



BSI Standards Publication

Railway applications — Urban guided transport management and command/control systems

Part 3: System requirements specification

National foreword

This British Standard is the UK implementation of EN IEC 62290-3:2019. It is identical to IEC 62290-3:2019, incorporating corrigendum June 2020.

The UK participation in its preparation was entrusted to Technical Committee GEL/9, Railway Electrotechnical Applications.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2020

ISBN 978 0 539 14327 0

ICS 45.060.01; 35.240.60; 45.020

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2019.

Amendments/corrigenda issued since publication

Date	Text affected
30 June 2020	Implementation of IEC corrigendum June 2020: Figure 3 replaced

English Version

Railway applications - Urban guided transport management and
command/control systems - Part 3: System requirements
specification
(IEC 62290-3:2019)

Applications ferroviaires - Systèmes de contrôle/commande
et de gestion des transports guidés urbains - Partie 3:
Spécification des exigences système
(IEC 62290-3:2019)

Bahnanwendungen - Betriebsleit- und
Zugsicherungssysteme für den städtischen
schienengebundenen Personennahverkehr - Teil 3:
Systembezogene Anforderungsspezifikation
(IEC 62290-3:2019)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 9/2531/FDIS, future edition 1 of IEC 62290-3, prepared by IEC/TC 9 "Electrical equipment and systems for railways" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62290-3:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-07-24
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-10-24

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Endorsement notice

The text of the International Standard IEC 62290-3:2019 was approved by CENELEC as a European Standard without any modification.

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 62290-1	2014	Railway applications - Urban guided transport management and command/control systems - Part 1: System principles and fundamental concepts	EN 62290-1	2014
IEC 62290-2	2014	Railway applications - Urban guided transport management and command/control systems - Part 2: Functional requirements specification	EN 62290-2	2014

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RAILWAY APPLICATIONS – URBAN GUIDED TRANSPORT MANAGEMENT AND COMMAND/CONTROL SYSTEMS –

Part 3: System requirements specification

FOREWORD

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International Standard IEC 62290-3 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
9/2531/FDIS	9/2544/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62290 series, under the general title *Railway applications – Urban guided transport management and command/control systems*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

The contents of the corrigendum of June 2020 have been included in this copy.

INTRODUCTION

IEC 62290 standard series specifies the functional, system and interface requirements for the command, control, and management systems intended to be used on urban, guided passenger transport lines and networks. This series does not apply to lines that are operated under specific railway regulations, unless otherwise specified by the authority having jurisdiction.

These systems are designated herein as Urban Guided Transport Management and Command/Control Systems (UGTMS). UGTMS cover a wide range of operations needs from non-automated (GOA1) to unattended (GOA4) operation. A line may be equipped with UGTMS on its full length or only partly equipped.

This series does not specifically address security issues. However, aspects of safety requirements may apply to ensuring security within the urban guided transit system.

The main objective of this series is to achieve interoperability, interchangeability and compatibility.

This series is a recommendation for those transport authorities wishing to introduce interoperable, interchangeable and compatible equipment.

It is the responsibility of the transport authority concerned in accordance with the authority having jurisdiction to decide on how to apply this series and to take into account their particular needs.

IEC 62290 series is also intended to support applications for upgrading existing signalling and command control systems. In this case, interchangeability and compatibility could be ensured only for the additional UGTMS equipment. Checking the possibility for upgrading existing equipment and the level of interoperability is the responsibility of the transport authority concerned.

Application of the series should take into account the differences between the various networks operated in different nations. Those differences include operational and regulatory requirements as well as different safety cultures.

This series defines a catalogue of UGTMS requirements split into mandatory and optional functions. The functions used are based on the given grade of automation. By fulfilling the requirements, a supplier can create one or more generic applications including all mandatory functions and all or a subset of optional functions. A generic application will achieve interoperability within the defined specific application conditions. Customising a generic application will create a specific application taking into account of local conditions such as track layout and headway requirements. It is the choice of supplier and transport authority to add additional functions to a generic or specific application. These additional functions are not described in this series.

According to IEC 62278, it is the responsibility of the transport authority, in agreement with the authority having jurisdiction, to decide, taking into account their risk acceptance principles to conduct specific hazard and risk analysis for each specific application. The safety levels for the functions of each specific application have to be determined by a specific risk analysis.

Terms like "safety related command", "safety conditions", "safe station departure" are mentioned without having performed any hazard analysis.

Standard series IEC 62290 is intended to consist of four parts:

- Part 1 “System principles and fundamental concepts” provides an introduction to the standard and deals with the main concepts, the system definition, the principles and the basic functions of UGTMS (Urban Guided Transport Management and Command/Control Systems).

The three other parts correspond to the three steps (see Figure 1) required in the process of specifying UGTMS and are to be used accordingly.

- Part 2 “Functional requirements specification” specifies the functional requirements associated to the basic functions provided by Part 1, within the system boundaries and interfaces as defined in Figure 3 of Part 1.

The FRS (Functional Requirements Specification) identifies and defines the functions that are necessary to operate an urban guided transport system. Two types of functions are distinguished for a given grade of automation: mandatory functions (e.g. train detection) and optional functions (e.g. interfaces to passenger information and passenger surveillance systems). Requirements of functions have the same allocation, unless they are marked otherwise.

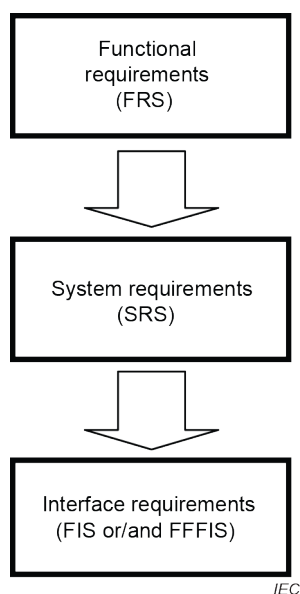
- Part 3 “System requirements specifications” deals with the architecture of the system and the allocation of the requirements and functions identified in Part 2 to architecture constituents.

The SRS (System Requirement Specification) specifies the architecture of a UGTMS system, with mandatory and optional constituents.

- Part 4 (under consideration) “Interface specifications” deals with the definition of the interfaces, as well as the data exchanged by them (FIS and FFFIS), for the interoperable and interchangeable constituents identified in Part 3.

For interfaces between UGTMS constituents, the logical interface or FIS (Functional Interface Specification) and/or the physical and logical interface or FFFIS (Form Fit Functional Interface Specification) will be considered.

NOTE The specific structures of Part 3 and Part 4 will be established following completion of Part 2 to accommodate optional and mandatory constituents, and to reflect local conditions. In principle, only one FIS or/and FFFIS will be defined for the same interface. However, when justified in some cases, several FISs or several FFFISs will be defined for the same interface.



IEC

Figure 1 – The three-step process followed by the UGTMS standard

Requirements are those necessary to fulfil all operational needs for safe and orderly operation requested by transport authorities without regard to technical solutions.

The chosen level of detail in describing requirements enables customers as well as authorities having jurisdiction to be assured that generic applications delivered by different suppliers will cover at least the same functionality as specified in this part of IEC 62290.

Requirements which are established by this series are indicated clearly with a requirement identification number related to the function to be covered.

RAILWAY APPLICATIONS – URBAN GUIDED TRANSPORT MANAGEMENT AND COMMAND/CONTROL SYSTEMS –

Part 3: System requirements specification

1 Scope

This part of IEC 62290 specifies the system architecture for Urban Guided Transport Management and Command/Control systems (UGTMS) as defined in IEC 62290-1 and IEC 62290-2, and the allocation of functions and requirements defined in IEC 62290-2 to the different UGTMS subsystems (designated as system constituents in IEC 62290-1 and IEC 62290-2), for use in urban guided passenger transport lines and networks.

