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SECTION I – DELIVERABLE SUMMARY

Definition of PSD Functional and Non-Functional Requirements, Including Interfaces Requirements	
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IP's	**Partners, (type, identification, date)**
Pre-existing Know-How	*Not relevant*
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Associated Risk analysis	**Type, solution envisaged, action, actors**	**Actual Reduction**
Before start	-	-
During task implementation	-	-

Definition of PSD Functional and Non-Functional Requirements, Including Interfaces Requirements
Deliverable Abstract   This document presents the results of MODACCESS Task 15.1, defining Platform Screen Door and Platform Edge Doors Functional and Non-Functional Requirements, planned for T0+18. The objective is to produce a MODURBAN specific specification facilitating a standard PSD/PED Functional and Non-Functional Requirement Specification that can be used by MODURBAN partners throughout Europe to aide in reducing procurement costs. A secondary objective will be to propose the basis for a future EN standard if practical.
Associated Milestone (if relevant):

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2 – DELIVERABLE DETAILED DESCRIPTION

1 INTRODUCTION

1.1 Preamble

This document presents the results of MODACCESS Task 15.1, defining Platform Screen Door (PSD) and Platform Edge Doors (PED) Functional and Non-Functional Requirements, planned for T0+18. Although during the process of planning the requirements the term Interface Requirements was used it emerged that the requirements fell into two simple groups, namely Functional and Non-Functional, dropping the need for Interface Requirements. The document is divided into the following sections:

- Section 1 – Introduction, (this section).
- Section 2 – System Description; provides a general description of the main elements of a PSD/PED system.
- Section 3 - Control and System Interfaces; provides an overview of the control functions and control function interfaces.
- Section 4 – General Requirements; details requirements that fall within the functional and non-functional requirements, and provide design philosophy or requirements that are on the periphery of the subject, such as gap fillers.
- Section 5 – Functional Requirements; presents detailed functional requirements for the normal operation of a PSD/PED system.
- Section 6 – Non-Functional Requirements; presents detailed non-functional requirements for the normal operation of a PSD/PED system.

1.1.1 Objectives

The objective is to produce a MODURBAN specific specification facilitating a standard PSD Functional and Non-Functional Requirement Specification that can be used by MODURBAN partners throughout Europe to aide in reducing procurement costs. A secondary objective will be to propose the basis for a future EN standard.

1.1.2 References

This first draft section is built upon:

[**DOW**] Annex I - “Description of Work” DOW-MODURBAN-516380-final.pdf

[**D77**] D77 Common Definition of MODURBAN Train Protection System050414_D77_Delivery report_p2_draft.doc

[D81] D81 MODURBAN prescriptions: overall architecture and allocation of vital functions

1.1.3 Glossary

AC	**Alternating Current**
ATO	**Automatic Train Operation**
ATP	**Automatic Train Protection**
CC	**Car borne Controller**
DC	**Direct Current**
DCU	**Door Control Unit**
EED	**Emergency Egress Doors**
EN	**European Standard**
GOA	**Grade of Automation**

HEC	**Head End Controller**
LSZH	**Low Smoke Zero Halogen**
OCC	**Operations Control Centre**
PDP	**Platform Distribution Panel**
PED	**Platform Edge Doors**
PEDC	**Platform Edge Door Controller**
PG	**Platform Gates**
PIP	**Power Interface Panel**
PSCC	**Platform Screen Control Cabinet**
PSD	**Platform Screen Doors**
PSL	**Local Control Panel**
PXSS	**Passenger eXchange Sub System**
SCADA	**Supervision, Control And Data Acquisition**
SMT	**System Maintenance Tool**
UPS	**Uninterruptible Power Supply**
TAD	**Tunnel Access Door**
WS	**Way Side**
ZC	**Zone Controller**

1.1.4 Definitions

- PSDs – Platform Screen Doors are full height screens which are fixed top and bottom, and form a climatic barrier between the platform and track to facilitate cost effective platform climate control.
- PEDs – Platform Edge Doors are full height screens which are only fixed at the bottom, having a gap of any proportion above them to the ceiling of the station.
- PGs – Platform Gates are commonly referred to as ‘half height’ barriers, and as implied are of a significantly reduced height, the minimum being 1 meter. *[This document version does not address PGs]*

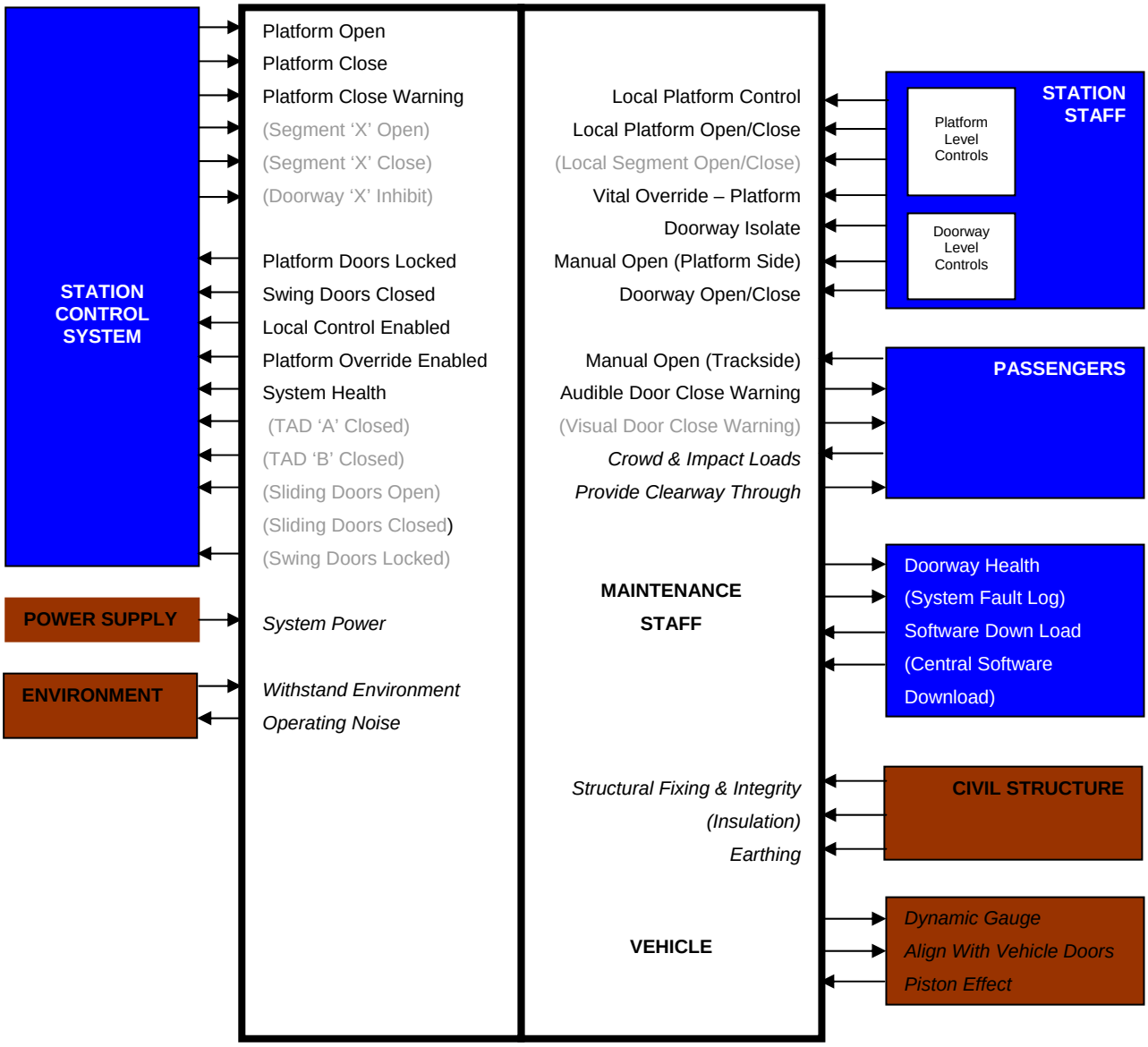
2 SYSTEM DESCRIPTION

2.1 General

The scope of this document and in particular the development of the functional (blue boxes) and non-functional requirements (brown boxes) is shown within the block diagram below and indicates the boundary of the Platform Screen Doors (PSD) and Platform Edges Doors PED study.

In terms of the MODURBAN project the PSD / PED system is a sub-system within the overall project and should be regarded as a 'slave' system. This means the system is dependant on the intelligent issue of signals form the Zone Controller (ZC) and cannot carry out any analysis or interpretation of signals from the ZC. The vital output signals are derived from given PSD / PED states that are controlled by simple functions which are not derived by Programmable Electronic Systems (PES).

It is intended that the applicable Grade of Automation (GOA) range for this particular sub-system is GOA1b to GOA4.



The system will be used differently during a typical day:

- hours during which passengers are present
- hours during which no passengers are present, and during which maintenance activities can be performed.

Requirements and functions will apply differently according the operation context.

