



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 62290-3:2025. It is identical to IEC 62290-3:2025. It supersedes BS EN IEC 62290-3:2019, which will be withdrawn on 31 May 2028.

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 committee manager.

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Railway applications - Urban guided transport management and
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specification
(IEC 62290-3:2025)

Applications ferroviaires - Systèmes de contrôle/commande
et de gestion des transports guidés urbains - Partie 3:
Spécification des exigences système
(IEC 62290-3:2025)

Bahnanwendungen - Betriebsleit- und
Zugsicherungssysteme für den städtischen
schienengebundenen Personennahverkehr - Teil 3:
Systembezogene Anforderungsspezifikation
(IEC 62290-3:2025)

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European Committee for Electrotechnical Standardization
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European foreword

The text of document 9/3168/FDIS, future edition 2 of IEC 62290-3, prepared by TC 9 "Electrical equipment and systems for railways" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62290-3:2025.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2026-05-31 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2028-05-31 document have to be withdrawn

This document supersedes EN IEC 62290-3:2019 and all of its amendments and corrigenda (if any).

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Endorsement notice

The text of the International Standard IEC 62290-3:2025 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.cencenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 62290-1	2025	Railway applications - Urban guided transport management and command/control systems - Part 1: System principles and fundamental concepts	EN IEC 62290-1	2025
IEC 62290-2	2025	Railway applications - Urban guided transport management and command/control systems - Part 2: Functional requirements specification	EN IEC 62290-2	2025

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	9
2 Normative references	9
3 Terms, definitions and abbreviated terms	10
3.1 Terms and definitions.....	10
3.2 Abbreviated terms.....	10
4 UGTMS system architecture and non-functional requirements	11
4.1 Overall system architecture.....	11
4.2 Hypotheses for UGTMS architecture	12
4.3 General description of UGTMS subsystems	13
4.3.1 General	13
4.3.2 UGTMS wayside subsystem (WS).....	13
4.3.3 UGTMS onboard subsystem (OBS).....	13
4.3.4 UGTMS spot transmission subsystem (SPTS)	13
4.3.5 UGTMS data communication subsystem (DCS)	14
4.3.6 UGTMS operation control subsystem (OCS)	14
4.4 External equipment in the UGTMS environment.....	14
4.4.1 General	14
4.4.2 Infrastructure related equipment (INF)	14
4.4.3 Trackside signalling related equipment (TSE)	15
4.4.4 Station related equipment (SE).....	15
4.4.5 External interlocking related equipment (EIXL)	15
4.4.6 Traction power control system related equipment (TPCS).....	15
4.4.7 Maintenance system related equipment (MS).....	16
4.4.8 Operations control HMI related equipment (OHMI).....	16
4.4.9 Operation planning system related equipment (OPS).....	16
4.4.10 Voice communication system related equipment (VCS)	16
4.4.11 CCTV surveillance system related equipment (CSS).....	16
4.4.12 Passenger information system related equipment (PIS)	17
4.4.13 Train related equipment (TR).....	17
4.4.14 Train HMI related equipment (THMI).....	17
5 UGTMS rail network description	18
5.1 General.....	18
5.2 Line section	18
5.3 Track segment	19
5.4 Connecting rules between track segments	20
5.5 Structure and content of the configuration data related to the rail network description	20
6 Requirement allocation and description	21
6.1 Functional and non-functional requirement allocation to UGTMS subsystems	21
6.1.1 General principles	21
6.1.2 Allocation of functional requirements from IEC 62290-2:2024	23
6.2 Summary of allocated functions and subfunctions from IEC 62290-2.....	251
6.3 Identification of interfaces for the UGTMS subsystems	259
6.3.1 General	259

6.3.2	Identification of interfaces between UGTMS subsystems	259
6.3.3	Interfaces between UGTMS subsystems and the environment	266
Bibliography		267
Figure 1 – The three-step process followed by the UGTMS standard		7
Figure 2 – UGTMS system environment (as defined in IEC 62290-1)		11
Figure 3 – UGTMS system architecture, external systems and external interfaces		12
Figure 4 – UGTMS concept of line section		19
Figure 5 – UGTMS track segment definition		19
Figure 6 – UGTMS track segment chaining		20
Figure 7 – Example for the description of 6.1.2		22
Table 1 – Summary of allocated functions and subfunctions from IEC 62290-2:2024		252
Table 2 – Identification of interfaces between UGTMS subsystems		260
Table 3 – Interfaces between UGTMS subsystems and the environment		266