This document is applicable for new lines or for upgrading existing signalling and command control systems.

This document is applicable to applications using:

- continuous data transmission
- continuous supervision of train movements by train protection profile
- localisation by reporting trains, and optionally by external wayside equipment for non-reporting ones (e.g. in case of mixed operation or degraded operation)

This document is not applicable to existing command and control systems or projects in progress prior to the effective date of this document.

The functional allocations of the UGTMS subsystems are mandatory (forming a sort of core system) or optional, according to the mandatory/optional functions and requirements defined in IEC 62290-2.

This document is applicable as a basis to define FIS and FFFIS. For specific applications, some elements may be added to meet the requirements coming from additional functions or equipment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62290-1:2014, *Railway applications – Urban guided transport management and command/control systems – Part 1: System principles and fundamental concepts*

IEC 62290-2:2014, *Railway applications – Urban guided transport management and command/control systems – Part 2: Functional requirements specification*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 62290-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Terms and definitions

3.1.1

train consist

basic train units coupled together, which can be split or coupled depending on operation needs

Note 1 to entry: When maintenance of IEC 62290-2:2014 is done, requirements in IEC 62290-2 will not use the expression “train consists” any more, in order to be consistent with the meaning of “consist” in the latest edition of IEC 60050-811:2017. IEC 62290-3 will not use as a consequence the expression “train consist” any more.

3.1.2

dwell time

time during which a train is berthed in a station served by the mission

3.1.3

headway

minimum time interval between consecutive trains allowed by the signalling system

Note 1 to entry: This definition comes from IEC 60050-821:2017, and is given for the term ‘signal headway’. In the rest of this document, only the term ‘headway’ is used.

[SOURCE: IEC 60050-821:2017, 821-02-54]

3.1.4

rollaway

unintended movement of the train in either a forward or reverse direction

3.1.5

run type

predefined speed profile which is managed at OCS level (energy saving profile, minimum run time, etc.)

3.1.6

safety-related command

operator triggered command whose execution has an impact on safety

3.2 Abbreviated terms

CCS	Central CCTV Surveillance
CPI	Central Passenger Information
CVC	Central Voice Communication
DCS	UGTMS Data Communication Subsystem
EB	Emergency Braking
EIXL	External Interlocking
FCN	Function

HVCB	High Voltage Circuit Breaker
INF	Infrastructure
MS	Maintenance System
OBCS	Onboard CCTV Surveillance
OBPI	Onboard Passenger Information
OBS	UGTMS Onboard Subsystem
OBVC	Onboard Voice Communication
OCS	UGTMS Operations Control Subsystem
OHMI	Operations Control HMI
OPS	Operation Planning System
PSD	Platform Screen Door
REQ	Requirement
SE	Station Equipment
SPTS	UGTMS Spot Transmission Subsystem
THMI	Train HMI
TPCS	Traction Power Control System
TR	Train (but not its HMI)
TSE	Trackside Signalling Equipment
TSR	Temporary Speed Restriction
WCS	Wayside CCTV surveillance
WPI	Wayside Passenger Information
WS	UGTMS Wayside Subsystem
WVC	Wayside Voice Communication
ZOP	Zone of Protection

4 UGTMS system architecture and non-functional requirements

4.1 Overall system architecture

This clause provides the general description of UGTMS architecture, the list of UGTMS subsystems, the identification of interfaces between UGTMS subsystems, and between UGTMS subsystems and the environment.

Non-functional requirements (like the ones related to performance) are described as well, in addition to the main choices made in this document, and having an impact on architecture.

Figure 2 and Figure 3 describe the UGTMS System architecture in consistency with the environment described in IEC 62290-1:2014, and highlighting external interfaces with this environment, and internal interfaces between UGTMS equipment.

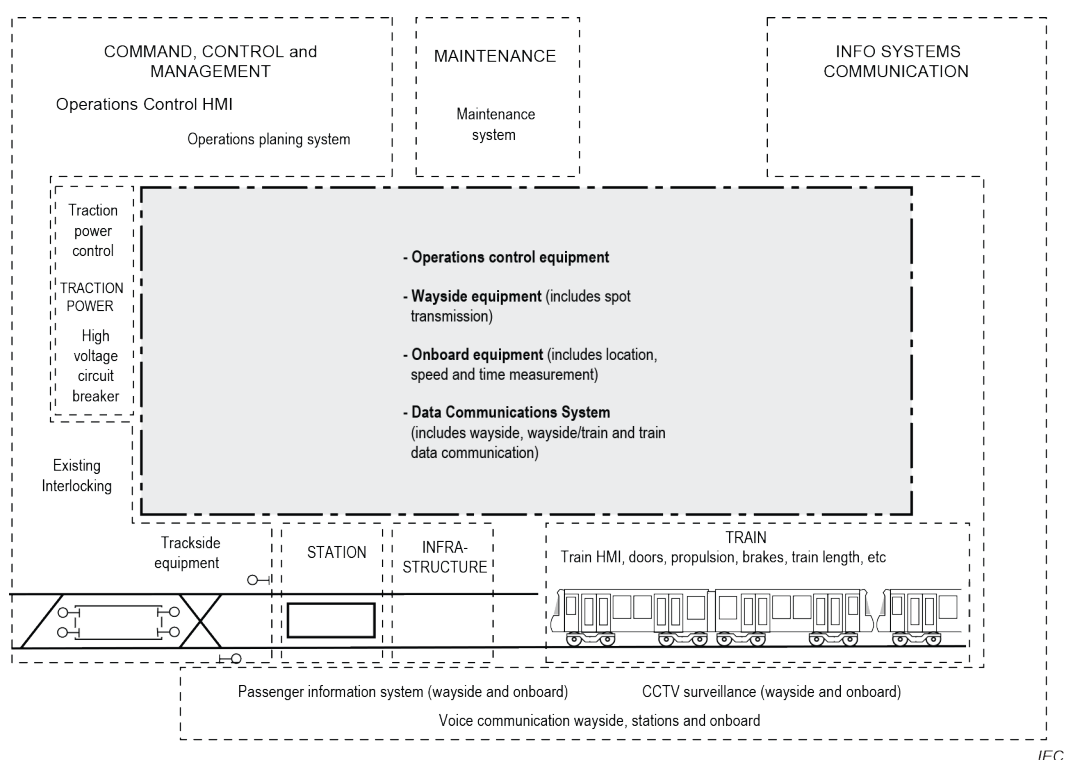


Figure 2 – UGTMS system environment (as defined in IEC 62290-1)

In the rest of the document, following an architecture decision (as shown in Figure 3), the Spot Transmission subsystem is considered as an independent UGTMS subsystem.

