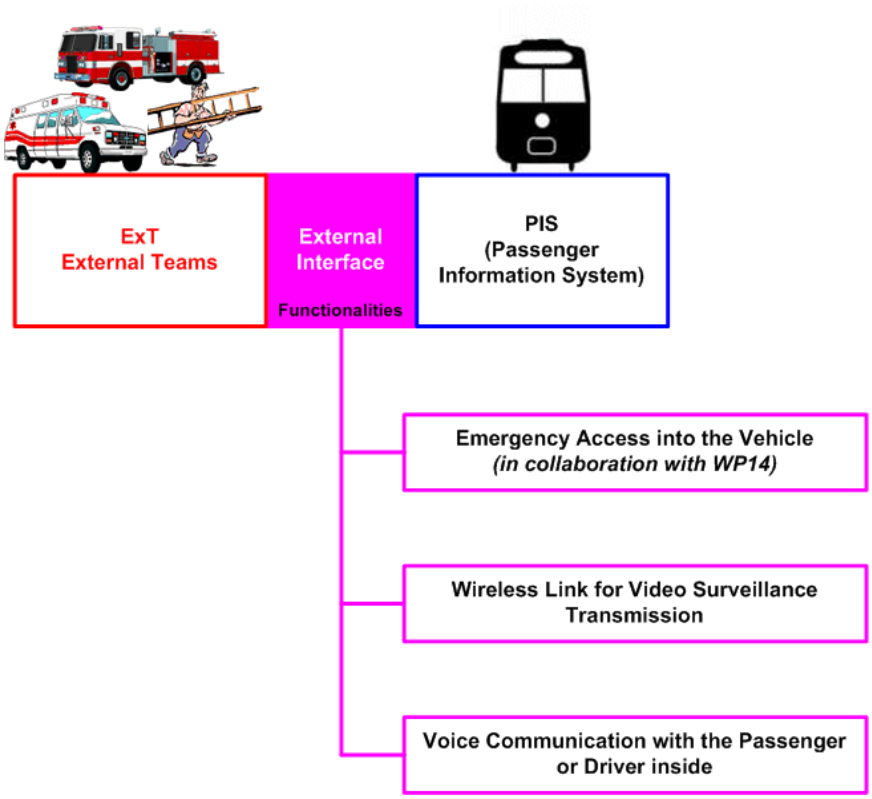

Figure 3 – Block Diagram of the External Interfaces between ExT and PIS and SAS

4.2. Internal Interfaces

The internal interfaces of the on-board PIS are the DRIVER (in the case of driverless vehicles the DRIVER interface is the supervision computer) and the Passengers. Unlike the case of the external interfaces where the PIS generally acts as go-between for the realization of connections between the OCC and the ExT, in this case the functions of the internal interfaces mainly ensure that both the DRIVER and the Passengers can interact with the PIS. In fact for the DRIVER there is the possibility to intervene directly on the pre-recorded messages of the PIS and for the Passengers the interface acts on the modalities with which the travel information is broadcast.

4.2.1. Functionalities of the Passenger Internal Interface

The internal PASSENGER interface of the PIS has six functionalities (Figure 4):

- Voice Communication Passenger – DRIVER
- Voice Communication Passenger – OCC (driverless)
- Public Address Communication

- Acoustic Alarms
- Visual Travel Information
- Emergency Devices Activations

The possibility of establishing a voice connection has different characteristics depending on the type of vehicle to which it refers. For driverless or unmanned vehicles the voice communication will of necessity be between the passengers and the OCC, while on normal vehicles with DRIVER the communication will be directly with the DRIVER himself.
Unlike the other interfaces of the PIS previously analysed, this has functions that are closely tied to the human perceptive sphere and, therefore, connected to the ergonomic characteristics of the information devices of the PIS. The main functional characteristics of the Passenger interface are in fact aimed at broadcasting information that is not only readily comprehensible but also clearly visible in the various light conditions and furnishings of the vehicle. Therefore the functionalities, in the case of displays, concern such variables as levels of contrast, luminosity, size of letters, colour and symbols.
The functional/ergonomic definition of a valid Passenger interface at European level is a very detailed analysis, as the perception of information by passengers changes according to the different customs of European countries. A simple example of this could be the diverse realization, on the part of the different European Public Operators, of the acoustic alarm and sound that warns that the doors are closing. Another example could be the different perception on the part of the passenger of the white cross symbol on a green background; in Italy this indicates where a first aid kit can be found while in Germany for example it indicates a seat for PRM (Person with Reduced Mobility).
Based on these considerations, the functionalities of this interface have been defined by keeping as much as possible to that which was already present in Europe in terms of regulations and standards.