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**RAILWAY APPLICATIONS – URBAN GUIDED TRANSPORT
MANAGEMENT AND COMMAND/CONTROL SYSTEMS –****Part 3: System requirements specification****FOREWORD**

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

This second edition cancels and replaces the first edition published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the last maintenance of IEC 62290-1 is taken into account, in particular the changes made for describing the external environment of UGTMS;
- b) the last maintenance of IEC 62290-2 is taken into account, as IEC 62290-3 is using the requirements defined in the latter. Therefore, the document reflects the deleted functions and requirements in IEC 62290-2, and also the new functions and requirements.

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

Draft	Report on voting
9/3168/FDIS	9/3199/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

For a better readability of the text, some elements of subclause 6.1.2 are in italic and bold characters to highlight the headlines of the functional tree of IEC 62290-2 (to avoid any confusion for the reader with the numbering of clauses and subclauses of IEC 62290-3), whose order and hierarchy is followed to do the allocation of requirements from this document IEC 62290-2. The mention of applicability depending on GOA of some functions having a condition to be mandatory is provided in bold characters.

Moreover, again for a question of a better readability of the text, the titles of the *functional tree of IEC 62290-2 standard are prefixed with "FCN"*.

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 document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The IEC 62290 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.

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.

The IEC 62290 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 objectives of this series are as follows:

- to provide a baseline system description and functional requirements specification for a transport authority to use in a request for proposal;
- to provide recommendations for those transport authorities wishing to acquire an interoperable or interchangeable system.

It is the responsibility of the transport authority concerned to decide on how to apply the IEC 62290 series and to take into account their particular needs.

The 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.

The IEC 62290 series defines a catalogue of UGTMS requirements split into mandatory and optional functions. The functions used are based on the given grade of automation. Most of the functions characterized as mandatory are considered with no condition. Some specific functions have a condition to be mandatory (this condition being generally related to the use of an external equipment by UGTMS). 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 the IEC 62290 series.

According to IEC 62278, it is the responsibility of the transport authority 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 are determined by a specific risk analysis.

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

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

- IEC 62290-1, "System principles and fundamental concepts", provides an introduction to the IEC 62290 series and deals with the main concepts, the system definition, the principles and the basic functions of UGTMS.

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

- IEC 62290-2, "Functional requirements specification", specifies the functional requirements associated to the basic functions provided by IEC 62290-1, within the system boundaries and interfaces as defined in IEC 62290-1:2024, Figure 3.

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. manage stabling). Requirements of functions have the same allocation, unless they are marked otherwise.

- IEC 62290-3, "System requirements specifications", deals with the architecture of the system and the allocation of the requirements and functions identified in IEC 62290-2 to UGTMS equipment.

The SRS (system requirement specification) specifies the architecture of a UGTMS system, with mandatory and optional UGTMS equipment.

- IEC 62290-4¹, "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 UGTMS equipment identified in IEC 62290-3.

For interfaces between UGTMS equipment, 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 structure of IEC 62290-4 will be established to accommodate optional and mandatory UGTMS equipment, and to reflect local conditions. In principle, only one FIS or 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.

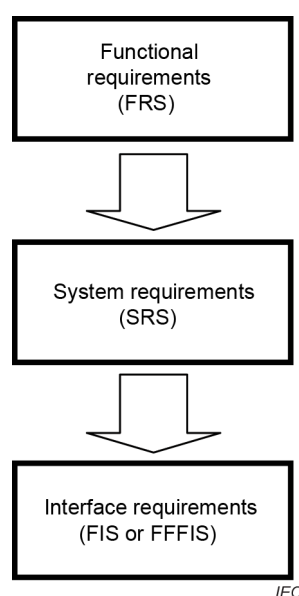


Figure 1 – The three-step process followed by the UGTMS standard

¹ Under consideration.

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 transport authorities to be assured that generic applications delivered by different suppliers will cover at least the same functionality as specified in this document.

Requirements which are established by the IEC 62290 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, and
- localisation by onboard UGTMS equipment (reporting trains), and optionally by external wayside (and optionally onboard) device.