A Platform Screen Door (PSD) or Platform Edge Door (PED) system provides the interface between the train and the station platform on which it is fitted by:

- Maintaining physical segregation between the passengers waiting on the platform and the track-way.
- Preventing passengers from moving between the platform and the train unless the train is fully stationary in its correct position. (For the purposes of this document the train's correct position shall be referred to as 'train docking'.)

The PSD/PED system is fitted parallel to the track at the platform edge. The sliding doors are positioned so that when the train comes to a halt, and is correctly docked, the car body side doors align with the sliding doors of the PSD/PED system. In the normal automatic operating mode only the sliding doors allow the transfer of passengers between the platform and the train.

Historically, the global term for these systems has tended to be PSDs, but variations have emerged that require their own terms and definitions, they are as follows:

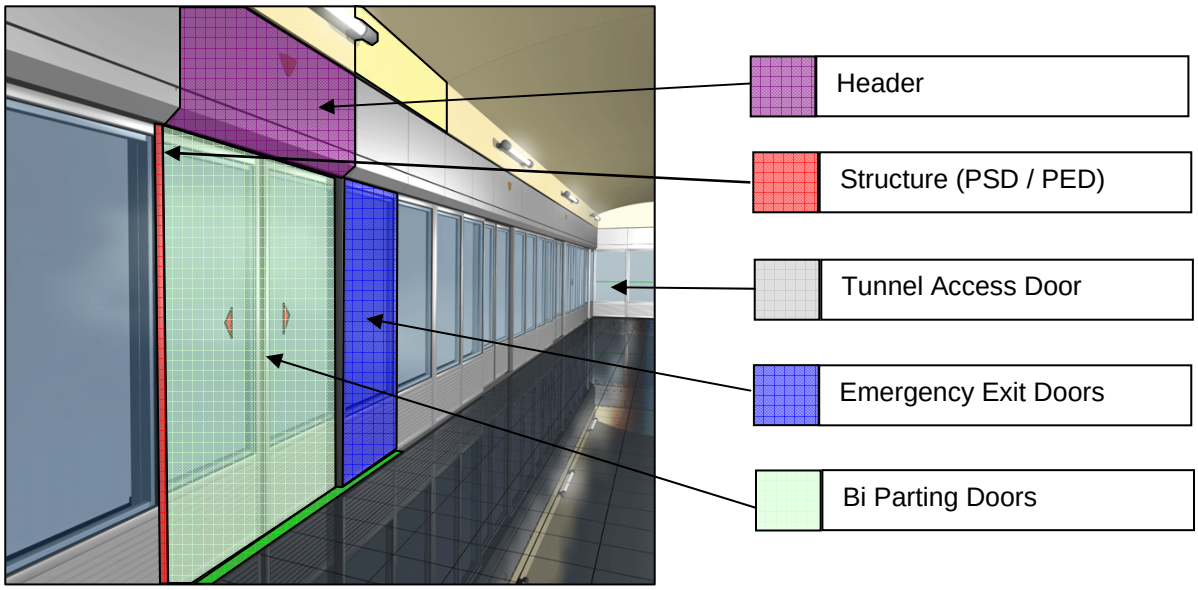
- PSDs – Platform Screen Doors are full height screens which are fixed top and bottom, and form a climatic barrier between the platform and track to facilitate cost effective platform climate control, although this need not always be the primary reason for adopting PSDs.
- PEDs – Platform Edge Doors are full height screens which are only fixed at the bottom, having a gap of any proportion above them to the ceiling of the station.
- PGs – Platform Gates are commonly referred to as 'half height' barriers, and as implied are of a significantly reduced height, the minimum being 1 meter. This concept is emerging in Europe as a potential cheaper alternative to either PSDs or PEDs.*[This document version does not address PGs]*

The arrangement for the 'screen work', meaning the overall barrier scheme whether PSD or PED may adopt many different arrangements, which is generally dependent on the prevailing architecture of the stations. It is not practical to define in detail a configuration that will be universally acceptable to meet all the potential station architectural variations. Therefore described below is a general 'screen work' description. Also described is the general layout for services and control equipment arrangements.

The system description within this section covers Platform Screen Doors (PSDs) and Platform Edge Doors (PEDs). The prime difference being a PSD is a full height structure that provides environmental screening, preventing air conditioning losses and dust control when installed underground. PEDs are similar in concept using very similar engineering solutions, with the prime difference being that the top of the structure does not connect to the station structure leaving a gap, and therefore cannot provide environmental screening to the same extent as a PSD system.

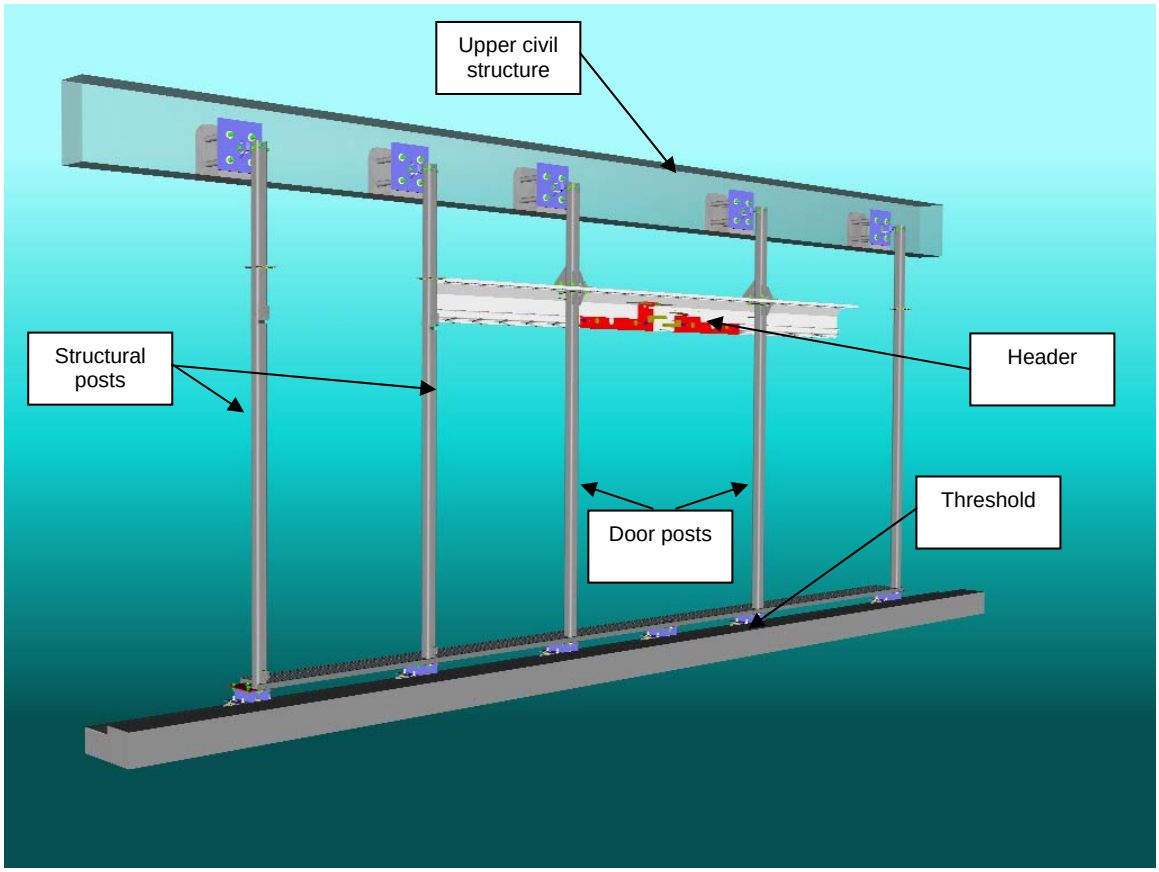
A PSD/PED system constitutes a full height screen-work load bearing structure installed using civil interface at platform and for PSD at the ceiling level which can be installed on both new build and retrofit platforms. The most significant difference between a PSD and PED system lie in its structure and this is shown below in 2.2 and 2.3.

The figure below illustrates the location of the major elements of typical systems.