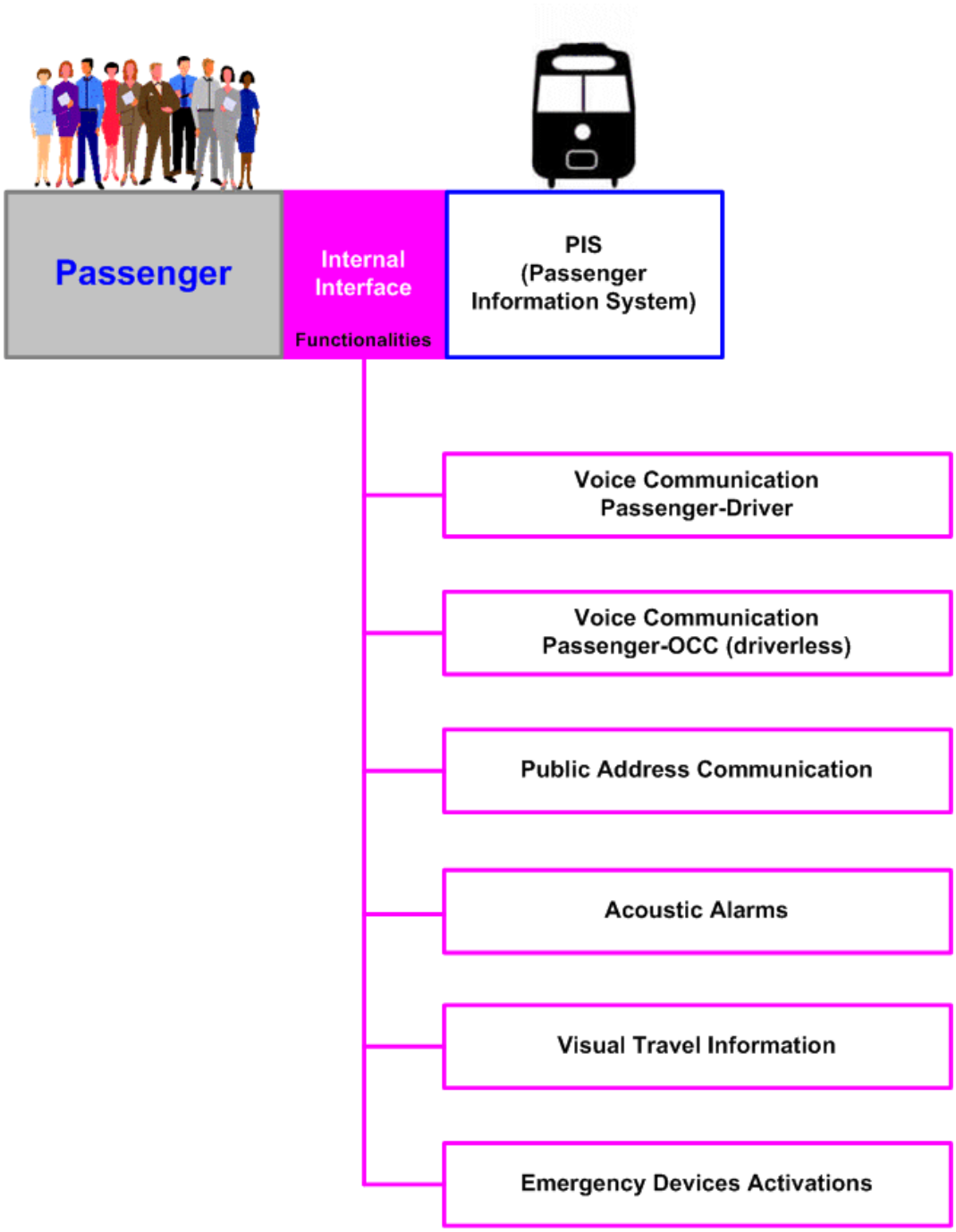

Figure 4 – Block Diagram of the Internal Interfaces between Passenger and PIS

4.2.2. Functionalities of the DRIVER Internal Interface

The internal DRIVER interface of the PIS has five functionalities (Figure 5):

- Management of the Voice Communication DRIVER – Passenger
- Voice Communication DRIVER – OCC
  (it an explanation not a requirements for PIS interfaces)

- Public Address Announces
- Alarms for Emergency Device Activation by Passenger
- Survey of Boarding Operation

In the case of the DRIVER interface, the functionalities are mainly focused on the management of the PIS, or allowing the DRIVER to control and modify not only the automatic broadcasting of announcements to passengers, but also to manage any emergency calls from passengers through the activation of alarm devices (handles and buttons). Another important functionality is the possibility of receiving in the DRIVER's cab images from the on-board video surveillance in order to control boarding operations, and images from the video surveillance on the platform as the train approaches the station to see in advance any potentially dangerous situations.

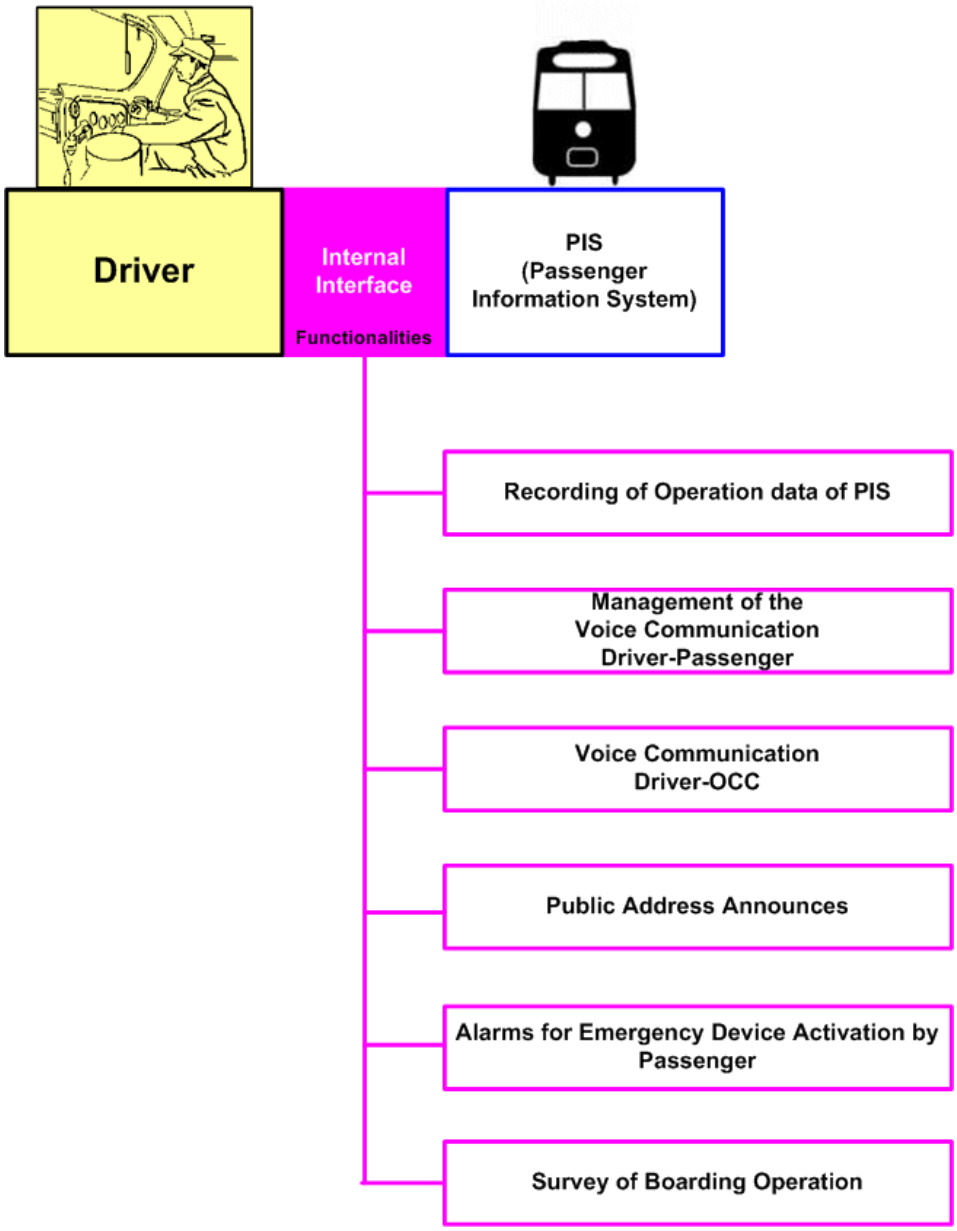

Figure 5 – Block Diagram of the Internal Interfaces between DRIVER and PIS

4.3. Wayside Interfaces

The wayside PIS has two interfaces, one with the PLATFORM and the other with the OCC (Figure 6). Due to the large amount of information and the different timing with which the different announcements are to be made to passengers, the Functional Specifications of these interfaces are connected to the information characteristic: dynamic or static.