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 can 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 62290-1:2024, *Railway applications – Urban guided transport management and command/control systems – Part 1: System principles and fundamental concepts*

IEC 62290-2:2024, *Railway applications – Urban guided transport management and command/control systems – Part 2: Functional requirements specification*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

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

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

3.1.1

run type

predefined speed profile which is managed at OCS level

EXAMPLE Energy saving profile, minimum run time.

3.2 Abbreviated terms

CSS	CCTV surveillance system
DCS	UGTMS data communication subsystem
EB	emergency braking
EIXL	external interlocking
FCN	function
HVCB	high voltage circuit breaker
INF	infrastructure
MS	maintenance system
OBS	UGTMS onboard subsystem
OCS	UGTMS operations control subsystem
OHMI	operations control HMI
OPS	operation planning system
PIS	passenger information system
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
VCS	voice communication system
WS	UGTMS wayside subsystem
ZOP	zone of protection

4 UGTMS system architecture and non-functional requirements

4.1 Overall system architecture

Clause 4 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, highlighting external interfaces with this environment and internal interfaces between UGTMS equipment.

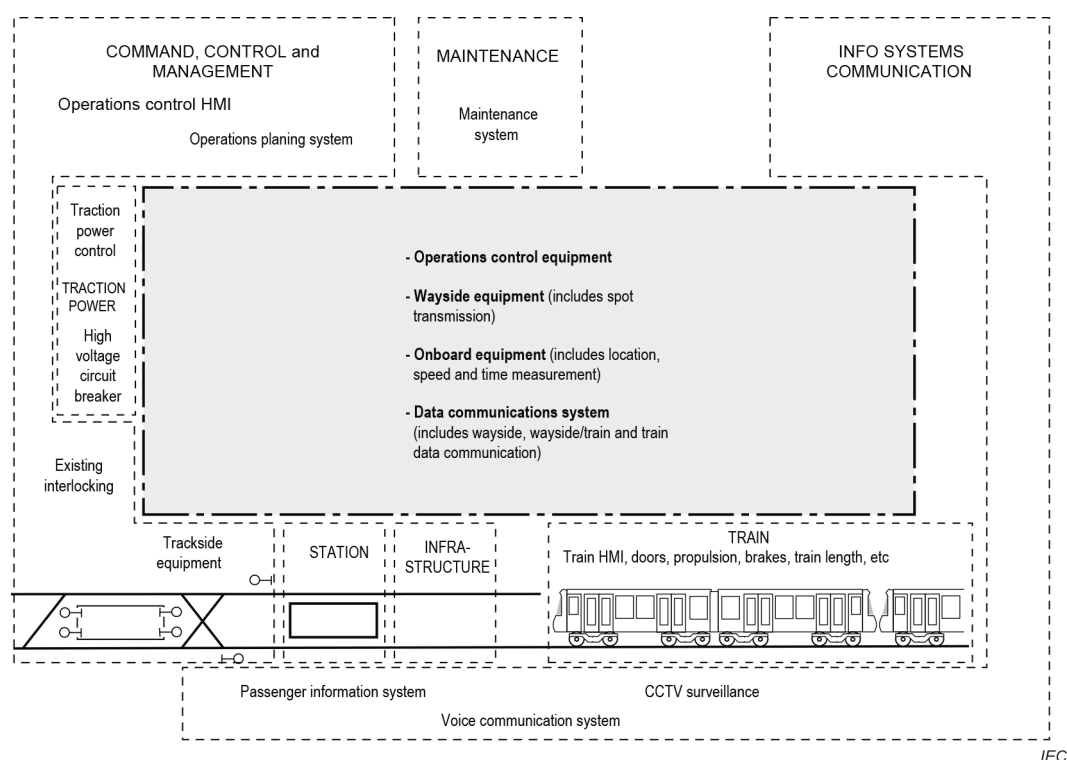


Figure 2 – UGTMS system environment (as defined in IEC 62290-1)

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.