2.2 PSD Structure

A typical PSD structure is shown in the diagram below:



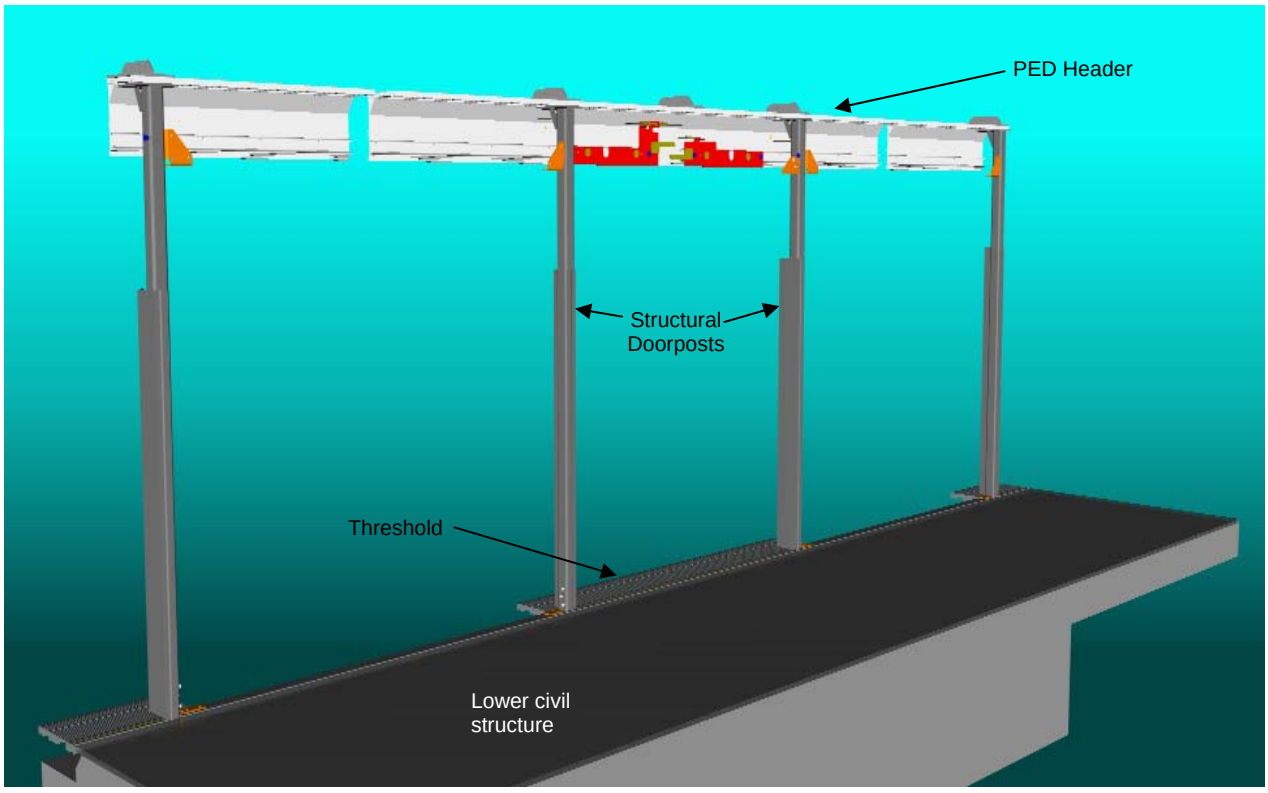
The PSD is mounted from structural elements attached to the station ceiling and platform edge. The structure is typically designed to safely resist the specified loadings and provide the mounting points for the covers, header assembly, doors and panels.

All materials, treatments and fixings utilised in the fixed structure should be selected to provide the required design life under the defined environmental conditions without compromising the fire, smoke and toxicity requirements.

2.3 PED Structure

The PED is mounted from structural elements attached to the station platform edge. The structure should be designed to safely resist the specified loadings and provide the mounting points for the covers, header assembly, doors and panels. The PED header is supported by the structural door posts, to which the operating equipment is mounted, providing structural support for the sliding doors and fixed panels and a load transference path from the doors to the header structure. The architectural elements (platform side & trackside header covers) are also mounted to the header structure.

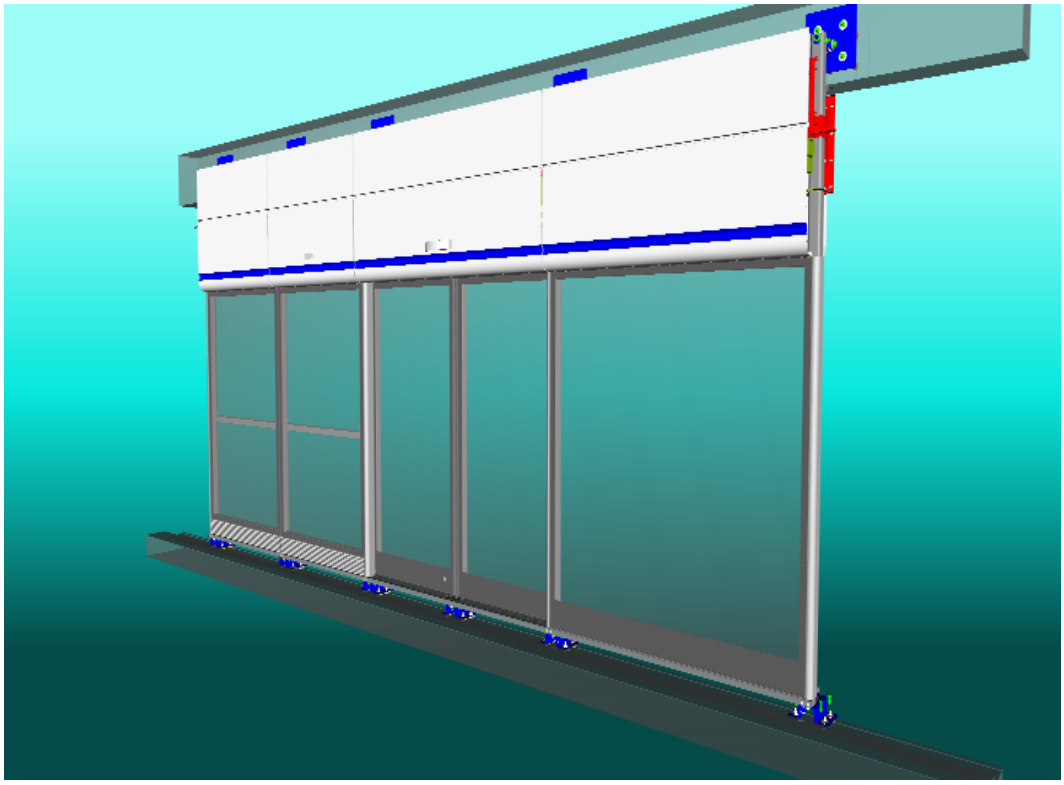
The typical PED structure is shown in the diagram below:



2.4 Header

Typically, covers run the length of the platform to enclose the header and the actuating, monitoring and power distribution equipment, providing environmental protection and an attractive aesthetic finish.

The front covers may hinge upwards to allow easy access from the platform side to the operating equipment housed in the header. The front covers are retained with a lock in the closed position and are supported by stays when open. Fixed covers can also be fitted to the trackside of the header, to provide further protection.



2.5 Bi-Parting Sliding Doors

It is common that the automatic doors are bi-parting doors, which align with the car body side doors of each vehicle when the train is stationary at the platform and correctly docked. There can be two variations, the first being the more common symmetrical arrangement and the less common asymmetrical arrangement for car body side, single leaf end doors.

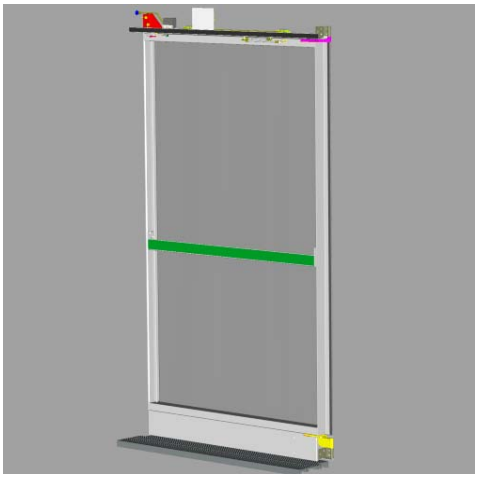
Typically a single piece of glass is bonded to the door frame. A guide strip is fitted to the lower door section. This is designed to withstand the design loads imposed on the sliding door and normal door operation for the design life of the PSD. A foothold deflector can be fitted to the trackside of the doors to prevent passengers from gaining access between the screen-work and train whilst the doors are in the open position, see figure below.

2.6 Emergency Exit Doors (EED)

Emergency Exit Door EED(s) are positioned in accordance with the customer requirements, and may be optional. Each EED should be fitted with a panic bar arrangement fitted horizontally across the panel at waist

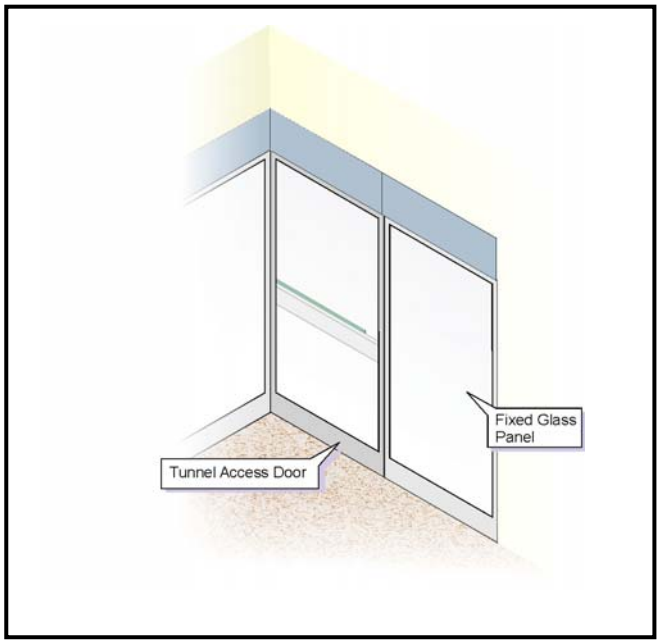
height, which allows the door to be opened from the trackside in an emergency. The EED can also be opened from the platform side by station staff using a key.