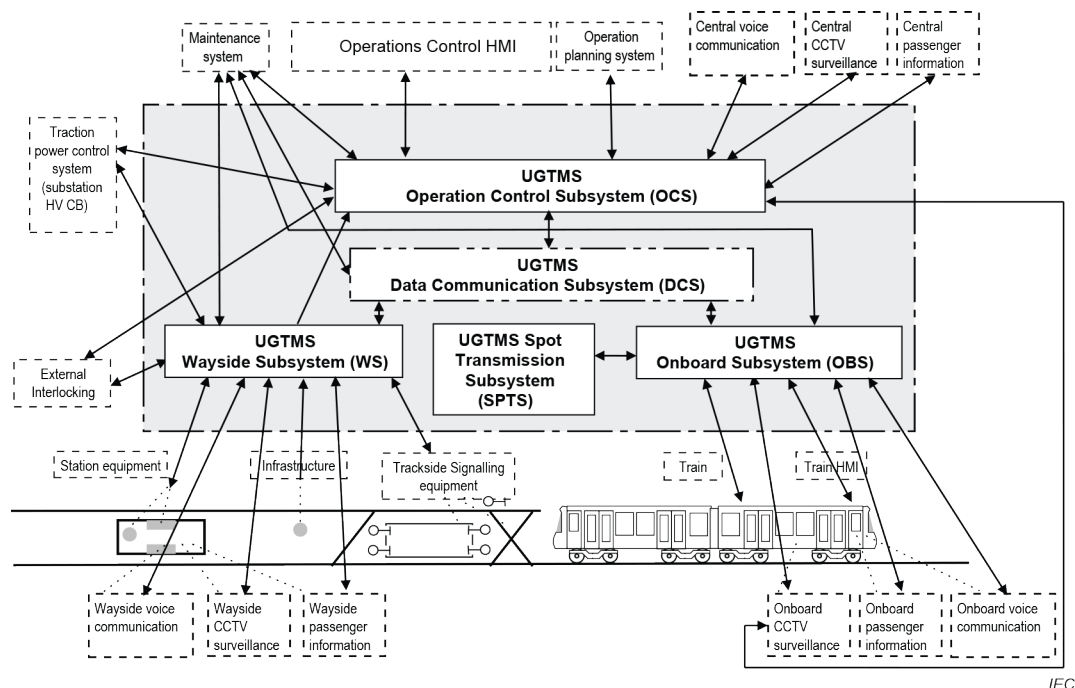


Figure 3 – UGTMS system architecture, external systems and external interfaces

It has to be noted that Figure 3 does not represent all the flows through the DCS subsystem, in order to keep it readable. The direct flows through the DCS existing possibly between external equipment and a UGTMS subsystem are described in detail in 4.3, in 6.1 and the corresponding subclauses of 6.3.

It has to be noted as well that the allocation work done in Clause 6 has permitted to identify the situations of direct link for external equipment through the DCS, but the document does not cover all possible direct links through the DCS.

4.2 General description of UGTMS subsystems

4.2.1 General

As shown on Figure 3, UGTMS system is split into five subsystems:

- the UGTMS Wayside Subsystem
- the UGTMS Onboard Subsystem
- the UGTMS Spot Transmission Subsystem
- the UGTMS Data Communication Subsystem
- the UGTMS Operation Control Subsystem

4.2.2 UGTMS Wayside Subsystem (WS)

The UGTMS Wayside Subsystem corresponds to the UGTMS equipment located in technical rooms.

A part of the equipment making the UGTMS Wayside Subsystem is able to manage trains on a portion or the whole line.

The equipment included in the UGTMS Wayside Subsystem is able to perform the following main functions:

- ensures safe route through interlocking related functions, or an interface with an external interlocking,
- ensures the safe separation of train, for instance through the determination of movement authority to be sent to trains, or contribution to it, and based on train locations,
- ensures the management of inputs/outputs to interface with trackside signalling equipment (such as points, signals, etc.) or platform door control systems.

4.2.3 UGTMS Onboard Subsystem (OBS)

The UGTMS Onboard Subsystem corresponds to the UGTMS equipment located onboard.

The equipment included in the UGTMS Onboard Subsystem performs the following main functions (depending on the GOA):

- determines the train location,
- ensures that the train proceeds safely in accordance with its movement authority and permitted speed,
- drives and controls the train automatically,
- interfaces with the Spot Transmission Subsystem

4.2.4 UGTMS Spot Transmission Subsystem (SPTS)

The UGTMS Spot Transmission Subsystem includes transponders located at wayside, an antenna for transmitting information, and a receiver located onboard.

The UGTMS Spot Transmission Subsystem performs synchronisation of train location.

4.2.5 UGTMS Data Communication Subsystem (DCS)

The UGTMS Data Communication Subsystem provides communication means between the different UGTMS subsystems.

It can be used as well for exchange between UGTMS subsystems and external systems.

It is made up of a wayside related part, an onboard one and the Radio making the relation between these two parts.

The Wayside Data Communication Network allows the interconnection between UGTMS wayside equipment, such as the UGTMS Operation Control Subsystem, the UGTMS Wayside Subsystem, or between UGTMS wayside equipment and external wayside systems.

The Onboard Data Communication Network interconnects the UGTMS Onboard equipment within a train. Another possible configuration might be for instance to connect a UGTMS Onboard Subsystem and a neighbouring subsystem, in the case of two trains coupled and equipped with UGTMS equipment.

The Radio Data Communication Network provides a radio link between UGTMS Wayside equipment and UGTMS Onboard subsystem.

4.2.6 UGTMS Operation Control Subsystem (OCS)

The UGTMS Operation Control Subsystem provides control and monitoring facilities to supervise the traffic and other subsystems.

The Operations Control Human Machine Interface (OHMI) is out of UGTMS scope.

4.3 External equipment in the UGTMS environment

4.3.1 General

These external devices as shown on Figure 3 have been defined accordingly with Figure 3 of IEC 62290-1:2014.

4.3.2 Infrastructure related equipment (INF)

The infrastructure related equipment covers:

- the track and related detectors (intrusion detection systems along the track, wayside obstacle detection, broken rail detection),
- devices used as staff protection purposes (e.g. plungers for switching off the power),
- the tunnel ventilation,
- fire and smoke detectors deployed in tunnels or along the track,
- flood gates or blasting doors,
- emergency exits.

4.3.3 Trackside signalling related equipment (TSE)

The concerned devices are those installed along the track, and that are in relation with signalling.

This covers:

- points, signals, track circuits and any other train detection devices like axle counters,
- equipment for displaying Train hold information,
- equipment for displaying wayside obstacle information,
- equipment for displaying working zone information,
- equipment for displaying station departure authorization,
- and equipment for initiating the unattended turnback.

4.3.4 Station related equipment (SE)

The concerned devices are those installed in stations.

The devices that are covered by this category are:

- fire detection/protection systems deployed in stations,
- auxiliaries like escalators and elevators,
- platform/track intrusion/fall detection systems,
- platform screen doors, and platform end doors,
- equipment for displaying platform screen door closing status,
- gap detection devices (falling or trapped objects/persons),
- gap filling devices,
- emergency handles,
- stop request devices,
- emergency call devices.

4.3.5 External interlocking related equipment (EIXL)

Such equipment is usually encountered when a choice has been made to retain an existing interlocking when upgrading the train control system to UGTMS.

External interlocking equipment may be of several different types, e.g. fully electronic, where both the control and safety functions are realised by a computer, all relay, where control and safety functions are realised by electromechanical relays and their associated wiring, or computer controlled relay interlockings, which are hybrid systems, where the control functions are carried out by computer, but the safety functions are performed by relays.

4.3.6 Traction Power control system related equipment (TPCS)

This equipment is intended to control the traction power system which supplies the trains with electrical power via the contact line or conductor rails.

The substations which feed the traction power system and their associated circuit-breakers are controlled from the Traction Power control system which may (but not necessarily) be located in the OCC.

4.3.7 Wayside voice communication related equipment (WVC)

This is equipment on the platform, and at other locations within a station or possibly along the track, that allows a passenger or staff to talk with staff in OCC or in other locations.

Such equipment has to provide an interface with the DCS in accordance with the DCS characteristics (e.g. communication protocols, or bandwidth, etc.).

4.3.8 Wayside CCTV surveillance related equipment (WCS)

The concerned devices are those installed along the track and in the stations (both in platforms, technical rooms and other station's rooms) for a real-time surveillance (monitoring and storing for additional processing) ensuring passengers' security and safety.