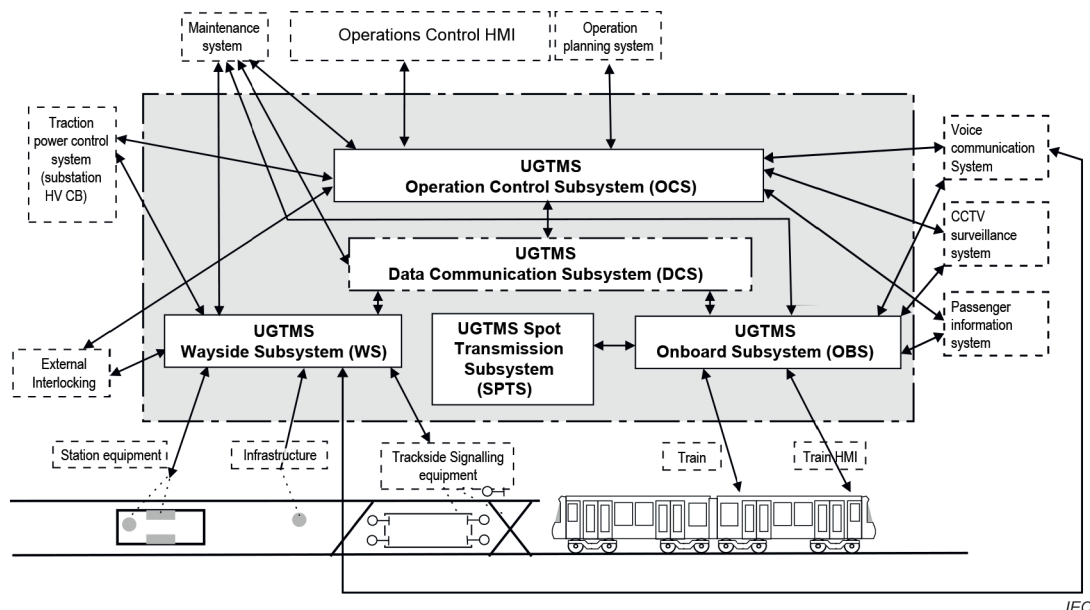


Figure 3 – UGTMS system architecture, external systems and external interfaces

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 4.4, in 6.1 and 6.3.

It has to be noted as well that the allocation work done in Clause 6 has permitted the identification of potential communication links for external equipment through the DCS, but the document does not cover all of these communication links.

Hypotheses [H1], [H2] and [H3] in 4.2 have been applied for the determination of this system architecture.

4.2 Hypotheses for UGTMS architecture

Subclause 4.2 describes the major choices identified in this document 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, 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, 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.

4.3 General description of UGTMS subsystems

4.3.1 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.

4.3.2 UGTMS wayside subsystem (WS)

The UGTMS wayside subsystem consists of UGTMS wayside equipment not related to the spot transmission subsystem.

The equipment included in the UGTMS wayside subsystem performs the following main functions:

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

4.3.3 UGTMS onboard subsystem (OBS)

The UGTMS onboard subsystem consists of UGTMS onboard equipment not related to the spot transmission subsystem.

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

- determine the train location;
- ensure that the train proceeds safely in accordance with its movement authority and permitted speed;
- drive and control the train automatically;
- interface with the spot transmission subsystem.

4.3.4 UGTMS spot transmission subsystem (SPTS)

The UGTMS spot transmission subsystem interfaces with the OBS to provide data from the wayside which is unique to a guideway location.

An example of this system is a transponder interrogator on the train and transponders on the track. Static devices on the track that can be accurately read with an onboard camera can also be considered as STPS.

The UGTMS spot transmission subsystem performs synchronisation of train location.

4.3.5 UGTMS data communication subsystem (DCS)

The UGTMS data communication subsystem provides data communication within UGTMS.

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

It is made up of a wayside related part, the wayside data communication network, an onboard part, the onboard data communication network, and the radio data communication network making the connection between these two parts.

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.

4.3.6 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.

4.4 External equipment in the UGTMS environment

4.4.1 General

These external devices as shown on Figure 3 have been defined accordingly with IEC 62290-1:2024, Figure 3.

For external devices which are described in 4.4.2 to 4.4.14, depending on choices of options made by applying IEC 62290-2, the corresponding clauses in this document are applicable or not.

For instance, if an application of IEC 62290 does not consider the interface with the external voice communication system, then 4.4.10 is not applicable, and everything in relation with such an interface in the rest of this document is also not applicable.