Typically, EEDs are secured at the top and bottom of the door using pivot assemblies that prevent the door being opened beyond the required opening space and should be arranged to automatically close when the door is left unattended. The figure below shows a typical EED with the (green) panic bar.



2.7 Tunnel Access Door (TAD)

Tunnel Access Door (TAD) can be installed perpendicular to the PSDs and prevents unauthorised access to the tunnel. Each TAD may comprise a single EED type door. The TAD is operable from the tunnel side by pressing a horizontal panic bar, mounted on the door frame. The TAD can also be opened from the platform side, under the control of the station staff, by using a key. A fixed panel fills the remaining space between the TAD and the station structure.



2.8 Driver Access Door

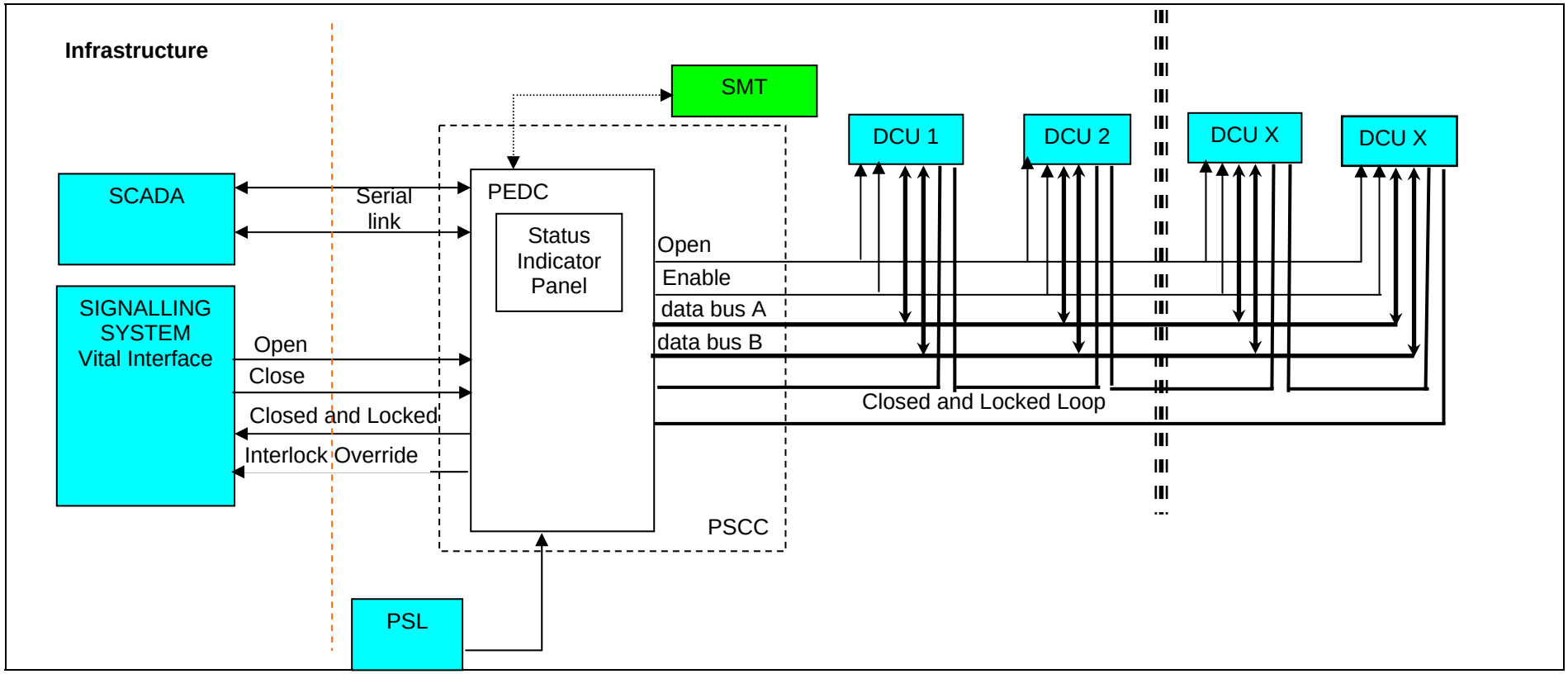
For some applications it may be necessary to install a Driver Access Door that provides access for the driver to the platform where additional control and supervision is required.

3 CONTROL AND SYSTEM INTERFACES

3.1 Typical Control Layout

A typical PSD control layout may consist of the following building blocks listed in the table and are also shown in the schematic below:

Equipment	Functions	Interfaces
PSCC (Platform Screen Control Cabinet)	- Central connection point for all control and monitoring system - Houses the PEDC & PDP units	- PEDC - PDP
PDP (Power Distribution Panel)	- All the PSD power distribution equipment for a platform is contained within the PDP	- Main Station Power Supply - Interface terminals within PSCC
PEDC (Platform Edge Door Controller)	- Interface between Signalling system and PSD - Central fault monitoring and reporting - Individual door inhibit - Communicate doorway status - Doors closed and locked	- Single point access for software level verification and upgrade - Central point for DCU configuration changes - Line replaceable unit (LRU)
DCU (Door Control Unit)	- Local control of door operation - Control of audio and visual indicators - Line Replaceable Unit - Monitoring of doorway health and status - Lock status - DCU health	- Door motion profile selection - Door motion profiles. - Customise: acceleration, speed & deceleration - Obstruction detection mode - Obstruction force - Re-close sequence
PSL (Local Control Panel)	- Allows manual door release with status indicators of all PSDs on a platform	- PEDC
SMT (System Maintenance Tool)	- System maintenance tool - Used for maintenance and fault-finding	- PEDC - DCU



Control System Schematic

3.2 Signalling Interface

A typical system is designed to be controlled on a platform basis, with control for each platform centred on a Platform Edge Door Controller (PEDC). The PEDC forms the interface between the PSD system and the signalling system. Each PEDC and associated hardware is typically contained within a sealed cabinet and designated as the Platform Screen Control Cabinet (PSCC).

3.3 Electrical Interfaces

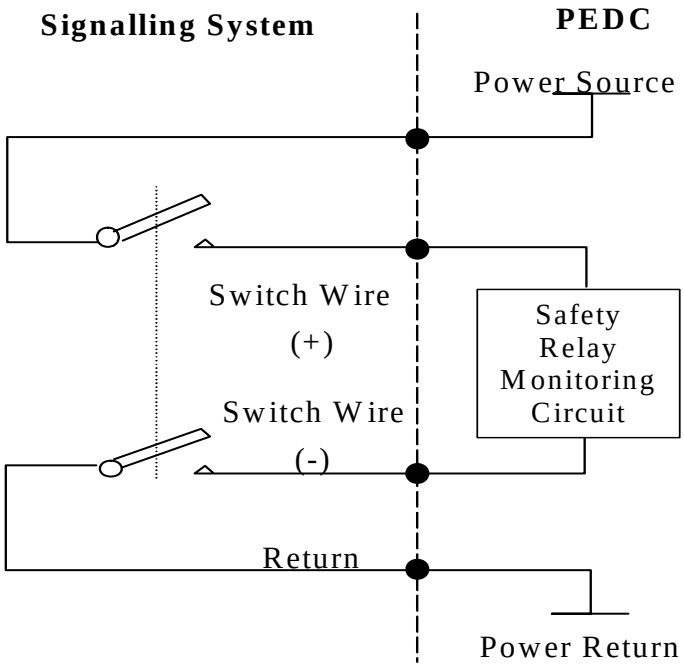
The interface between the signalling system and the PEDC comprises two vital commands:

- Open Doors
- Close Doors

And two status signals from the PEDC to the signalling system:

- All doors closed and locked
- Interlock override

The 'Open Doors' and 'Close Doors' are typically a 4 wire double cut volt free interface, as shown below.

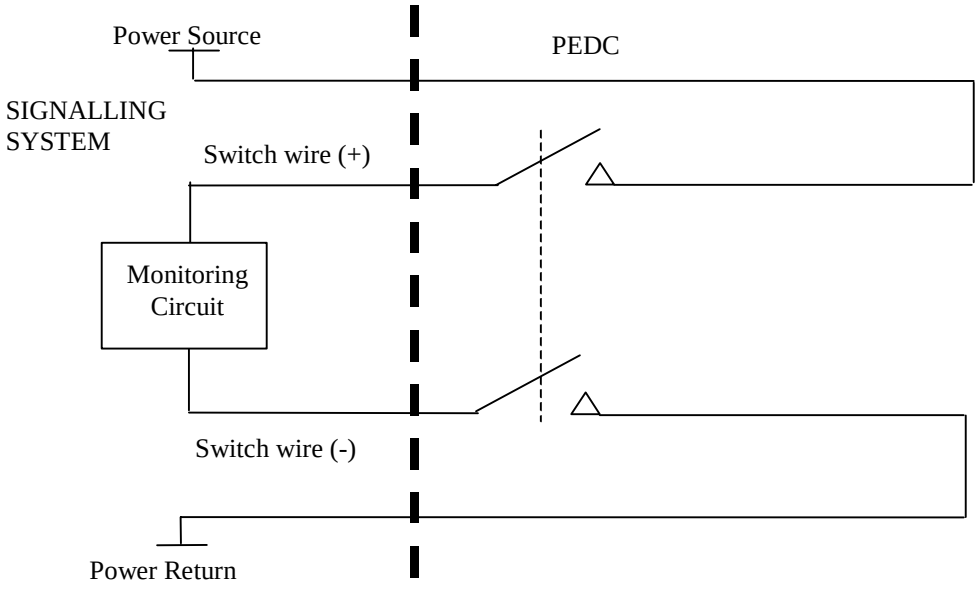


Double Cut Signalling Input to PEDC

In operation the 'Open Doors' command should be held active whilst the doors are opening and for the whole duration that the doors are to remain open.