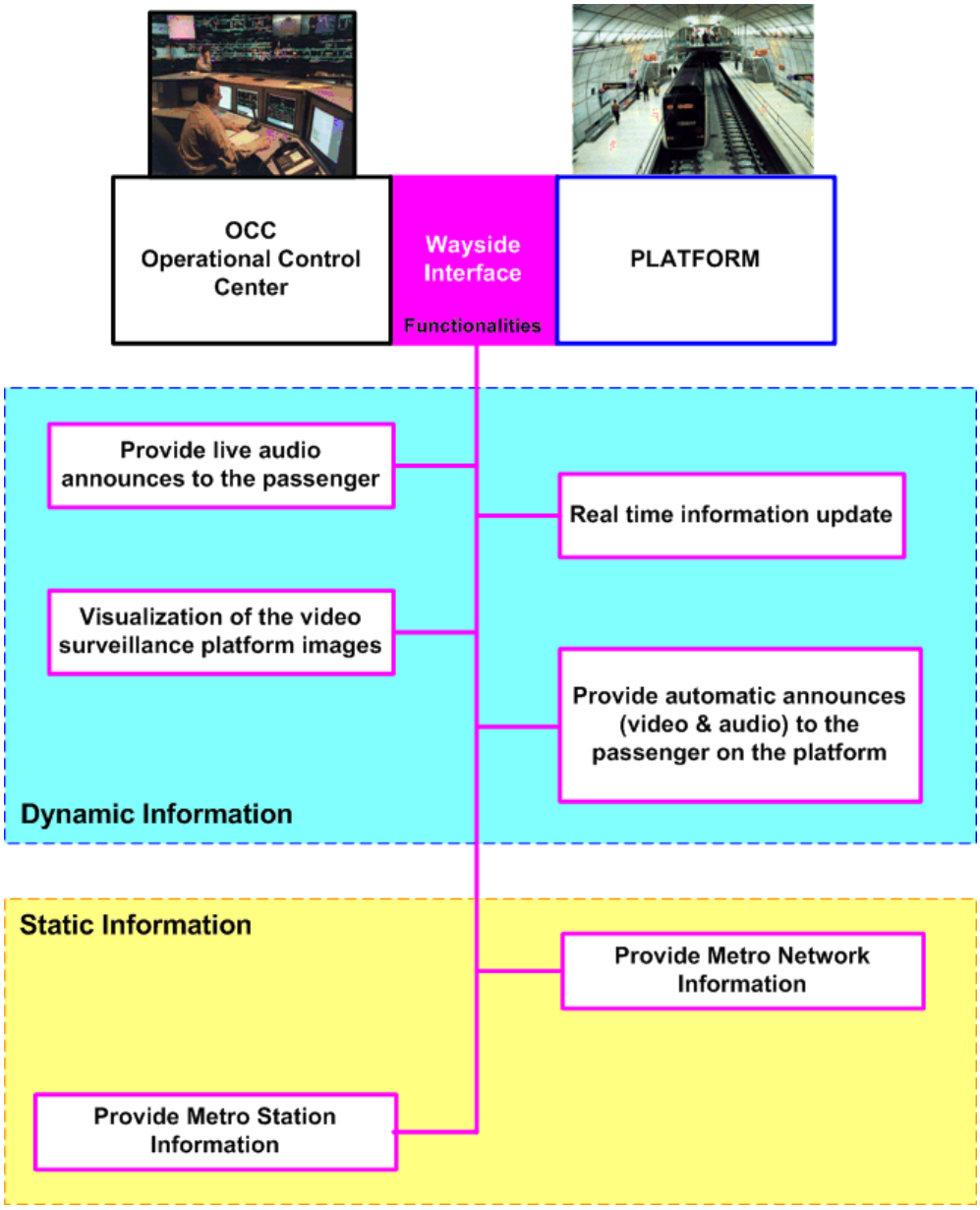

Figure 6 – Scheme of the PIS & SAS Interfaces between OCC and PLATFORM (Passenger)

5. Basic Set of PIS & SAS On-Board

The PIS & SAS of an urban public transport is made up of a set of on-board devices whose number can vary according to the functionalities of the system and the requirements of the individual operator. Based on studies previously conducted within the sphere of the European project MODURBAN subtask MODACCESS, a basic set of devices was identified sufficient to constitute a PIS & SAS model that reflects the functionalities both in normal operating situations and in critical situations.
The basic PIS & SAS set is made up of the following elements:

- External Display (Frontal and Side)
- Internal Display (alphanumeric and route display)
- PA Loudspeakers
- DRIVER Cab Intercom
- Emergency Passenger Call Unit
- Emergency Egress Device (EEDe)
- Emergency Alarm for Passenger (EAP)
- Manual Fire Extinguisher
- Emergency Lighting System
- Bells or Others Acoustic Alarms

In emergency situations the integrations of the Video Surveillance System into the PIS & SAS functionalities could be useful to give to the urban transport personnel into the OCC a global vision of the situation and to give to the passenger not only a feeling of security but also the feeling to be not alone. On the base of these considerations in emergency situations the video surveillance system, even if it is not a part of a PIS, could be integrated into the PIS & SAS functionalities.

The functionalities of a PIS and consequently of its interfaces are closely related to the functionalities of the elements that comprise it. Therefore the definition of the functional specifications of the interfaces of the PIS will be based on an analysis of the functionalities of the individual devices related to the type of interface under study (OCC, ExT, DRIVER, Passenger).

6. Basic Set of PIS & SAS on Wayside

On the base of some on site surveys of the PIS on Wayside actually used by the urban transport Operators in Europe, the basic set of the PIS devices is the following:

- Platform Display
- PA Loudspeakers on platform
- Passenger Alarm: Call Unit connected to the OCC (Operations Control Centre)
- Manual Fire Extinguisher (integrated or close to the Passenger Alarm)
- Emergency Exit
- Video Surveillance with live transmission to OCC
- Emergency Lighting System

The Video Surveillance System regarding emergency situations on platform and into the station could be considered a big aid for the OCC personnel and for the security. Video Surveillance is one of the most efficient ways to face the vandalism acts, aggressions and to give to the passenger a feeling of security in every situation. On the base of these considerations Video Surveillance System functionalities could integrate the PIS & SAS functionalities especially in emergency situation.