4.4.2 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,
- washing machines,
- flood gates or blasting doors, and
- emergency exits.

4.4.3 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.

4.4.4 Station related equipment (SE)

The devices concerned are those installed in stations.

The devices that are covered by this category are:

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

4.4.5 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, for example 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.

4.4.6 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.

4.4.7 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.

4.4.8 Operations control HMI related equipment (OHMI)

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

Such equipment is located in the OCC, but can also be located locally in equipment rooms, or be portable with a wireless connection.

4.4.9 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 the duty roster (see [H4] in 4.2).

4.4.10 Voice communication system related equipment (VCS)

This is a system whose equipment is located at the OCC, or on the platform, and at other locations within a station or possibly along the track, or onboard a train.

This system includes the emergency call devices for instance.

This system allows staff to talk with passengers and staff to communicate with other staff, wherever they are.

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

4.4.11 CCTV surveillance system related equipment (CSS)

The concerned devices are those installed at the OCC, along the track and in the stations (both in platforms, technical rooms and other station's rooms), or onboard vehicles. This system allows the display, elaboration, transmission and recording of real-time videos for a real-time surveillance (monitoring and storing for additional processing) ensuring passengers' security and safety.

The use of it is basically for the OCC staff, but also possibly the train operator.

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

4.4.12 Passenger information system related equipment (PIS)

The real-time passenger information can be displayed at platforms, in trains, concourses and ticket offices.

It may include the next station information, both predictions about arrival and departure times, as well as platform and train formation information. Onboard trains, it may also include predictions about arrival times and connections, as well as information about the nature and causes of disruptions.

4.4.13 Train related equipment (TR)

The devices that are covered by this category are the following (items listed in IEC 62290-1, Figure 3, "TRAIN" box):

- 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).

4.4.14 Train HMI related equipment (THMI)

The train HMI related equipment is to receive commands from train operator or staff, for instance about:

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

The train HMI related equipment provides information to train operator or staff, for instance about:

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

NOTE These commands and information items are extracted from statements of the REQ whose allocation includes a note with the expression "by REQ_6.5.2-1". The FCN 6.5.2 is "Manage the interface with the train HMI".

The external THMI covers all means intended for manual, visual, and audible interactions with operations staff onboard the train.

It could be made for instance via a combination of:

- screens,
- audible/visible indicators,
- dials,
- buttons,
- levers.

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.). The 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 5.2 to 5.5, 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 train).

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.

The configuration data related to the rail network description is structured according to the concepts of line sections and track segments described in 5.2 and 5.3.

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 or equivalent, 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.

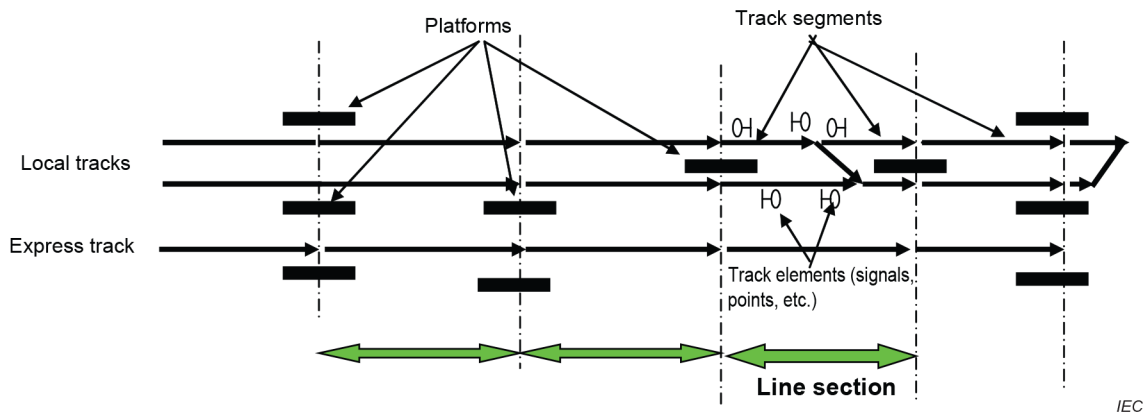


Figure 4 – UGTMS concept of line section

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, and
- an identity.