4.3.9 Wayside passenger information related equipment (WPI)

The interface between UGTMS and wayside passenger information related equipment allows for real-time passenger information to be displayed at platforms, concourses and ticket offices. It may include both predictions about arrival and departure times, as well as platform and train formation information.

4.3.10 Maintenance system related equipment (MS)

The Maintenance system related equipment is in charge of the maintenance support for the operation of a UGTMS system, and of the diagnostic for failures or accidents.

The Maintenance system covers the whole UGTMS system, and its subsystems, including the DCS.

The Maintenance system is connected to the UGTMS DCS, to the UGTMS OCS or in some cases to the UGTMS WS.

The maintenance support and diagnostic is performed by using data and reported statuses or alarms from the different UGTMS subsystems.

4.3.11 Operations Control HMI related equipment (OHMI)

The OHMI is the external equipment permitting the operation staff to manage the operations of UGTMS line through a set of displayed information and a set of commands.

Such equipment is located either in OCC, either decentralized in local facilities (e.g. station room) or through handheld devices such as pads.

4.3.12 Operation planning system related equipment (OPS)

This is the external equipment which supports the staff to plan and manage timetables, and provides to UGTMS the planned timetables for a given line, and see [H4] in 4.4.

4.3.13 Central voice communication related equipment (CVC)

This is equipment at the OCC that allows staff to talk with passengers or staff located in other locations.

Such equipment has to provide an interface with the DCS in accordance with the DCS characteristics (e.g. communication protocols, or bandwidth, etc.).

4.3.14 Central CCTV surveillance related equipment (CCS)

The concerned devices are those installed at the OCC in order to display, elaborate and record real-time videos received from Wayside and Onboard CCTV surveillance related equipment.

4.3.15 Central passenger information related equipment (CPI)

The interface between UGTMS and central passenger information related equipment allows for the operator to organize and plan the real-time passenger information to be provided wayside and onboard.

4.3.16 Train related equipment (TR)

The devices that are covered by this category are (items listed in “TRAIN” box of Figure 3 in IEC 62290-1:2014):

- doors, propulsion, brakes, train length device (e.g. couplers),
- obstacle detection device, derailment detection device, fire/smoke detection device,
- gap detection device or gap closing device (gap fillers, moveable steps and similar devices),
- emergency stop/door release handles/alarm buttons,
- other equipment interfaces (e.g. lighting, HVAC, battery),
- train diagnostics (for maintenance),
- train status (for fitness for operation),
- fare collection (location information).

4.3.17 Train HMI related equipment (THMI)

The train HMI related equipment is to receive commands, for instance about:

- changing driving modes,
- reset of emergency brake,
- train identification, train length,
- activation/resume of onboard equipment,
- destination of train journey, etc.

from train driver or staff, and to provide information, for instance:

- driving modes,

- door status,
- permitted maximum speed,
- failure information, test results,
- station departure authorization, etc.

to train driver or staff.

NOTE Those commands and information items are extracted from statements of the REQ whose allocation-Note description includes the expression “by REQ_6.5.2#1”. The FCN 6.5.2 is “Manage the interface with the train HMI”.

4.3.18 Onboard voice communication related equipment (OBVC)

This is equipment on a train that allows a passenger or staff to communicate with staff (e.g the driver, the OCC operator).

Such equipment has to provide an interface with the DCS in accordance with the DCS characteristics (e.g. communication protocols, or bandwidth, etc.).

4.3.19 Onboard CCTV surveillance related equipment (OBSCS)

The concerned devices are those installed on the vehicle for a real-time surveillance (monitoring and storing for additional processing) ensuring passengers’ security and safety. The corresponding data are made available for elaboration, recording and transmission to the Central CCTV surveillance related equipment and possibly to the driver.

4.3.20 Onboard passenger information related equipment (OBPI)

The interface between UGTMS and onboard passenger information related equipment allows for real-time passenger information to be displayed. It may include both predictions about arrival times and connections, as well as information about the nature and causes of disruptions.

4.4 Hypotheses for UGTMS architecture

This subclause describes the major choices identified in the standard and having an impact on architecture, and that result from the allocation done in 6.1, and in 6.2.

While Figure 3 is an architecture prepared to achieve the allocation of functions and requirements defined in IEC 62290-2:2014, some allocating works are difficult on this system breakdown structure level of the figure. The following hypotheses complement the representation of architecture to complete the allocations (tag with “H” is added to each item in preparation to link related descriptions):

- [H1] It is assumed that the external OHMI is connected to the UGTMS subsystems via the OCS. As an option, according to the decided allocation for requirements from IEC 62290-2:2014, the connection can be done directly through the DCS.
- [H2] It is assumed that the external Train HMI is directly connected to the OBS. As an option, it could be through the DCS
- [H3] The architecture and the related allocation considered in this document is the one of the current state of the art which involves both WS and OBS (different approaches induced by technology evolution could be considered in the future maintenance of this document, such as for instance an architecture which allocates a maximum of functions to OBS)
- [H4] The duty roster, if any, is considered to be included in the Operation Planning System.

5 UGTMS rail network description

5.1 General

The UGTMS urban subsystems use a common description of the railway network.

In this model, the various objects of the network have fixed characteristics (track singularity such as permanent speed restriction, etc.). Static description is managed separately from the dynamic characteristics (e.g. aspect of wayside signals, etc.) or temporary characteristics (e.g. Temporary Speed Restriction).

In the following subclauses, the UGTMS rail network description is mentioned as configuration data (the other configuration data referred to in this document are the ones in relation with the description of the rolling stock).

It is assumed that, under normal operation, each OBS shall have access to the entire configuration data corresponding at least to the whole line where it is expected to operate.

It is assumed that, under normal operation a WS supervises the trains in a geographical area (a zone), which is a portion of the overall network.

The configuration data related to the rail network description is structured according to the concepts of line sections and track segments described hereinafter.

5.2 Line section

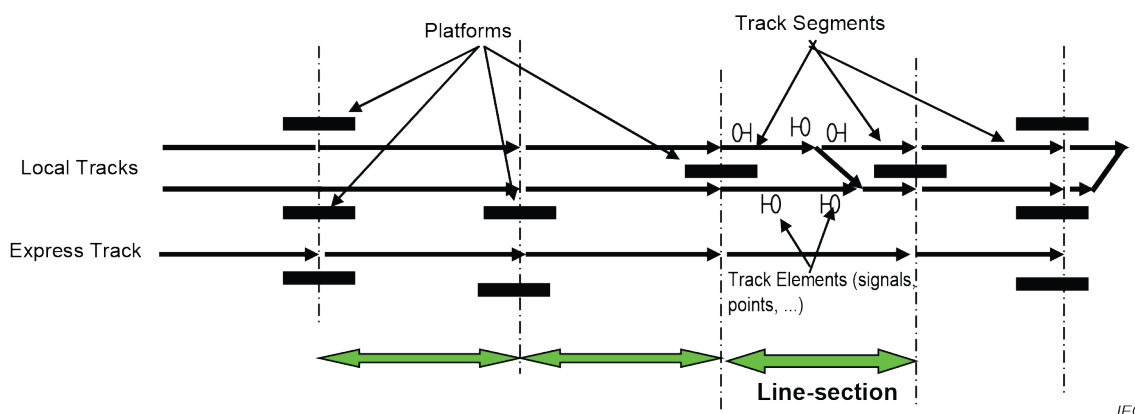
The configuration data related to the rail network description is split into distinct sets.

Each set is named a line section, and gathers information such as description of track segments (see 5.3), description of transponders, descriptions of gradients, locations of signals, etc.

The line section concept is used for modelling static data describing the track (and related elements).