In operation the 'Close Doors' command should be held active until the doors report closed and locked. In practise the 'Close Doors' command is held active for the whole duration that the doors are to remain closed although if the command becomes inactive the doors will remain locked and not open.

The 'All doors closed and locked' status from the PEDC to the signalling system can comprise a 4 wire double cut volt free interface, as shown below.



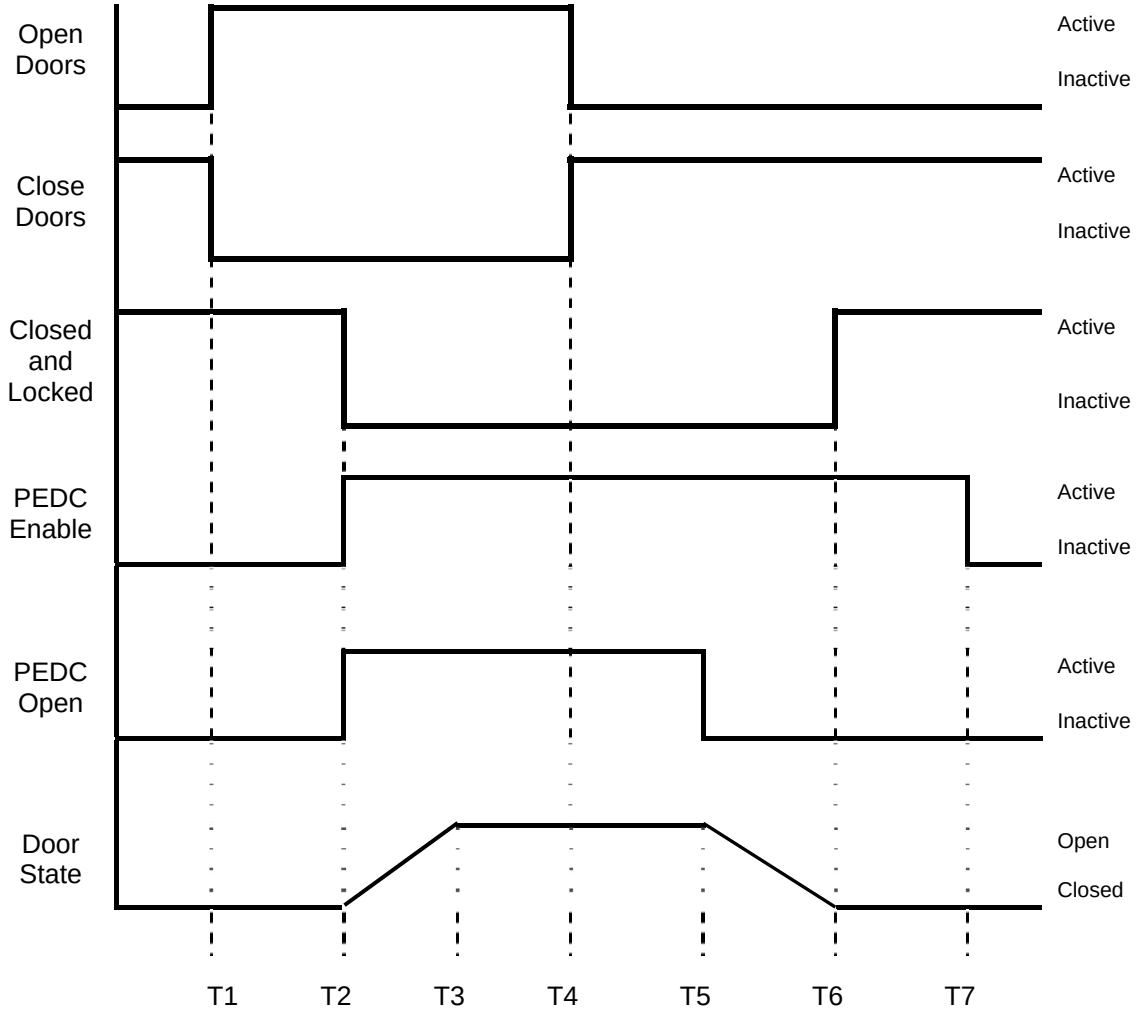
Double Cut PEDC Input to Signalling System

The interface is active when all the doorways are closed and locked.

3.4 Command Operation and Timing

The following example sequence of events takes place for a normal open and close cycle of the doors:

1. T1 - The signalling system makes an 'Open Doors' command active and the 'Close Doors' command inactive. Note that if both commands are active, or inactive, this is registered as a fault condition and will be ignored by the PEDC.
2. T2 - The PEDC generates the 'Enable' and 'Open' signals to each DCU, in parallel. Each doorway will release its mechanical lock, thus breaking the closed and locked loop, and start to open.
3. T3 - The doors are fully open.
4. T4 - The signalling system will make the 'Open Door' command inactive and the 'Close Door' command active.
5. T5 - The PEDC will remove the 'Open' signal to all the DCUs but keep the 'Enable' signal active. Each doorway will start to close
6. T6 - All doorways are now closed and locked. The PEDC will make the 'All doors closed and locked' signal to the signalling system active.
7. T7 - The PEDC will remove the 'Enable' signal from all the DCUs, in response to the closed and locked signal.


Open Doors
Active
Inactive
Close Doors
Active
Inactive
Closed and Locked
Active
Inactive
PEDC Enable
Active
Inactive
PEDC Open
Active
Inactive
Door State
Open
Closed
T1
T2
T3
T4
T5
T6
T7

4 GENERAL REQUIREMENTS

4.1 General

The following general topics are addressed within this section:

- System Health Monitoring
- Managing Train to PSD/PED Gap
- Gap Fillers
- Faulty Door Isolation
- Track to Platform Access for Large Equipment
- Headway Performance Requirements
- PSD/PED Portal Requirements
- Touch Potential Difference
- Current Applicable Standards
- Train Docking
- Door Synchronization
- Selective Re-Opening
- Security of Closed and Locked Function
- Audible and Visual Warnings for Door Operation
- Passenger Exchange Sub-System

4.2 System Health Monitoring

A PSD/PED system should be able to manage and communicate the health status of the system to the infrastructure at the appropriate level. It is recommended that the amount of information that is communicated is limited to avoid overloading staff, and is limited to the vital control elements. Typically this could include:

- Status of the Vital Loop.
- Status of the Local Over-ride function.
- A general Health Status signal, which can be interrogated by other means.
- Miscellaneous information should be organised between maintenance and operations information type and sent to the appropriate decision centres.

4.3 Managing Train to PSD/PED Gap

An important safety consideration when designing a platform with a PSD/PED system is to minimize the gap between the train and the PSD/PED to reduce the risk of entrapment. The controlling factor in managing this feature is the train's kinematic envelope. It is recommended that if the gap cannot be reduced to an acceptable distance of approximately 100 mm, then obstruction detection means should be considered. (This aspect is to be determined by others).

4.4 Gap Fillers

In situations were the gap between the train and platform is considered larger than optimal, gap fillers may be considered. There two types currently available, they are:

- Passive gap fillers manufactured using elastomer material designed to take a vertical load, but to deform with a horizontal load.

- Active gap fillers, which are mechanically controlled devices providing a step between platform and train.

Mechanically controlled gap fillers have the additional risk which needs to interface with the vital control system to ensure correct deployment and retraction.

However, it should be noted that this topic is not part of the scope of this document, and the information is for informative purposes.

4.5 Faulty Door Isolation

The ability to isolate a faulty door is an important feature, and one which has been done mechanically using a manual isolation facility located at each door way. However, with the increasing use of data bus systems it is now feasible to isolate a door out of service using a bus system. It is also feasible that an incoming train which has a faulty door communicates with the PSD/PED system and takes a door out of service for a specific train.

4.6 Track to Platform Access for Large Equipment

An increasing requirement is to be able to facilitate the transfer of large equipment from the track to the platform and visa versa for maintenance or upgrading of station plant. To facilitate this requirement would mean having a section of the screen being removable. At the design stage a removable section would have to be designed into the screen work once the size of access was understood. However, the current concept is that the header equipment which includes the wiring and data bus that runs the length of the system would stay in place, placing height restriction on the concept.

4.7 Headway Performance Requirements

A PSD/PED system must be capable of meeting and maintaining a level of availability commensurate with operators intended time table. It is typical to specify a given number of open / close cycles for peak operation and non peak operation. It is also necessary to specify the total number of hours per day the system must operate for a given number of days per year. This specification should be aligned for the anticipated headway and dwell times anticipated for a system.