On the base of the difference architecture of the stations the number of PIS components could be changed, but the functionalities of the PIS wayside remain always the same.

7. Functional External Interfaces Specifications for Passenger Information

The Functional Specifications of the external interfaces of the PIS comprise the functionalities of the various devices of the PIS itself that send information to the ground. The external PIS interfaces involve the following devices and their functional specifications:

Travel Safety & Security Devices	*Information Flux*		
Video Surveillance	vehicle	=>	OCC & ExT (only as optional)
Manual Fire Extinguisher	vehicle	=>	OCC
Emergency Alarm for Passenger	vehicle	=>	OCC
Emergency Egress Handle	vehicle	=>	OCC
Emergency Passenger Call Unit	passenger	⇔	OCC (driverless)

Travel Information Devices	*Information Flux*		
External & Internal Display	OCC	=>	vehicle/passenger
PA loudspeakers	OCC	=>	vehicle/passenger

7.1. Emergency Alarm for Passenger

(The definition of the mechanical functions is the responsibility of WP14)
When there is an emergency on board, for example sudden indisposition of a passenger, the Emergency Alarm device represents the quickest way to signal the problem to the DRIVER, or to the OCC in the case of a driverless vehicle (Table 1).

Table 1 - Main functional external interface specifications for Emergency Alarm for Passenger

Interface	Functional Specification
ExT (only as ptional)	*At the discretion of OCC the ExT shall informed*
OCC	▪ It shall be activated an alarm in the OCC when a passenger active the emergency handle inside a coach. ▪ It should be activated a voice communication between the OCC and the passenger (via the emergency call unit) in the vehicle when an emergency handle is pulled (Mandatory for GOA4).

7.2. Emergency Passenger Call Unit (driverless)

On driverless vehicles the possibility for a passenger to communicate with the OCC personnel represents one of the basic on-board safety aspects. Hence activation of the Emergency Passenger Call Unit shall be possible both through a dedicated handle or button and through activation of the Emergency Alarm and Emergency Egress devices (Table 2).

Table 2 - Main functional external interface specifications for Passenger Call Unit

Interface	Functional Specification
ExT (only as ptional)	*At the discretion of OCC the ExT shall informed*
OCC	▪ It shall be possible to realize a voice communication in PTT with the OCC (Mandatory for GOA4) ▪ It shall be possible the management of multiple Call Unit activations by the OCC (Mandatory for GOA4) ▪ The activation of the Call Unit should be possible directly by the passenger via a dedicated handle or push button ▪ The activation of the Call Unit shall be connected with the activation of the EAP by a passenger (Mandatory for GOA4) ▪ The activation of the Call Unit shall be connected with the activation of the EEDe by a passenger (Mandatory for GOA4)

7.3. External & Internal Display

The External and Internal Displays (alphanumeric and route displays) are one of the elements through which it is possible to provide travel information inside the train and during stops in stations. It is therefore essential for the DRIVER, or the OCC in the case of driverless vehicles, to be able to control and change the automatic announcements displayed if necessary (Table 3).

Table 3 - Main functional external interface specifications for External & Internal Display

Interface	Functional Specification
ExT (only as ptional)	---
OCC	▪ It should be possible to update the passenger information about the daily metro travel via wireless communication ▪ It should be possible to change the visualized information during the travel ▪ It shall be possible to update or to change the travel information provided to the passenger via wireless communication

7.4. PA loudspeakers

The PA loudspeakers, like the already cited displays, are one of the possible ways to communicate travel information to passengers. In case of need the DRIVER, or the OCC personnel, must be able to make vocal announcements (Table 4).

Table 4- Main functional external interface specifications for PA Loudspeakers

Interface	Functional Specification
ExT (only as ptional)	---
OCC	▪ It should be possible to update the audio announces for passenger about the daily metro travel via wireless communication ▪ It shall be possible to provide audio announces in real voice to the passenger via wireless communication (Mandatory for GOA4)

7.5. Video Surveillance

The video surveillance is one of the most important on-board security systems for urban transport. Especially in a driverless vehicle this represents the only way for the crew to have an idea of what is happening on board in real time when necessary. At the same time the presence (it is necessary to inform passenger about the video surveillance system presence on the base of the privacy law) of the video surveillance is also important to give passengers a feeling of security knowing that someone in the OCC knows at all times what is happening on board and this is essential to prevent aggressions or vandalism (Table 5).

Table 5 - Main functional external interface specifications for Video Surveillance System

Interface	Functional Specification
ExT (only as ptional)	▪ It should be possible to visualize the image on the field via a portable wireless device during an emergency
OCC	▪ Real time full motion image transmission ▪ Image visualization up to 0,1 lux ▪ It shall be possible to visualize the image automatically with an alarm activation ▪ It shall be possible to visualize a defined camera on a defined metro in real time ▪ It shall be possible to record the images according to the privacy rules ▪ It should be possible, specially for driverless trains, the audio and video supervision from the OCC

7.6. Emergency Egress Handle

(The definition of the mechanical functions is the responsibility of WP14)
Should the door opening mechanism not work due to a failure, the Emergency Egress Handle allows passengers to open the door. Activation of this device shall activate an alarm in OCC or in the driver's cab (Table 6).

Table 6- Main functional external interface specifications for Emergency Egress Handle

Interface	Functional Specification
ExT (only as ptional)	*At the discretion of OCC the ExT shall informed*
OCC	▪ It shall be activated an alarm in the OCC when a passenger active the emergency egress handle. ▪ It should be activated a voice communication between the OCC and the passenger (via the emergency call unit) in the vehicle when an emergency egress handle is pulled (Mandatory for GOA4).

7.7. Manual Fire Extinguisher

Should a fire break out, especially on-board driverless vehicles, the manual fire extinguisher can be the quickest way to meet the emergency. Needless to say unhooking the extinguisher must activate an alarm in the OCC or on the DRIVER's desk to inform personnel of a possible emergency and to safeguard against tampering and theft (Table 7).