The line section, as shown in Figure 4, is therefore the elementary set of consistent data allowing the description of the network:

- a line section can be as small as one interstation, and as large as a complete line,
- geographically, a line section corresponds to a set of track segments.



IEC

Figure 4 – UGTMS concept of line section

5.3 Track segment

The configuration data related to the rail network description is based on track segments connected to one another.

Track segment is the basic functional entity for managing locations.

A track segment, as shown in Figure 5, is a linear track part defined by:

- an origin
- a conventional orientation
- a length
- an identity

Any point of the train and any track singularity are perfectly located by using the track segment number and an offset (distance to the origin of the track segment).

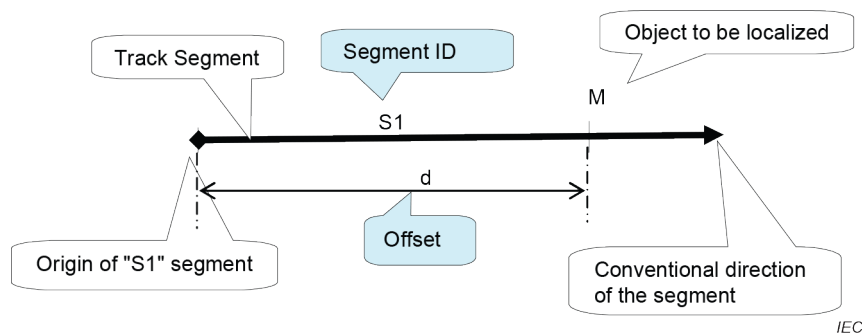


Figure 5 – UGTMS track segment definition

In Figure 5, location of "M" is defined by [S1 (Segment ID); d (Offset)].

"M" applies for any object, and such a way to describe a location applies as well for the determination of the position of a train, as described in corresponding requirements and allocations in the rest of the document.

Each track segment has an orientation.

Two adjacent track segments may have opposite orientations.

Configuration data related to the rail network description shall define relative orientation of neighbouring segments.

The direction of a train which is linked with the train movement is relative to the orientation of the segment where the train front is localised.

5.4 Connecting rules between track segments

The topology for configuration data related to the rail network description is represented by a graph of connected track segments.

The following rules shall be respected:

- each track segment can be linked to at least one adjacent track segment (the maximum number of adjacent track segments linked to the extremity of one segment is defined site specifically).

- when a track segment extremity meets facing points the connection relation is defined by the point indication (see track segments S2, S3 and S8 in Figure 6).
- when track segment extremity meets trailing points the connection relation is considered as perfectly defined: the “destination” is always the same (see track segments S3, S4 and S9 in Figure 6).
- where there is no point, the connection relation between two track segments is fixed (see track segments S1 to S2 in Figure 6).

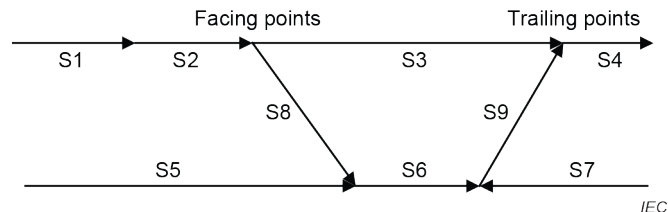


Figure 6 – UGTMS track segment chaining

5.5 Structure and content of the configuration data related to the rail network description

The structure of the configuration data related to the rail network description is based on line sections, and their associated track segments.

And for each track segment, the configuration data contain the list of objects belonging to the segment (for example, objects like points, signals or transponders, or properties like maximum speeds, gradients). These data are only static predefined information.

The configuration data related to the rail network description provides for example the following characteristics:

- topology: determines the connectivity of the track work, points and boundary,
- orientation: determines the origin and the extremity of track segments, allowing a unique location to be defined for all objects,
- distances: determines the distance of the track work between points,
- resolution: determines the smallest unit of measurement (quantum) by which an object can be located on the guideway,
- constraints: determines the direction points can be passed, and if boundaries can be crossed,
- zones: determines the location of various regions on the guideway (e.g. the length of a train detection section, station, traction power section),
- object locations: determines the location of objects on the guideway (e.g. signals, transponders),
- properties: determines the features of the guideway (e.g. authorised travel directions, maximum speeds in each direction, gradients).

6 Requirement allocation and description

6.1 Functional and non-functional requirement allocation to UGTMS subsystems

6.1.1 General principles

Subclause 6.1.2 describes the allocation of functional and non-functional requirements to UGTMS subsystems.

It is structured according to the function tree of IEC 62290-2:2014 for functional requirements.

For each function or subfunction, its associated applicability depending on the GOA or other conditions is given.

For each requirement from IEC 62290-2:2014:

- the requirement from IEC 62290-2:2014 is given, with its associated applicability depending on the GOA, and on options,
- the column 'Option' permits to describe each possible option associated to the allocation of a requirement,
- the column 'Processing' describes which subsystem has been allocated the processing of a requirement,
- the column 'Internal inputs' describes inputs coming from other UGTMS subsystems into the considered processing subsystem,
- the column 'Internal outputs' describes outputs sent to other UGTMS subsystems, from the considered processing subsystem,
- the column 'External inputs' describes inputs coming from external equipment of the UGTMS environment into the considered processing subsystem,
- the column 'External outputs' describes outputs sent to external equipment of the UGTMS environment, from the considered processing subsystem.

Inputs are noted with letter I, outputs with letter O, associated numbered suffixes are references to the corresponding note. The letter X is used for the UGTMS subsystem(s) in charge of the processing.

An important rule for allocating the functional requirements of IEC 62290-2:2014 is: when processing the allocation of a requirement from IEC 62290-2:2014, the 'I' and 'O' with UGTMS subsystems and external equipment are given for data that are not already provided or used by another requirement. If it would be provided or used by another related requirement, then a reference to this requirement should be made in the "Note" for traceability.

The example of charts and figures in this clause is shown as Figure 7.

Figure 7 shows a typical case of 6.1.2 description to understand the note expression with options and the process diagram using letter "I", "X" and "O".

Figure 7 shows that requirement ("REQ_5.x.x.x.x#x") allocated can be implemented in two ways (option A and option B).

In option A, the requirement is processed by WS (WS X1) using input data from external input (TSE I1).

In option B, input data from external input (TSE I2) is processed by OCS (OCS X2), OCS sends output data to WS (WS O2), then the output data is received as input data from OCS (OCS I3) and processed by WS (WS X3).

[REQ_5.x.x.x.x#x]

{ GOA1: y; GOA2: y; GOA3: y; GOA4: y }

Inserted here is the requirement to be performed by the subfunction, as stated in or derived from IEC 62290-2, and with the indication y mentioning if this requirement is seen as mandatory (M), optional (O) or not applicable (n/a) for GOA1 to 4.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
A	WS X1			TSE I1	
B	OCS X2	OCS I3	WS O2	TSE I2	
	WS X3				

This requirement can be implemented in two ways.

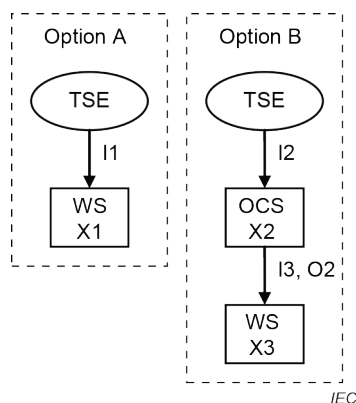
Option A:

NOTE 1 Inserted here any notes about X1 and TSE I1.

Option B:

NOTE 2 Inserted here any notes about X2, O2 and TSE I2.

NOTE 3 Inserted here any notes about X3 and I3.