4.8 PSD/PED Portal Sizing

It is generally accepted that the PSD/PED portal sizing is as follows:

- Portal width is train body side door portal width, plus train stopping tolerance.
- Portal height is train body side door portal height, plus x mm to minimise the risk of head injuries as the human body goes through the stepping motion.

4.9 Touch Potential Difference (PD)

In some applications it is necessary to monitor the touch Potential Difference (PD) due to earth leakages. Options exist to control the touch PD, such as clamping the structure to the traction return scheme. An option may be to provide an alarm that detects unacceptable touch PDs if it is not practical to manage the risk of electrocution to passengers.

4.10 Current Applicable Standards

- ASCE 21-00 Parts 1, 2 & 3 Automated People Mover Standards
- Electrical:
    - BS7671 IEE Wiring Regulations
    - Relevant IEEE Protocols
- EMC:
    - EN 61000-4-2-95

  - EN 61000-4-3-97
  - EN 61000-4-4-95
  - EN 61000-4-5-95
  - EN 61000-4-6-96
  - EN 61000-4-8-93
  - EN 61000-4-11-94
  - EN 55022-93
- Quality:
  - ISO 9001
  - ISO 14001
- Software:
  - EN 50128(2001) - European Norm - Software for Railway Control and Protection Systems

4.11 Train Docking

'Train Docking' is the term used, amongst others, to refer to the correct stopping and positioning of a train at a station that must occur before the PSDs/PEDs are permitted to open. With an automated system the train's ATO system will automatically stop the train. The train's ATP system will determine that the train has correctly 'docked' and will transmit to the ZC that the PSDs can be opened. If the train is not correctly positioned, the onboard ATP will never transmit a door enable signal to the ZC.

4.12 Door Synchronization

Train body side doors and PSD/PED door opening and closing are synchronized independently of each system. The precise way in which the respective train and platform systems are signalled to operate may vary from system to system. Assuming the open or close signals are virtually simultaneous the way in which each system is 'synchronized' is achieved through the door timings. The PSD/PED contains door profiles which permit the rate at which a door opens and closes to be altered so that it can be aligned with the train door profile. The respective systems appear synchronized without having any interaction that would cause unnecessary complications.

4.13 Selective Re-Opening

A facility to selectively re-open a door that has failed to fully close may be a useful requirement, but historically has not been a common need. The benefit of such a function would prevent the complete re-opening of all doors which may encourage passengers to attempt to board the train, thus hindering train dispatch. Such a function may only be achievable using a data bus system that communicates a specific door is not closed and locked, permits it to be re-opened and close. The system could be such that it permits re-opening to operate a given number of times until either achieving the closed and locked state, or is reported as system unhealthy. Train dispatch would be inhibited until the fault is corrected manually.

4.14 Security of the Closed and Locked Function

The security of the closed and locked function shall be achieved through the integrity of the lock and switch actuation. A lock design should never permit the signals closed and locked to be activated without the lock actually being in the locked state.

4.15 Audible & Visual Warnings for Door Operation

It is normal for either or both audible and visual warning to be provided for impending door operation. Historically, neither have been given priority, but clearly both are preferable as they cater for the visually or sight impaired person.

4.16 Passenger eXchange Sub System (PXSS)

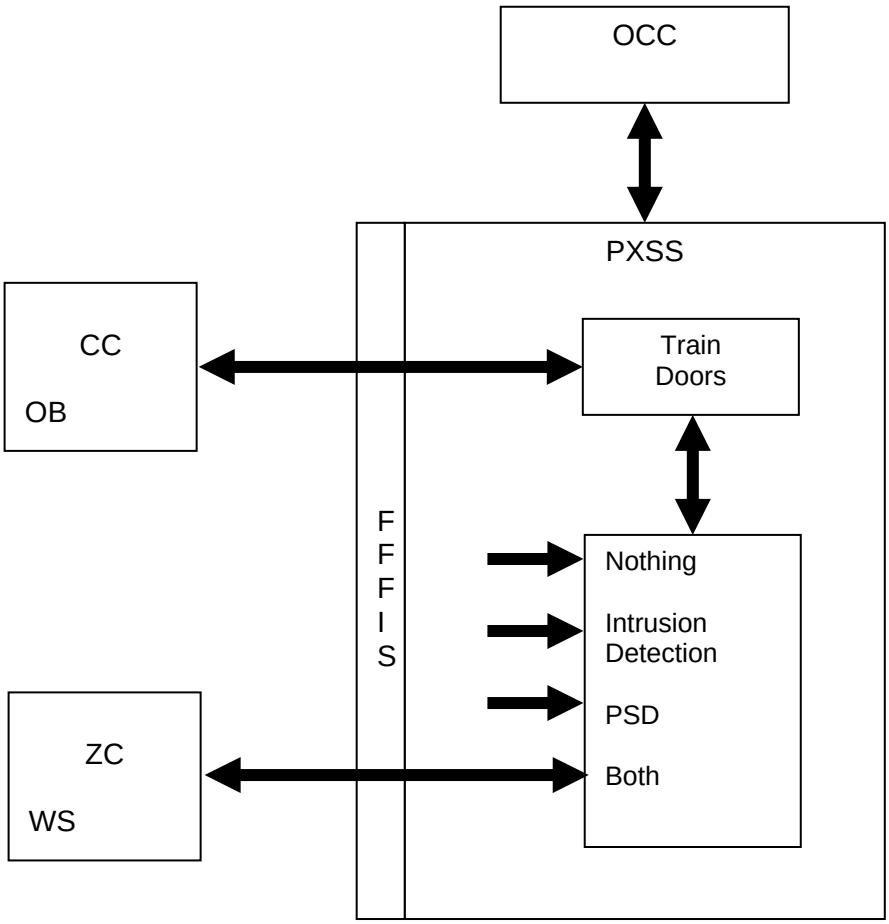
Unique to the MODURBAN project has been the development of the PXSS concept, which is depicted below. In essence the concept is a form of communications system between the train door system and the PSD/PED system. The PXSS interfaces with the train Command & Control (CC) system, the Operations Command & Control (OCC) system and the Zone Control (ZC) systems to provide a global communication system.

Its precise functionality has yet to be understood and agreed, but current ideas include:

- Providing a level of control where a system may have a combination of PSD/PED and other passenger intrusion warning systems.
- Providing the ability to assist in controlling out of service doors
- Providing passenger information.

Using the concept for safety related purposes may not be acceptable which may limit its usefulness.

[Of note; it was agreed at the 3rd MODACCESS meeting (Munich, December 2005) that for the next year the project should concentrate on the basic functional requirements, and once these were agreed, development of the PXSS could continue in earnest in years three and four – this approach was agreed by those present.]



5 FUNCTIONAL REQUIREMENTS

The Functional Requirements breakdown into the following groups:

- Station Control System Functional Requirements
- Station Staff Functional Requirements
- Passenger Functional Requirements
- Maintainer Functional Requirements
- Emergency Functional Requirements

5.1 STATION CONTROL SYSTEM FUNCTIONAL REQUIRMENTS

5.1.1 PLATFORM PASSENGER DOORS OPEN

a) The PSD system shall receive a PLATFORM PASSENGER DOORS OPEN signal from the ZC.
b) One PLATFORM PASSENGER DOORS OPEN signal shall be provided for each platform.
c) The PLATFORM PASSENGER DOORS OPEN signal shall have two states; Active & Inactive.
d) When the PLATFORM PASSENGER DOORS OPEN signal for a platform is Active then all available passenger doors shall open on that platform.
e) The PLATFORM PASSENGER DOORS OPEN signal shall not open a passenger door that has been isolated from service.
f) The PLATFORM PASSENGER DOORS OPEN signal shall remain Active for the full period that the passenger doors are required to be open.
g) Removal of or, loss of the PLATFORM PASSENGER DOOS OPEN signal when the passenger doors are in any position other than closed shall cause the passenger doors to close on that platform.

5.1.2 PLATFORM PASSENGER DOORS CLOSED

a) The PSD system shall receive a PLATFORM PASSENGER DOORS CLOSED signal from the ZC.
b) One PLATFORM PASSENGER DOORS CLOSED signal shall be provided for each platform.
c) The PLATFORM PASSENGER DOORS CLOSED signal shall have two states; Active & Inactive.
d) The PLATFORM PASSENGER DOORS CLOSED and PLATFORM PASSENGER DOORS OPEN signals shall be interlocked, by others, externally to the PSD system to ensure that the two signals shall not both be Active at the same time.
e) If both PLATFORM PASSENGER DOORS CLOSE and PLATFORM PASSENGER DOORS OPEN signals are in the same state for more than xxx ms then the PSD system shall close all passenger doors on that platform.
f) When the PLATFORM PASSENGER DOORS CLOSE signal is active the PSD system shall close all passenger doors on that platform.