Table 7 - Main functional external interface specifications for Manual Fire Extinguisher

Interface	Functional Specification
ExT (only as ptional)	*At the discretion of OCC the ExT shall informed*
OCC	▪ It shall be activated an alarm in the OCC when a passenger unhooks a manual extinguisher inside a coach (Mandatory for GOA4)

8. Functional Internal Interfaces Specifications for Passenger Information

The Functional Specifications of the internal PIS interfaces consist of the functional specifications of the on-board PIS devices that realizes communication with the DRIVER and Passenger interfaces.
The internal PIS interfaces involve the following devices and their functional specifications:

Travel Safety & Security Devices	*Information Flux*		
Video Surveillance	DRIVER	=>	Passenger (i.e. approaching, boarding, alighting)
Manual Fire Extinguisher	vehicle	=>	DRIVER
Emergency Alarm for Passenger	vehicle	=>	DRIVER
Emergency Egress Handle	vehicle	=>	DRIVER
DRIVER Cab Intercomm	passenger	⇔	DRIVER

Travel Information Devices	*Information Flux*		
External & Internal Display	DRIVER	=>	vehicle/passenger
PA loudspeakers	DRIVER	=>	vehicle/passenger

8.1. Emergency Alarm for Passenger

(The definition of the mechanical functionalities are the responsibility of WP14)
The activation of the passenger alarm and its height from the floor shall be in line with the provisions of UIC and TSI standards as all passengers, including PRM, must be able to reach it (Table 8).

Table 8 - Main functional internal interface specifications for Emergency Alarm for Passenger

Interface	Functional Specification
Passenger	▪ It shall be installed in a fixed position inside the coach close to the Intercom system, at a max. height of 1600 mm from floor level (considering also PRM) ▪ It shall be possible to pull the handle applying a force of 150 N or 15 Nm ▪ It shall be protected against accidental activation
DRIVER	▪ an alarm shall be activated on the driver's desk when a passenger actives the emergency handle inside a coach. ▪ It should be possible to automatically active the visualization on the driver's desk of the images related to the pooled EAP ▪ It should be activated a voice communication between the DRIVER and the passenger (via the intercom system) when an emergency handle is pulled.

8.2. DRIVER / Passenger Intercom

The functionalities represented by this device are related to the possibility for the passenger to activate direct communication with the DRIVER in an emergency and for the DRIVER to manage multiple calls. The functionalities for the Passenger and DRIVER interfaces involve not only ergonomics in terms of being able to be reached and used, but also the possibility that activation of the cab intercom will automatically activate the Emergency Alarm or the Emergency Egress. In the event of an emergency this would guarantee greater assistance to passengers and be a valid solution for providing the DRIVER with a picture of the situation (Table 9).

Table 9 - Main functional internal interface specifications for Driver Cab Intercomm

Interface	Functional Specification
Passenger	▪ It shall be installed in a fixed position inside the coach at a max. height of 1600 mm above floor level (considering also PRM) ▪ The activation of the Intercom should be possible by dedicated handle or push button ▪ The activation of the Intercom shall be connected with the activation of the EAP by a passenger ▪ The activation of the Intercom shall be connected with the activation of the EEDe by a passenger
DRIVER	▪ It shall be possible to realize a voice communication in PTT with the Passenger ▪ It shall be possible the management of multiple Intercom activations by the DRIVER

8.3. External & Internal Displays

The external and internal displays (alphanumeric and route display) constitute for passengers on the metro one of the sources of dynamic travel information. In particular the route displays give passengers an immediate visual perception of where the train is with respect to the route and the distance in time to the intermediate stations and to one's final destination. There specific functions must therefore be able to guarantee easily understandable information in all possible light conditions on-board. Based on these considerations it is also necessary that the DRIVER himself be able to control the correct operation of automatic announcements and, if necessary, intervene to change them (

Table 10 and Table 11).

Table 10 - Main functional internal interface specifications for External Display

Interface	Functional Specification (External Display)
Passenger	▪ It shall provide the passenger with a basic set of travel information such as: ▪ Arrival station (direction) ▪ Line number ▪ Frontal Display ▪ Active Area (minimum) 150 x 1500 mm ▪ Max range of visibility < 15 m ▪ Side Display ▪ Active Area (minimum) 100 x 900 mm ▪ Max range of visibility < 7 m ▪ Angle of view (vertical) < 130° ▪ Contrast > 0.6 ▪ Brightness > 4000 cd/m2 minimum ▪ Character Color Amber or Green or Red ▪ Background Color Black
DRIVER	▪ It should be possible to update passenger information about the daily metro travel ▪ It should be possible to change the visualized information during the travel

Table 11 - Main functional internal interface specifications for Internal Display

Interface	Functional Specification (Internal Display: alphanumeric and route display)
Passenger	▪ It shall provide the passenger with a basic set of travel information such as: ▪ Arrival station (direction) ▪ Line number ▪ Next station ▪ Active Area (minimum) 50 x 800 mm ▪ Angle of view > +50° ▪ Max range of visibility < 5 m ▪ Contrast > 0.8 ▪ Brightness > 800 cd/m2 ▪ Character Color Amber, Green, Red ▪ Background Color Black ▪ Minimum resolution 4 mm

	▪ Graphic Functionalities
DRIVER	▪ It should be possible to update passenger information about the daily metro travel ▪ It should be possible to change the visualized information during the travel

8.4. PA Loudspeakers

The PA loudspeakers, even more than the internal and external displays, are the quickest and most direct way to provide passengers with travel information. Also in this case it is therefore essential that comprehension of the announcements be acceptable in any part of the carriage during service. It is therefore necessary also for the DRIVER to be able to make voice announcements to announce any changes or in the event of failure of the automatic announcement system (Table 12).

Table 12 - Main functional internal interface specifications for PA Loudspeakers

Interface	Functional Specification
Passenger	▪ It shall provide the passenger with a basic set of travel information such as: ▪ Arrival station (direction) ▪ Next station ▪ Possible connection ▪ Tourist information ▪ SNR >45 dB ▪ Total harmonic distortion < 2 % ,1 kHz ▪ Frequency Response (-3dB band) 200 – 5000 Hz
DRIVER	▪ It should be possible to update the audio announcements for passenger about the daily metro travel ▪ It shall be possible to provide audio announcements in real voice to the passenger

8.5. Video Surveillance

Within the sphere of the internal interfaces the video surveillance introduces some very important functions both for the security of passengers and for safe travel. In particular the DRIVER interface can supply the cab with images from the on-board video surveillance to control the boarding of passengers more effectively than with the classic mirrors. To avoid accidents when entering the station (e.g. accidental falling onto tracks) it could also be a big help to automatically display in the cab the images from the platform as the train approaches (Table 13). On the base of the privacy law it is necessary to inform passenger about the video surveillance system presence inside the metro.