**Figure 7 – Example for the description of 6.1.2**

6.1.2 Allocation of functional requirements from IEC 62290-2:2014

The functional tree in italic characters hereinafter, prefixed with 'FCN' and starting from Clause 5 to end with 6.10 is the one from IEC 62290-2:2014, which structures the functional requirements in this document.

FCN 5 – Functions for Train Operation

FCN 5.1 – Ensure safe movement of trains

FCN 5.1.1 – Ensure safe route

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Mandatory: all GOAs if "Ensure safe route" functions are provided by UGTMS

FCN 5.1.1.1 – Set and protect route

FCN 5.1.1.1.1 – Set route

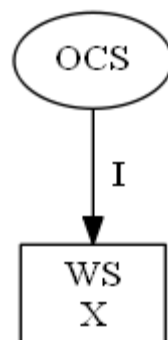
{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

[REQ_5.1.1.1.1#1]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall set a route by command provided via the interface with the operations control HMI or by the function set routes automatically.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X	OCS I			
NOTE The processing is done by WS with inputs from OCS coming: – either from an operator command (the input from OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3), – or from an automatic route setting command provided either by REQ_6.2.2#4, 6 or 7					

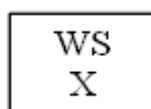


[REQ_5.1.1.1.1#2]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

For the route to be set, UGTMS shall determine the route elements required based on the route origin and destination, including elements required for flank protection, and for overlap.

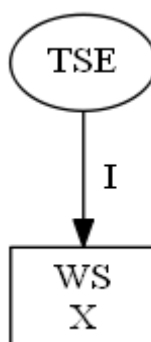
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X				
NOTE The route composition is provided by configuration data describing all routes with their elements and their required dynamic conditions.					

**[REQ_5.1.1.1.1#3]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

For the route to be set, the availability of all determined route elements shall be checked.

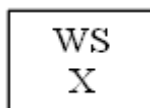
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I	

**[REQ_5.1.1.1.1#4]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Availability shall be given if a route element is not used for another route or blocked against route setting.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X				

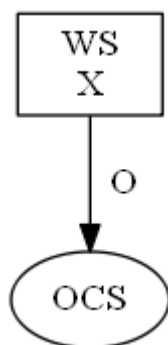


[REQ_5.1.1.1.1#5]

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

The reserved status of a route element shall be provided to the interface with the operations control HMI to be displayed. (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X		OCS O		
NOTE The output to OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.					

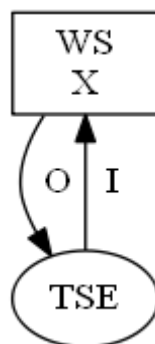


[REQ_5.1.1.1.1#6]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall move a reserved movable route element to the desired position if it is not already in that position, not occupied by a train and not blocked against moving.

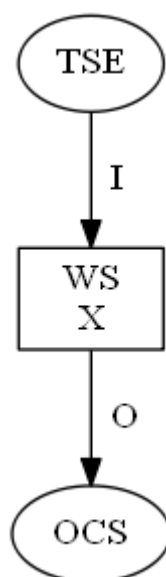
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I	TSE O
NOTE – TSE I for checking position of movable route element – TSE O for moving the movable route element – the occupancy resulting from reporting trains is provided by REQ_5.1.2.1.4#1 – the occupancy resulting from non-reporting trains is provided by REQ_5.1.2.2#1					

**[REQ_5.1.1.1.1#7]**

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

If a movable route element does not reach the desired position in a predefined time a failure message shall be provided to the interface with the operations control HMI to be displayed.
(O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X		OCS O	TSE I	
NOTE – TSE I for checking position of movable route elements – WS for predefined time, provided by configuration data determined for each type of element – OCS O then the output to OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.					

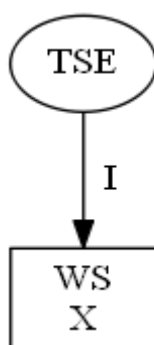


[REQ_5.1.1.1.1#8]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall lock all route elements in a route to be set if they are confirmed in the required position.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I	
NOTE TSE I for checking position of movable route elements.					

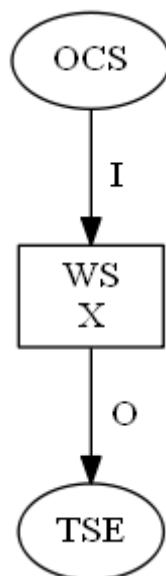


[REQ_5.1.1.1.1#9]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall command movable route elements (e.g. a point) from one position to the other by command provided via the interface with the operations control HMI.

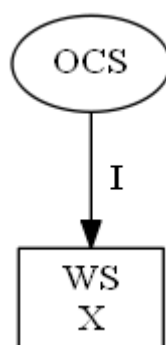
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X	OCS I			TSE O
NOTE – TSE O for commanding movable route elements – OCS I from OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.					

**[REQ_5.1.1.1.1#10]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall block a movable route element against switching by command provided via the interface with the operations control HMI.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X	OCS I			
NOTE The input from OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.					



FCN 5.1.1.1.2 – Supervise route

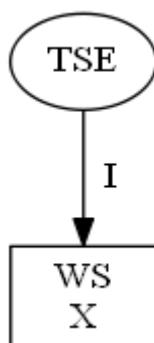
{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

[REQ_5.1.1.1.2#1]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall supervise that determined route elements are confirmed in the required position and locked.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I	
NOTE TSE I for checking position of route elements.					

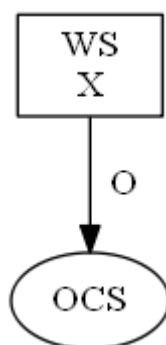


[REQ_5.1.1.1.2#2]

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

The supervision status of a route shall be provided to the interface with the operations control HMI to be displayed. (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X		OCS O		
NOTE The output to OHMI is provided by either REQ_6.5.1#2 or REQ_6.5.1#3.					

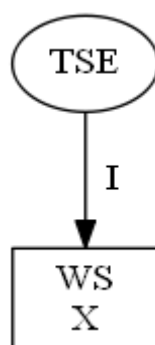


[REQ_5.1.1.1.2#3]

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

A route can be supervised with missing conditions if a specified subset of conditions is present. (O)

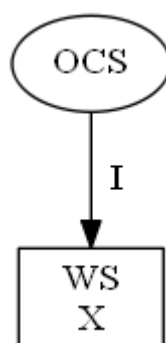
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I	
NOTE TSE I for checking position of route elements.					

**[REQ_5.1.1.1.2#4]**

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

The entrance to a route shall be prohibited by a safety related command provided via the interface with the operations control HMI. (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X	OCS I			
NOTE The input from OHMI is provided by REQ_6.5.1#3.					



FCN 5.1.1.1.3 – Lock route

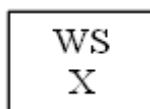
{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

[REQ_5.1.1.1.3#1]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

A train approach area shall be determined in front of a route origin for which movement authority has been given.

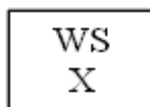
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X				
NOTE To be determined in configuration data for each route origin.					

**[REQ_5.1.1.1.3#2]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

The route shall be locked by approach if a train is in the approach area and a movement authority has been given to a train.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X				
NOTE – for checking occupancy of approach area, see the corresponding REQ_5.1.2.1.4#1 for reporting trains – for checking occupancy of approach area, see the corresponding REQ_5.1.2.2#1 for non-reporting trains – for movement authority, see the corresponding REQ_5.1.4.2#5 for reporting trains – for movement authority, see the corresponding REQ_5.1.4.3#1 for non-reporting trains checking entry signal					

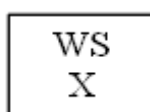


[REQ_5.1.1.1.3#3]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

The route elements in front of the train shall be maintained locked as soon as the train has entered the set route.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X				
NOTE – refer to REQ_5.1.2.1.4#1 for determining the location from reporting trains – refer to REQ_5.1.2.2#1 for determining the location from non-reporting trains					

**FCN 5.1.1.2 – Release route**

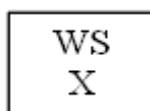
{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

[REQ_5.1.1.2#1]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall release a route element by element, group of elements, or as a whole by a train traversing the elements in the sequence corresponding to the authorized direction.