5.1.3 PLATFORM PASSENGER DOORS LOCKED

a) When all of the PLATFORM PASSENGER DOOR LOCKS are in the Locked state the PSD system shall provide the PLATFORM PASSENGER DOORS LOCKED signal.
b) The PLATFORM PASSENGER DOORS LOCKED signal shall have two states; Active and Inactive.
c) The state PLATFORM PASSENGER DOORS LOCKED = Active shall correspond with all of the PASSEGER DOORS locks being in the ‘Locked’ state.
d) The PLATFORM PASSENGER DOORS LOCKED signal shall be passed to the ZC via a hardwired signal dedicated to this signal only.

e) The status of the signal PLATFORM PASSENGER DOORS LOCKED shall be displayed on the front of the Head End Controller (HEC).

5.1.4 EMERGENCY EGRESS DOORS (EED) & TUNNEL ACCESS DOORS (TAD) CLOSED

a) When all of the EEDSs & TADs are in the closed position the system shall provide the signal 'SWING DOORS CLOSED' (see note below).
b) The SWING DOORS CLOSED signal shall have two states, Active & Inactive.
c) The state SWING DOORS CLOSED = Active shall correspond with all of the swing doors being in the closed state.
d) The SWING DOORS CLOSED signal shall be passed to the ZC via a hardwired signal path dedicated to this signal only.
e) The status of the SWING DOORS CLOSED shall be displayed on the front panel of the HEC.

Note: EEDs & TADs are collectively known as SWING DOORS.

5.2 STATION STAFF FUNCTIONAL REQUIREMENTS

5.2.1 LOCAL CONTROL ENABLED

a) Within xxx ms of the LOCAL CONTROL ENABLED signal being initiated by the station staff at the HEC, the system shall provide the signal 'LOCAL CONTROL ENABLED' to the ZC.
b) The 'LOCAL CONTROL ENABLED' signal shall have two states; 'Active' & 'Inactive'.
c) The 'LOCAL CONTROL ENABLED' signal shall remain 'Active' for the duration that the LOCAL CONTROL ENABLED signal remains 'Active'.

5.2.2 PLATFORM OVERRIDE ENABLED

a) Within xxx ms of the 'Vital override – platform' signal being initiated by station staff at the HEC. The system shall provide the signal PLATFORM OVERRIDE ENABLED to the ZC.
b) The PLATFORM OVERRIDE ENABLED signal shall have two states; 'Active' & 'Inactive'.
c) The PLATFORM OVERRIDE ENABLED signal shall remain 'Active' for the duration that the 'Vital override – platform' signal remains Active.

5.2.3 LOCAL PLATFORM CONTROL

a) The platform staff shall be able to switch the entire platform between 'Automatic' and 'Manual-powered' modes at the HEC. This function shall be referred to as the LOCAL PLATFORM CONTROL function.
b) The transition between Automatic & Manual Powered modes shall be effective by the use of a key operated, (two position) switch on the HEC front panel.
c) It shall not be possible to remove the key from the mode switch unless the switch is in the Automatic position.
d) The position and design of the switch shall make it impossible to close the door to the HEC cabinet whilst the key is in the key-switch.
e) With the LOCAL PLATFORM CONTROL in the manual-powered position the system shall be isolated from the ZC.

5.2.4 LOCAL PLATFORM OPEN/CLOSE

a) The HEC shall feature a momentary action, two position switch, which allows, when used in conjunction with the LOCAL PLATFORM CONTROL switch the opening of all Platform Passenger Doors. This function shall be referred to as the LOCAL PLATFORM OPEN/CLOSE function.
b) The status of the LOCAL PLATFORM OPEN/CLOSE function shall be isolated and inactive, unless the LOCAL PLATFORM CONTROL function is in the Manual mode.
c) The LOCAL PLATFORM OPEN/CLOSE function shall be mechanically biased towards the closed position.

5.2.5 MANUAL OPEN (PLATFORM SIDE) – GENERAL REQUIREMENTS

a) Each platform passenger doors and each swing door shall have a key operated mechanism that permits unlocking and opening of the doors by station staff. This function shall be called PLATFORM SIDE RELEASE.
b) The design of the key/lock system shall be tamper proof.
c) The PLATFORM SIDE RELEASE shall be so positioned to be accessible to station staff with no form of assistance.

5.2.6 MANUAL OPEN (PLATFORM SIDE) – PLATFORM PASSENGER DOORS

a) On operation of the PLATFORM SIDE RELEASE function electrical power to the sliding door drive shall be cut, thus preventing powered motion.
b) Operation of the PLATFORM SIDE RELEASE shall mechanically unlock the door lock and allow the manual opening of the door.
c) Once a set time has elapsed (configurable in software between x s & x s) has elapsed from activation of the PLATFORM SIDE RELEASE function power shall be restored to the door drive and the doors will move to the closed position at a reduced speed of x.x m/s.

5.2.7 MANUAL OPEN (PLATFORM SIDE) – SWING DOORS

a) Operation of the PLATFORM SIDE RELEASE function shall mechanically unlock the swing door lock and allow the manual opening of the swing door.
b) The swing doors shall be fitted with a mechanical automatic close device that shall return a manually opened swing door to the closed and locked position.

5.2.8 SEGMENT CONTROL

a) The system shall feature the facility to switch the opening and closing of the PLATFORM PASSENGER DOORS within a given segment for trains of different lengths.
b) The SEGMENT CONTROL should be interlocked with the LOCAL PLATFORM CONTROL to ensure the integrity of this function.

5.3 PASSENGER FUNCTIONAL REQUIREMENTS

5.3.1 PLATFORM PASSENGER DOOR CLOSE WARNING

a) The PLATFORM PASSENGER DOOR CLOSE WARNING shall have two states, active and inactive.
b) Within xxx ms of receipt of the PLATFORM PASSENGER DOOR CLOSE WARNING signal the system shall provide the ‘audible door closing warning’ and ‘visual door closing warning’ signal to the passengers.
c) The PLATFORM PASSENGER DOOR CLOSE WARNING signal = active shall correspond with the ‘audible door closing warning’ and ‘visual door closing warning’ signal to the passengers.

5.3.2 PLATFORM PASSENGER DOOR OBSTRUCTION DETECTION

a) The PLATFORM PASSENGER DOOR OBSTRUCTION DETECTION shall detect obstructions to the closing or opening of the active sliding doors.
b) The PLATFORM PASSENGER DOOR OBSTRUCTION DETECTION routine shall detect as a minimum rod diameter x mm placed between the closing sliding doors at any point over the full height of the door leaves.
c) The PLATFORM PASSENGER DOOR OBSTRUCTION DETECTION function shall be active in both automatic & manual powered modes.
d) The PLATFORM PASSENGER DOOR OBSTRUCTION DETECTION shall function on all platform passenger doors.
e) The detection of an obstruction the platform passenger door system shall enter an obstruction routine.
f) Following the detection of the obstruction the platform passenger doors shall actively brake the sliding door(s) motion.

g) Following the braking of the sliding door(s) the platform passenger doors shall step back xx mm.
h) The nominal duration of the step back phase shall be set at xx seconds.
i) The duration of the step back phase shall be adjustable within the software configuration between xx and xx seconds.
j) At the end of the step back phase the platform passenger door system shall attempt to resume the direction of motion, at low speed, prior to obstruction.
k) If no further obstruction is encountered by the sliding door(s) during the 'resume' phase then the sliding door(s) will re-commence at normal speed the operation being undertaken at the point of obstruction.
l) If a further obstruction is encountered by the sliding door(s) during the 'resume' phase, then the sliding door(s) re-enter the set back phase.
m) The PLATFORM PASSENGER DOOR OBSTRUCTION DETECTION system shall be capable of performing continuous obstruction routines for x hours without detriment to the system performance and life. [For testing purposes the door drive force shall be assumed to be xxx N and the set back time to be xx seconds.]

5.4 MAINTAINER FUNCTIONAL REQUIREMENTS

5.4.1 PLATFORM PASSENGER DOOR HEALTH MONITORING

a) The HEC shall feature an indicator that allows determination of the location of faulty platform passenger doors.
b) Each Platform Passenger Door Control Unit (DCU) shall contain a 'resistance' that can be switched in or out of the doorway health circuit dependent on the health status of that doorway.
c) The doorway healthy circuits shall contain these 'door healthy' resistors in parallel such that the resistance of the entire circuit as indicated at the HEC shall indicate which doorway is un-healthy.

5.4.2 SYSTEM HEALTH MONITORING

a) The HEC shall provide the ZC with a 'System Health' signal.
b) The 'System Health' signal shall have two states; Active & Inactive.
c) The state 'System Health = Active shall correspond with all of the platform passenger doors healthy.
d) The state 'System Health = Inactive shall correspond with all of the platform passenger doors unhealthy.

5.4.3 PLATFORM PASSENGER DOOR SOFTWARE

a) It shall be possible for maintenance staff to download software upgrades to the DCU at each doorway using a connector on the terminal panel.
b) The standard software download option shall require access to each individual doorway.