Table 13 - Main functional internal interface specifications for Video Surveillance

Interface	Functional Specification
Passenger	▪ The cameras shall be hidden to avoid vandalism ▪ The presence of the video surveillance should signed to discourage aggression or vandalism
DRIVER	▪ Real time full motion image transmission ▪ Image visualization up to 0,1 lux ▪ It shall be possible to automatically visualize on the driver's desk the image with an alarm activation ▪ It shall be possible to visualize on the driver's desk the images coming from a defined coach in real time ▪ It should be possible to automatically visualize on the driver's desk the images from the platform cameras when the train is approaching the station, via wireless communication ▪ It should be possible to visualize on the driver's desk the images from the platform cameras or from the on-board cameras to supervise boarding operations

8.6. Emergency Egress Handle

(The definition of the mechanical functionalities are the responsibility of WP14)
This document does not deal with the mechanical functionalities of how the door is opened in an emergency as this is the responsibility of WP14. However, the functional requirements at ergonomic level for the Passenger interface and the functional logic for the DRIVER interface will be analysed (Table 14).

Table 14 - Main functional internal interface specifications for Emergency Egress Handle

Interface	Functional Specification
Passenger	▪ It shall be installed in a fixed position inside the coach close to the Intercom system, at an max. height of 1600 mm above floor level (considering also PRM) ▪ It shall be possible to pool the handle applying a force of 150 N or 15 Nm ▪ It shall be protected against accidental activation ▪ It shall be installed close to the egresses
DRIVER	▪ an alarm shall be activated on the driver's desk when a passenger actives the emergency egress handle.

	▪ a voice communication should be activated between the DRIVER and the passenger (via the intercom system) when an emergency egress handle is pulled.

8.7. Manual Fire Extinguisher

This device shall be protected against accidental activation or vandalism as it represents an immediate method to cope with a fire on board. Unhooking of the extinguisher should be connected to an alarm in the cab that warns the DRIVER of a possible fire (Table 15).

Table 15 - Main functional internal interface specifications for Manual Fire Extinguisher

Interface	Functional Specification
Passenger	▪ It shall be possible to unhook the extinguisher applying a force of 150 N or 15 Nm ▪ It shall be protected against accidental unhooking ▪ It shall be installed in a position visible by the video surveillance system
DRIVER	▪ an alarm shall be activated on the driver's desk when a passenger unhooks a manual extinguisher inside a coach

9. Functional Interfaces Specification for PIS Wayside

The functional specifications of the PIS Wayside interfaces could be divided in relation to the different kind of provided information into the station: dynamic and static. The classification of information into dynamic and static is based on the time required to update such information in order to be useful to the passenger.

The main Functional Specifications of the Wayside PIS interfaces related to dynamic information are:

- Provide live audio announcements to the passenger
- Visualization of the video surveillance platform images
- Real time information update
- Provide automatic announcements (video & audio) to the passenger on the platform

The main Functional Specifications of the Wayside PIS interfaces related to static information are:

- Provide metro network information
- Provide metro station information

On the basis of the analysis already made in the D115 it is possible to define as static that information that is updated seasonally (e.g. timetables) or that is related to the structure of the station (e.g. egress signs, line direction signs, PRM facilities). The information classified as dynamic is information that needs to be continually updated and is related to daily metro runs. Dynamic information in particular is present on platforms with tracks upon which different lines travel. Hence while static information is found in all stations, whether big or small, there are greater concentrations of dynamic information in connecting stations.

9.1. Functional Specifications for PIS Wayside Dynamic Information

The Functional Specifications related to dynamic information are related to the speed of data transmission and its management. In particular for the OCC it is important to be able to control, and if necessary correct, the information to passengers very quickly or even in real time. These specifications also include specifications related to the video surveillance of the platform and the station in general (Table 16).
For the Platform interface the functional specifications are related to the timing of information displayed based on the presence of the train in a station as well as to the method of display of images on the monitors or displays in ergonomic terms (visibility and comprehension).

Table 16 - Main functional specifications for dynamic information of PIS Wayside

Interface	Functional Specification for Dynamic Information
OCC	▪ It shall be possible to update the travel information on the base of seasonally services by the OCC

	▪ It shall be possible to update in real time by the OCC the travel information (i.e. delay, work on the track, others) ▪ Video Surveillance system shall have the following functionalities: ▪ Real time full motion image transmission from the platform ▪ Image visualization up to 0,1 lux ▪ It shall be possible to automatically visualize the image with an alarm activation ▪ It shall be possible to visualize a defined camera in a defined station or platform area ▪ It shall be possible to record the images according to the rules on privacy ▪ It shall be possible the transitions between the existing and the new modified timetable ▪ It shall be possible to provide live audio announces to the passenger on platform via the PA loudspeakers on platform. ▪ Train Interface: o It shall be possible to have a report of the geographical position of all trains on a HMI into the OCC (Mandatory for GOA 1a, 1b, 2, 3, 4) o It shall be possible to have a report of unauthorized train departure on a HMI into the OCC (Mandatory for GOA 1a, 1b, 2, 3, 4) o It shall be possible to have information about the stations skipped on a HMI into the OCC (Mandatory for GOA 1a, 1b, 2, 3, 4) o It shall be possible to have information necessary to enable train tracking on a HMI into the OCC (Mandatory for GOA 1a, 1b, 2, 3, 4) ▪ It shall be possible to have the transmission to an HMI, into the OCC, of information necessary to enable train tracking ▪ It shall be possible to realize a voice communication from OCC with the passenger inside the metro (Mandatory for GOA4) ▪ It shall be possible to realize a voice communication from the OCC with the driver inside the metro ▪ It shall be possible to have the transmission to an HMI, into the OCC, of audio and video information (video surveillance) (Mandatory for GOA4)
PLATFORM (Passenger)	▪ After the train departure, the platform displays shall provide line information about the next train (i.e. number, direction, train length, arrival time, others) ▪ 15 s (maximum) before the metro arrives at the platform audio line information (i.e. number, direction, train length,

	others) shall be provided ▪ Electronic panels that provide video information shall have the following functionalities: o Readability (minimum) 30 m o Angle of view > +80° (minimum) o Contrast > 0.8 o Brightness > 500 cd/m2 o Anti glare

9.2. Functional Specifications for PIS Wayside Static Information

Given that static information does not require continual updating but instead needs to be highly legible and comprehensible, the functional specifications concentrate on the ergonomic aspects of information. That is they are related to how the information is to be proposed for it to be correctly received by all types of passengers (based on the analysis made in D115: Regular, Commuter, Occasional, Tourist and PRM) in the various environmental conditions possible in a station (open platforms, same platforms for various lines, crowded platforms, illumination) (Table 17).