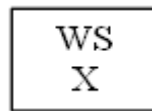
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X				
NOTE – refer to REQ_5.1.2.1.4#1 for determining the location from reporting trains – refer to REQ_5.1.2.2#1 for determining the location from non-reporting trains					

**[REQ_5.1.1.2#2]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Route elements in the flank protection area shall be released together with the corresponding route elements.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X				
NOTE Corresponding flank protection elements are provided by configuration data.					



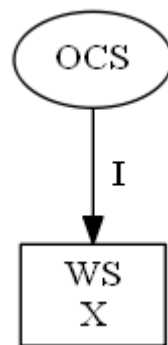
[REQ_5.1.1.2#3]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall allow route release by operational command provided via the interface with the operations control HMI if the route is not locked.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X	OCS I			

NOTE The input from OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.



[REQ_5.1.1.2#4]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall allow route release by operational command provided via the interface with the operations control HMI for a route that is locked if it can be ensured that an approaching train will not enter the route.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X1 OBS X2	WS I2 OBS I1 OCS I1	WS O2 OBS O1		TR O2

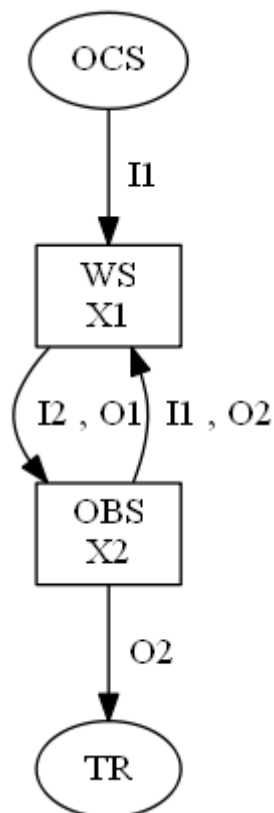
The processing is done by WS and OBS.

NOTE 1 WS receives the command I1 from OCS (this is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.). The presence of an approaching train is covered in REQ_5.1.2.1.4#1 and REQ_5.1.2.2#1 (respectively for reporting and non-reporting trains). In the case of non-reporting trains, the WS won't allow the release, as no guaranty for ensuring that this train will not enter the route can be obtained.

For reporting trains, the output O1 is sent to OBS to obtain then a confirmation I1 from OBS that it can ensure or not the stopping before the entrance of the route.

NOTE 2 When receiving I2 from the WS to check if it can stop before the entrance of the route, OBS determines this capability. And then send back to WS O2 accordingly.

If OBS determines it can stop in advance of the route, then it sends O2 to the Train (but not its HMI) a request for braking.

**[REQ_5.1.1.2#5]**

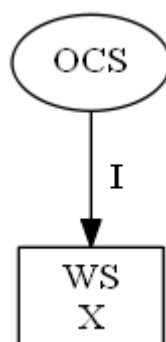
{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

UGTMS shall allow route release by operational command provided via the interface with the operations control HMI if the route is locked or occupied by a train. (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X	OCS I			

NOTE The input from OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.

It has to be noticed that the movement authority is then impacted accordingly, as covered in REQ_5.1.4.1#1 or REQ_5.1.4.1#2.

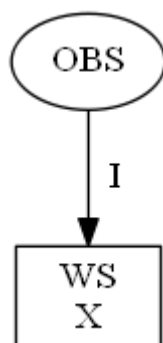


[REQ_5.1.1.2#6]

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

UGTMS shall cancel an overlap when the train has stopped at the route destination. (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X	OBS I			
NOTE – the information about the location of reporting trains is covered in REQ_5.1.2.1.4#1 and the stopping information is provided by OBS thanks to REQ_5.1.5.1#3; – the information about the stopping of non-reporting trains is managed through a WS internal processing (e.g. a timer), and about the location in REQ_5.1.2.2#1.					



FCN 5.1.2 – Ensure safe separation of trains

FCN 5.1.2.1 – Locate UGTMS reporting trains

FCN 5.1.2.1.1 – Initialise UGTMS reporting trains location

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

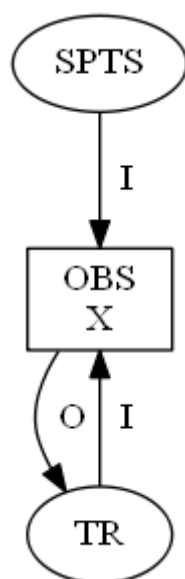
Mandatory: all GOAs if determination of train location by reporting trains is used by UGTMS

[REQ_5.1.2.1.1#1]

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

UGTMS shall initialise the train location for reporting trains stationary in stabling locations after the awakening process. (O)

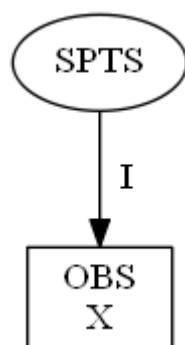
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I		TR I	TR O
NOTE OBS manages the awakening process through exchanges with the rolling stock (Train (but not its HMI)). OBS manages the initialization on its own, or optionally by using SPTS which provides the location through dedicated wayside devices, installed in stabling locations.					

**[REQ_5.1.2.1.1#2]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall initialise the train location for reporting trains entering UGTMS territory.

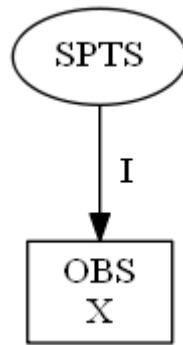
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I			
NOTE SPTS provides the location through dedicated wayside devices on UGTMS territory.					

**[REQ_5.1.2.1.1#3]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

For reporting trains, UGTMS shall initialise the train location on recovery from UGTMS equipment failures leading to loss of train location.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I			
NOTE SPTS provides the location through dedicated wayside devices for location recovery.					

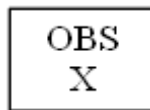


[REQ_5.1.2.1.1#4]

{ GOA1: O; GOA2: O; GOA3: O; GOA4: M }

The UGTMS train location initialisation of reporting train shall not require the manual input of train location or train length data. (O for GOA1 to 3, M for GOA4)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				



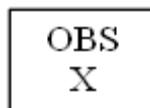
[REQ_5.1.2.1.1#5]

{ GOA1: O; GOA2: O; GOA3: O; GOA4: n/a }

UGTMS shall allow manual input of train length data of reporting trains. (O for GOA1 to 3, not applicable for GOA4)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				

NOTE The input from THMI is provided by REQ_6.5.2#1.



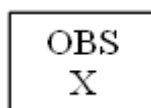
[REQ_5.1.2.1.1#6]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall allow initialisation of the train location for reporting trains in manual driving mode.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				

NOTE See REQ_5.5.2#3, REQ_5.5.2#4, REQ_5.5.2#5 and REQ_5.5.2#6 for the manual Driving Mode management.