5.5 EMERGECY FUNTIONAL REQUIREMENTS

5.5.1 PLATFORM PASSENGER DOOR - TRACK SIDE - EMERGENCY RELEASE MECHANISM

a) Each Platform Passenger Door shall have handles called the 'EMERGENCY RELEASE MECHANISM on the trackside that permits passengers to manually unlock and open the Platform Passenger Door.
b) The EMERGENCY RELEASE MECHANISM handle shall be in a position accessible to passengers waiting in an open train doorway aligned correctly with the Platform Passenger door.
c) On operation of the EMERGENCY RELEASE MECHANISM handle electrical power to the Platform Passenger Door drive mechanism shall be cut, preventing powered motion.

d) On operation of the EMERGENCY RELEASE MECHANISM handle shall mechanically unlock door lock and allow the manual opening of the Platform Passenger Door drive mechanism shall be cut, preventing powered motion.
e) Once a set time has elapsed (configurable in software between x s & x s) has elapsed from activation of the EMERGENCY RELEASE MECHANISM handles power shall be restored to the door drive and the doors will move to the closed position at a reduced speed of x.x m/s.
f) The force required to activate the EMERGENCY RELEASE MECHANISM handles such that the door becomes unlocked shall not be greater than xx N. [Note: A suitable measurement technique should be agreed during the design phase.]
g) Once the EMERGENCY RELEASE MECHANISM handle has been used to unlock the door, the force to open the door using the EMERGENCY RELEASE MECHANISM handle shall not be more than xxx N.

5.5.2 SWING DOOR - TRACK SIDE – PANIC DEVICE

a) Each swing door will be fitted with a track side PANIC DEVICE that allows passengers to manually unlock and open the swing doors from the track side.
b) The PANIC DEVICE will be mounted in a position so that its vertical height shall generally correspond to the midriff of an adult passenger standing in the train doorway.
c) The PANIC DEVICE shall be sized so that it will permit the Platform Passenger Doors to achieve their full open position without striking the PANIC DEVICE.
d) On operation of the PANIC DEVICE, power operation of the Platform Passenger Doors shall be inhibited.
e) Operation of the PANIC DEVICE shall mechanically unlock the Swing Door lock and allow the manual opening of the door.
f) The maximum force required to open a swing door from track side shall be no greater than xx N. [Note: A suitable measurement technique should be agreed during the design phase.]

6 NON-FUNCTIONAL REQUIRMENTS

The Non-functional Requirements are divided into the following sub-groups:

- Power supplies
- Environment
- Civil – Structural Loads
- Sliding Door Dynamic Performance
- Fire Performance
- Earthing & Insulation

6.1 POWER SUPPLIES

6.1.1 GENERAL

The system shall have different power distribution options, the selection of a scheme shall be based on practical considerations such as voltage drop over platform length and conductor sizing.

6.1.2 HIGH VOLTAGE DISTRIBUTION

a) A high voltage distribution scheme shall consist of a 380/415V 3 phase AC supply provided to the Power Interface Panel (PIP) and subsequently distributed as 380/415V 3 phase to each individual Platform Passenger Door.
b) The PIP shall have an isolation switch for the incoming supply.
c) The PIP shall have appropriately rated circuit breakers for each outgoing circuit.
d) For the high voltage distribution scheme the AC supply circuits from the PIP to the doors shall be divided into two. One circuit shall supply the odd numbered doors and the other circuit shall supply the even numbered doors.
e) In the high voltage scheme a facility to transform the high voltage to a low voltage shall be provided at each door.
f) As an option the system shall provided for an isolation transformer upstream of the PIP.

6.1.3 LOW VOLTAGE DISTRIBUTION

a) The system shall have a low voltage DC or AC power distribution scheme derived from an incoming 380/415 V 3 Phase AC supply.
b) The PIP shall have an isolation switch for the incoming supply.
c) The PIP shall have appropriately rated circuit breakers for each outgoing circuit.
d) For the low voltage distribution scheme the supply circuits from the PIP to the doors shall be divided into two. One circuit shall supply the odd numbered doors and the other circuit shall supply the even numbered doors.
e) As an option the system shall provided for an isolation transformer upstream of the PIP.

6.1.4 UNITERUPTED POWER SUPPLY (UPS) or BATTERY BACK UP

a) As an option the system shall provide an UPS or battery back-up system.
b) If fitted, the UPS or battery back-up system shall be situated up-stream of PIP.
c) If fitted the UPS or battery back-up system shall be capable of X hour(s) operation or XX open and closed door cycles.

6.2 ENVIRONMENT

6.2.1 TEMPERATURE

a) For non tunnel applications, the system shall operate correctly over an ambient temperature range of -xx to +xx degrees Celsius.
b) For tunnel applications, the system shall operate correctly over an ambient temperature range of -x to +xx degrees

6.2.2 HUMIDITY

a) The system shall operate correctly up to a humidity level of 100% rh.
b) The system shall operate correctly in conditions where the dew point has exceeded and condensation forms on the system.

6.2.3 ELECTOMAGNETIC COMPATABILITY

To be agreed

6.2.4 ACOUSTICS

The sound pressure level created by the simultaneous operation of all sliding doors shall not exceed 70 dB(A).

6.3 CIVIL – STUCTURAL LOADS

The system will be subject to a number of external structural loads acting in different combinations. The basic loads are defined below followed by an explanation of the different combinations to be considered. The system shall be capable normal operation under the specified load conditions.

6.3.1 PISTON EFFECT LOAD

a) The system shall be subjected to a maximum load of xxx N per square metre of screen work applied in both the positive and negative Z directions. This load shall arise from the piston effect of a train passing through the station at maximum speed.
b) The maximum piston effect, arising from through trains, shall be taken to be applied xxx times per year.
c) In addition to the maximum piston effect, a reduced piston effect of xxx N per square metre of screen shall be taken to be applied xxx times per year.

6.3.2 CROWD LOAD

The system shall be subject to a load of xxx N per linear metre applied 1 m above finished floor level in the positive Z direction. This load shall arise from the action of platform crowds on the platform side face of the screen work.

6.3.3 WIND LOAD

External PSD installations shall be subject to a load arising from the action of the wind of the screen work. The wind load shall be xxx N per square metre of screen work applied in the negative Z direction.

6.3.4 IMPACT LOAD

All glass panels fitted with laminate glass must withstand the following qualification tests without penetration or breaching. Cracking of the glass is permitted:
a) Hard Body Impact
b) Soft Body Impact
c) Pendulum Impact

6.3.5 LOAD COMBINATIONS

a) The PSD system shall be designed to resist the following load combinations:
   - Standard Underground
   - Worst Case Underground
   - Standard Open Air
   - Worst Case Open Air
b) The application of any of the load cases shall not cause plastic deformation of any load bearing part of the PSD system.

c) The application of any load cases at a frequency of xxx per year shall not cause fatigue failure of any load bearing part of the PSD system.
d) The application of any of the load case combinations shall not cause any part of the PSD system to deflect more than xx mm from nominal towards the track.

6.4 SLIDING DOOR DYNAMIC PERFORMACE

6.4.1 OPENING REPOSNCE TIME

The delay between the receipt of the completed open command sequence at the Head End Controller (HEC) and the initial movement of the sliding doors should not be greater than xxx ms.

6.4.2 OPEN TIME

a) The open times for the active sliding doors shall be x.x s +/- x.x s
b) Open time shall be defined as the time between the receipt of the completed open command sequence at the HEC and the moment at which the sliding door achieves the open position.

6.4.3 CLOSE TIME

a) The close times for the active sliding doors shall be x.x s +/- x.x s
b) Close time shall be defined as the time between the receipt of the completed close command sequence at the HEC and the moment at which the HEC receives the sliding door locked signal.

6.4.4 OPEN/CLOSE ADJUSTEMENT

The open/close times shall be adjustable independently on each doorway in the range +/- 25%.

6.4.5 CLOSING PROFILE

a) The profile of speed against distance for the sliding doors when closing shall contain two distinct constant sped phases.
b) The first stage after initial acceleration from the start of opening until the sliding doors are xxx mm (+/- x mm) from the closed position shall be at a maximum speed considering the kinetic energy requirements.
c) The second stage (over the last xxx mm of door travel) shall be at a reduced speed prior to final deceleration so as to limit the kinetic energy of the moving mass to not more than x J.

6.4.6 KINETIC ENERGY

The speed and mass of the sliding doors shall be such that the kinetic energy of the moving mass is less than xx J at the maximum closing speed.

6.4.7 DOOR DRIVE FORCE

The force with which the drive equipment moves the sliding doors shall be adjustable between xx & xxx N

6.5 FIRE PERFORMANCE

a) All components of the system will be either:
   - Fire proof (class M0)
   - Non flammable (class M1)
   - Fire resistance (class M2)
b) Testing should be in accordance with NFP 92-501 or some equivalent standard.
c) Cables and electrical flexes must be class C1 without halogen.
d) Al materials will be chosen to be Low Smoke Zero Halogen (LSZH).where possible.

6.6 EARTHING & INSULATION

6.6.1 EARTHING

a) The installation shall be electrically earthed to the station civil structure
b) The system shall provide electrical earth connection between the different elements such that the impedance of the earth path from any point of the system to the station earth shall be less than x.x Ohm for a xx A current injection.

6.6.2 INSULATION

a) As an option it shall be possible to insulate the system from the station structure.
b) The resistive value of the insulation shall be shall provide xxx Ohm resistance at xxx V between any point of the system and the station earth.