Table 17 - Main functional specifications for static information of PIS Wayside

Interface	Functional Specification for Static Information
OCC	*At discretion of OCC the static information shall be updated*
PLATFORM (Passenger)	▪ It shall provide at the station egresses the following main information for passenger orientation: ▪ Station Name (legible from 50 m) ▪ Station Exit Direction (legible from 30 m) ▪ Metro Lines (legible from 30 m) ▪ Platforms (legible from 30 m) ▪ Metro Network map (legible from 10 m) ▪ It shall provide information for passenger safety: ▪ Fire Extinguisher position or Fire Alarm position (legible from 10 m) ▪ Video surveillance (legible from 10 m) ▪ Emergency call unit to speak directly to the station crew (legible from 10 m) ▪ Any other information to prevent dangererous situations for passenger (i.e. dangerous behaviour, dangerous acts) (legible from 10 m) ▪ Connection information shall be indicated on panels with different background colour with

	respect to the metro line ▪ Information easy to understand and to find for PRM: ▪ Braille ▪ Tactile map ▪ Tactile signs ▪ Rough path on the platform

10. Conclusions

The main Functional Specifications for the on-board and wayside PIS interfaces are summarized in this chapter.
For the on-board PIS they are grouped in relation to the class of interface (internal and external) and to the PIS devices that carry out the functions analyzed.
For the Wayside PIS they are grouped according to the class of information (dynamic and static) and the interface of reference.

10.1. PIS On-Board

10.1.1. Main Functional Specifications for PIS External Interfaces

Table 18 - Main functional specifications for PIS external interfaces

Main Functional Specifications for PIS External Interfaces for PIS onboard		
	Main Functional Specifications for PIS External Interfaces	
Related PIS Devices	**ExT Interface (only as optional)**	**OCC Interface**
Passenger Call Unit	---	▪ It shall be possible to realize a voice communication in PTT with the OCC (Mandatory for GOA4) ▪ It shall be possible the management of multiple Call Unit activations by the OCC (Mandatory for GOA4) ▪ The activation of the Call Unit should be possible directly by the passenger via a dedicated handle or push button ▪ The activation of the Call Unit shall be connected with the activation of the EAP by a passenger (Mandatory for GOA4) ▪ The activation of the Call Unit shall be connected with the activation of the EEDe by a passenger (Mandatory for GOA4)

Main Functional Specifications for PIS External Interfaces for PIS onboard		
External & Internal Display	---	▪ It should be possible to update the passenger information about the daily metro travel via wireless communication ▪ It should be possible to change the visualized information during the travel ▪ It shall be possible to update or to change the travel information provided to the passenger via wireless communication
PA Loudspeakers (on board)	---	▪ It should be possible to update the audio announces for passenger about the daily metro travel via wireless communication ▪ It shall be possible to provide audio announces in real voice to the passenger via wireless communication (Mandatory for GOA4)
Video Surveillance	It should be possible to visualize the image on the field via a portable wireless device during an emergency	▪ Real time full motion image transmission ▪ Image visualization up to 0,1 lux ▪ It shall be possible to visualize the image automatically with an alarm activation ▪ It shall be possible to visualize a defined camera on a defined metro in real time ▪ It shall be possible to record the images according to the privacy rules ▪ It should be possible, specially for driverless trains, the audio and video supervision from the OCC
Manual Fire extinguisher	*At the discretion of OCC the ExT shall informed*	▪ It shall be activated an alarm in the OCC when a passenger unhooks a manual extinguisher inside a coach (Mandatory for GOA4)

Main Functional Specifications for PIS External Interfaces for PIS onboard		
Emergency Alarm for Passenger	*At the discretion of OCC the ExT shall informed*	▪ It shall be activated an alarm in the OCC when a passenger active the emergency handle inside a coach. ▪ It should be activated a voice communication between the OCC and the passenger (via the emergency call unit) in the vehicle when an emergency handle is pulled (Mandatory for GOA4).
Emergency Egress Handle	*At discretion of OCC shall informed the ExT*	▪ It shall be activated an alarm in the OCC when a passenger active the emergency egress handle. ▪ It should be activated a voice communication between the OCC and the passenger (via the emergency call unit) in the vehicle when an emergency egress handle is pulled (Mandatory for GOA4).

10.1.2. Main Functional Specifications for PIS Internal Interfaces

Table 19 - Main functional specifications for PIS internal interfaces

Main Functional Specifications for PIS Internal Interfaces for PIS onboard		
	Main Functional Specifications for PIS Internal Interfaces	
Related PIS Devices	**DRIVER Interface**	**PASSENGER Interface**
DRIVER Cab Intercom	▪ It shall be possible to realize a voice communication in PTT with the Passenger ▪ It shall be possible the management of multiple Intercom activations by the DRIVER	▪ It shall be installed in a fixed position inside the coach at a max. height of 1600 mm above floor level (considering also PRM) ▪ The activation of the Intercom should be possible by dedicated handle or push button ▪ The activation of the Intercom shall be connected with the activation of the EAP by a passenger ▪ The activation of the Intercom shall be connected with the activation of the EEDe by a passenger

Main Functional Specifications for PIS Internal Interfaces for PIS onboard		
External Display	▪ It should be possible to update passenger information about the daily metro travel ▪ It should be possible to change the visualized information during the travel	▪ It shall provide the passenger with a basic set of travel information such as: ▪ Arrival station (direction) ▪ Line number ▪ Frontal Display ▪ Active Area (minimum) 150 x 1500 mm ▪ Max range of visibility < 15 m ▪ Side Display ▪ Active Area (minimum) 100 x 900 mm ▪ Max range of visibility < 7 m ▪ ▪ Angle of view (vertical) < 130° ▪ Contrast > 0.6 ▪ Brightness > 4000 cd/m2 minimum ▪ Character Color Amber or Green or Red ▪ Background Color Black
Internal Display	▪ It should be possible to update passenger information about the daily metro travel ▪ It should be possible to change the visualized information during the travel	▪ It shall provide the passenger with a basic set of travel information such as: ▪ Arrival station (direction) ▪ Line number ▪ Next station ▪ Active Area (minimum) 50 x 800 mm ▪ Angle of view > +50° ▪ Max range of visibility < 5 m ▪ Contrast > 0.8 ▪ Brightness > 800 cd/m2 ▪ Character Color Amber, Green, Red ▪ Background Color Black ▪ Minimum resolution 4 mm ▪ Graphic Functionalities