**FCN 5.1.2.1.2 – Determine train orientation**

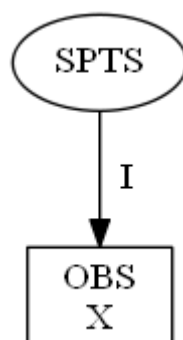
{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Mandatory: all GOAs if determination of train location by reporting trains is used by UGTMS**[REQ_5.1.2.1.2#1]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall determine the physical orientation of the reporting train relative to the defined orientation of the track.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I			

**FCN 5.1.2.1.3 – Determine actual train travel direction**

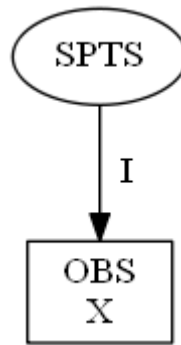
{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Mandatory: all GOAs if determination of train location by reporting trains is used by UGTMS**[REQ_5.1.2.1.3#1]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall determine the actual travel direction of the reporting train on the track.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I			

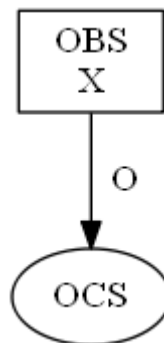


[REQ_5.1.2.1.3#2]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Actual train travel direction of reporting train shall be provided to the interface with the operations control HMI.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X		OCS O		
NOTE The output to OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.					



FCN 5.1.2.1.4 – Determine train location

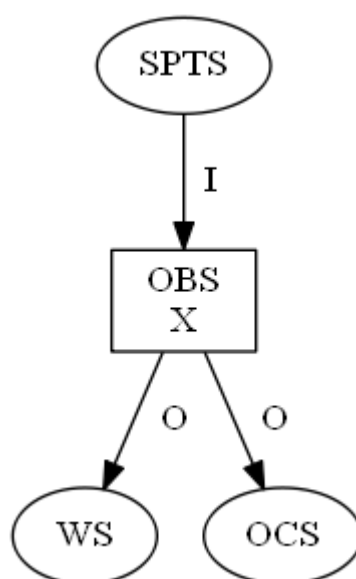
{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Mandatory: all GOAs if determination of train location by reporting trains is used by UGTMS**[REQ_5.1.2.1.4#1]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall determine the location of the front and rear of all reporting trains.

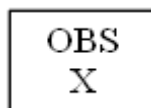
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I	WS O OCS O		
NOTE – after having initialized the train location (REQ_5.1.2.1.1#1 or, REQ_5.1.2.1.1#2 or, REQ_5.1.2.1.1#3 or, REQ_5.1.2.1.1#4 or REQ_5.1.2.1.1#6) the travel distance is measured using input information from UGTMS onboard sensors (e.g. odometers, radar sensors, accelerometers, etc.), – to keep the travel distance within acceptable accuracy it can be corrected whilst the train is passing over SPTS wayside devices, – the train location is transmitted to WS, and possibly to OCS.					

**[REQ_5.1.2.1.4#2]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall take into account inaccuracies in determining location for reporting trains.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				



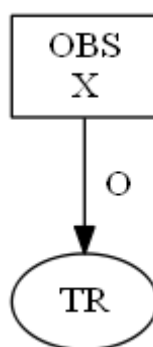
[REQ_5.1.2.1.4#3]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall immediately stop the train by applying the emergency brake when it has detected a train localisation failure for reporting trains.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				TR O

NOTE An example of train location failure is the failure of UGTMS sensors (e.g. odometer).



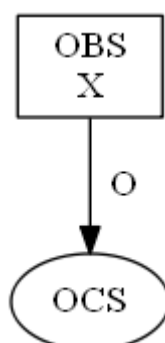
[REQ_5.1.2.1.4#4]

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

UGTMS shall provide the information about the train location failure of reporting trains to the interface with the operations control HMI and with the external train HMI. (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X		OCS O		

NOTE The output to OHMI is provided either by REQ_6.5.1#2 or REQ_6.5.1#3.
The output to THMI is provided by REQ_6.5.2#1.

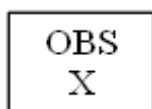


[REQ_5.1.2.1.4#5]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Following loss of train localisation, UGTMS shall re-initialise train location.

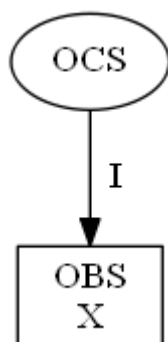
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				
NOTE See REQ_5.1.2.1.1#3.					

**[REQ_5.1.2.1.4#6]**

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Following recovery from loss of train localisation, if there is no longer a condition for triggering the emergency brake (recovery of location or driving mode permitting re-initialisation), UGTMS shall release the emergency brake provided by a safety related command via the interface with the external train HMI or via the interface with the operations control HMI.

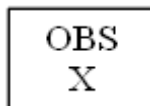
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	OCS I			
NOTE The processing is done by OBS with inputs coming from: – OCS via an operator command (the input from OHMI is provided by REQ_6.5.1#3), – or THMI provided by REQ_6.5.2#1.					

**[REQ_5.1.2.1.4#7]**

{ GOA1: O; GOA2: O; GOA3: O; GOA4: O }

UGTMS shall provide train location status to the interface with the external train HMI. (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				
NOTE The output to THMI is provided by REQ_6.5.2#1.					



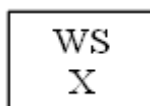
[REQ_5.1.2.1.4#8]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Following the loss of train location status of a reporting train, UGTMS shall determine the area where the concerned train is and set the corresponding zone(s) of protection.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X				

NOTE See the REQ_5.1.4.4#1 for the setting of ZOP.



[REQ_5.1.2.1.4#9]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

In the event of the detection of a parted reporting train, UGTMS shall determine the areas where the parts of the parted train are and set the corresponding zone(s) of protection.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
A	WS X2 OBS X1	OBS I2	WS O1	TR I1	
B	WS X4 OBS X3	OBS I4	WS O3		

This requirement can be implemented in two ways.

Option A: the parted status is provided by the Train (but not its HMI) from the couplers.

NOTE 1 An input I1 from TR about its parted status is transmitted to OBS.

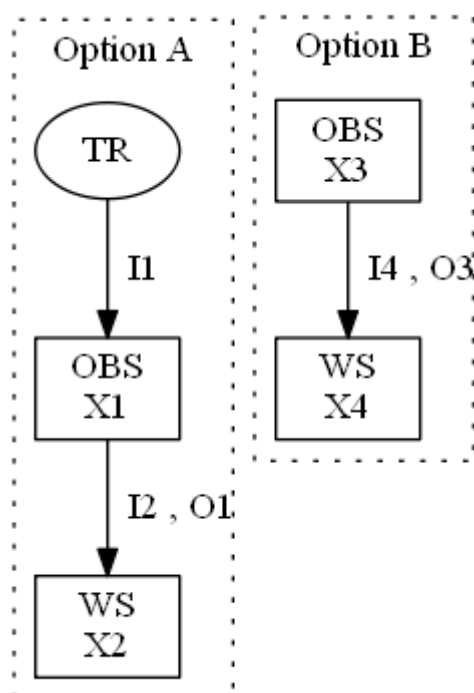
OBS is forwarding this information O1 to WS.

NOTE 2 WS is setting the ZOP (see the REQ_5.1.4.4#1).

Option B: the parted status is determined by OBS.

NOTE 3 OBS determines the parted status on its own, and sends this information to WS.

NOTE 4 WS is setting the ZOP (see the REQ_5.1.4.4#1) when receiving I4 from OBS about the parted status.



FCN 5.1.2.2 – Locate non-reporting trains by track sections

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

Mandatory: all GOAs if external train detection devices are used by UGTMS

[REQ_5.1.2.2#1]

{ GOA1: M; GOA2: M; GOA3: M; GOA4: M }

UGTMS shall determine if a section of track is occupied by non-reporting trains based on inputs received from external devices.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I	