Main Functional Specifications for PIS Internal Interfaces for PIS onboard		
PA Loudspeakers	▪ It should be possible to update the audio announcements for passenger about the daily metro travel ▪ It shall be possible to provide audio announcements in real voice to the passenger	▪ It shall provide the passenger with a basic set of travel information such as: ▪ Arrival station (direction) ▪ Next station ▪ Possible connection ▪ Tourist information ▪ SNR >45 dB ▪ Total harmonic distortion < 2 % , 1 kHz ▪ Frequency Response (-3dB band) 200 – 5000 Hz
Video Surveillance	▪ Real time full motion image transmission ▪ Image visualization up to 0,1 lux ▪ It shall be possible to automatically visualize on the driver's desk the image with an alarm activation ▪ It shall be possible to visualize on the driver's desk the images coming from a defined coach in real time ▪ It should be possible to automatically visualize on the driver's desk the images from the platform cameras when the train is approaching the station, via wireless communication ▪ It should be possible to visualize on the driver's desk the images from the platform cameras or from the on-board cameras to supervise boarding operations	▪ The cameras shall be hidden to avoid vandalism ▪ The presence of the video surveillance should signed to discourage aggression or vandalism

Main Functional Specifications for PIS Internal Interfaces for PIS onboard		
Manual Fire extinguisher	▪ an alarm shall be activated on the driver's desk when a passenger unhooks a manual extinguisher inside a coach ▪ voice communication should be activated a between the DRIVER and the OCC when a manual extinguisher is unhooked	▪ It shall be possible to unhook the extinguisher applying a force of 150 N or a torque of 15 Nm ▪ It shall be protected against accidental unhooking ▪ It shall be installed in a position visible by the video surveillance system
Emergency Alarm for Passenger	▪ an alarm shall be activated on the driver's desk when a passenger actives the emergency handle inside a coach. ▪ It should be possible to automatically active the visualization on the driver's desk of the images related to the pooled EAP ▪ It should be activated a voice communication between the DRIVER and the passenger (via the intercom system) when an emergency handle is pulled. ▪ a voice communication should be activated between the DRIVER and the OCC when an emergency handle is pulled.	▪ It shall be installed in a fixed position inside the coach close to the Intercom system, at a max. height of 1600 mm from floor level (considering also PRM) ▪ It shall be possible to pull the handle applying a force of 150 N or 15 Nm ▪ It shall be protected against accidental activation

Main Functional Specifications for PIS Internal Interfaces for PIS onboard		
Egress Handle	▪ an alarm shall be activated on the driver's desk when a passenger actives the emergency egress handle. ▪ a voice communication should be activated between the DRIVER and the passenger (via the intercom system) when an emergency egress handle is pulled. ▪ a voice communication should be activated between the DRIVER and the OCC when an emergency egress handle is pulled.	▪ It shall be installed in a fixed position inside the coach close to the Intercom system, at an max. height of 1600 mm above floor level (considering also PRM) ▪ It shall be possible to pool the handle applying a force of 150 N or 15 Nm ▪ It shall be protected against accidental activation ▪ It shall be installed close to the egresses

10.2. PIS Wayside

Table 20 - Main functional specifications for PIS Wayside interfaces

Main Functional Specifications for PIS Wayside Interfaces for PIS Wayside		
	Main Functional Specifications for PIS Wayside Interfaces	
Related PIS Information	**OCC**	**PLATFORM**
Dynamic Information	▪ It shall be possible to update the travel information on the base of seasonally services by the OCC ▪ It shall be possible to update in real time by the OCC the travel information (i.e. delay, work on the track, others) ▪ Video Surveillance system shall have the following functionalities: ▪ Real time full motion image transmission from the platform ▪ Image visualization up to 0,1 lux ▪ It shall be possible to automatically visualize the image with an alarm activation ▪ It shall be possible to visualize a defined camera in a defined station or platform area ▪ It shall be possible to record the images according to the rules on privacy ▪ It shall be possible the transitions between the existing and the new modified timetable ▪ It shall be possible to provide live audio announces to the passenger on platform via the PA loudspeakers on platform.	▪ After the train departure, the platform displays shall provide line information about the next train (i.e. number, direction, train length, arrival time, others) ▪ 15 s (maximum) before the metro arrives at the platform audio line information (i.e. number, direction, train length, others) shall be provided ▪ Electronic panels that provide information shall have the following functionalities: ▪ Readability (minimum) 30 m ▪ Angle of view > +80° (minimum) ▪ Contrast > 0.8 ▪ Brightness > 500 cd/m2 ▪ Anti glare

Main Functional Specifications for PIS Wayside Interfaces for PIS Wayside		
	▪ Train Interface: o It shall be possible to have a report of the geographical position of all trains on a HMI into the OCC (Mandatory for GOA 1a, 1b, 2, 3, 4) o It shall be possible to have a report of unauthorized train departure on a HMI into the OCC (Mandatory for GOA 1a, 1b, 2, 3, 4) o It shall be possible to have information about the stations skipped on a HMI into the OCC (Mandatory for GOA 1a, 1b, 2, 3, 4) o It shall be possible to have information necessary to enable train tracking on a HMI into the OCC (Mandatory for GOA 1a, 1b, 2, 3, 4) ▪ It shall be possible to have the transmission to an HMI, into the OCC, of information necessary to enable train tracking ▪ It shall be possible to realize a voice communication from OCC with the passenger inside the metro (Mandatory for GOA4) ▪ It shall be possible to realize a voice communication from the OCC with the driver inside the metro ▪ It shall be possible to have the transmission to an HMI, into the OCC, of audio and video information (video surveillance) (Mandatory for GOA4)	
Static	*static information shall be updated*	▪ It shall provide at the station

Main Functional Specifications for PIS Wayside Interfaces for PIS Wayside		
Information	*at discretion of OCC*	egresses the following main information for passenger orientation: ▪ Station Name (legible from 50 m) ▪ Station Exit Direction (legible from 30 m) ▪ Metro Lines (legible from 30 m) ▪ Platforms (legible from 30 m) ▪ Metro Network map (legible from 10 m) ▪ It shall provide information for passenger safety: ▪ Fire Extinguisher position or Fire Alarm position (legible from 10 m) ▪ Video surveillance (legible from 10 m) ▪ Emergency call unit to speak directly to the station crew (legible from 10 m) ▪ Any other information to prevent dangerous situations for passenger (i.e. dangerous behaviour, dangerous acts) (legible from 10 m) ▪ Connection information shall be indicated on panels with different background colour with respect to the metro line ▪ Information easy to understand and to find for PRM: ▪ Braille ▪ Tactile map ▪ Tactile signs ▪ Rough path on the platform

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