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

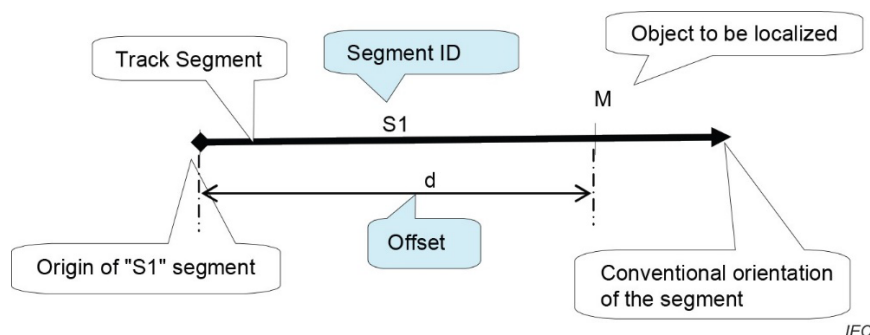


Figure 5 – UGTMS track segment definition

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).

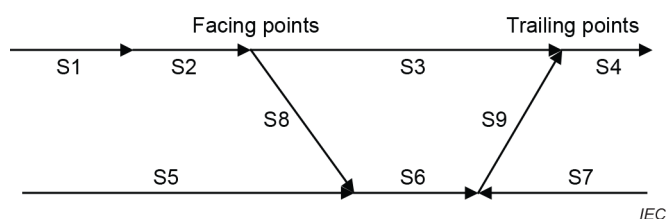


Figure 6 – UGTMS track segment chaining

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.

For each track segment, the configuration data contains 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 if 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 6.1.1 describes the allocation of functional and non-functional requirements to UGTMS subsystems.

It is structured according to the functional tree of IEC 62290-2 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:

- the requirement from IEC 62290-2 is given, with its associated applicability depending on the GOA, and on options,
- the column "Option" describes 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, and
- 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 is: when processing the allocation of a requirement from IEC 62290-2, 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 6.1.2 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") 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: y1; GOA2: y2; GOA3: y3; GOA4: y4}

Inserted here is the requirement to be performed by the subfunction, as stated in or derived from IEC 62290-2, and with the indications y1 to y4 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 WS X3	OCS I3	WS O2	TSE I2	

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.

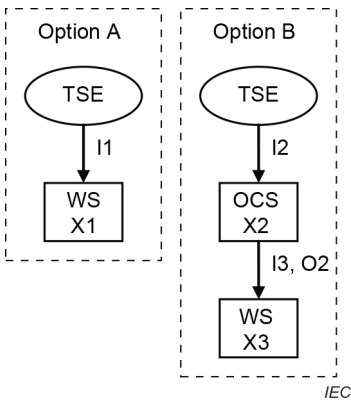


Figure 7 – Example for the description of 6.1.2

It has to be noted that every time, for each allocation done for requirements of IEC 62290-2, the part {GOA1: y1; GOA2: y2; GOA3: y3; GOA4: y4} applies at the requirement level. It says if the requirement as such applies for a given GOA.

When this requirement is described as mandatory for all GOAs, it means that we have a description {GOA1: M; GOA2: M; GOA3: M; GOA4: M}.

When this requirement is described as optional for all GOAs, it means that we have a description {GOA1: O; GOA2: O; GOA3: O GOA4: O}.

These situations for the two cases just above are simple ones, where the part {GOA1: y1; GOA2: y2; GOA3: y3; GOA4: y4} directly reflects the text of IEC 62290-2.

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For the situation when the requirement belongs to a function which is not applicable for a GOA, then it has to be reflected in {GOA1: y1; GOA2: y2; GOA3: y3; GOA4: y4}. For instance, if a function is not applicable for GOA1, a mandatory requirement in IEC 62290-2 means we reflect it with {GOA1: n/a; GOA2: M; GOA3: M; GOA4: M}.

The last situation to consider for {GOA1: y1; GOA2: y2; GOA3: y3; GOA4: y4} is when a requirement of IEC 62290-2 has parts describing different options for GOA.

For instance, in the case of [REQ_5.1.2.1.4-4], "UGTMS shall provide the information about the train location failure of reporting trains to the interface

- with the external operations control HMI, and
- with the external train HMI. (M for GOA1, M for GOA2, O for GOA3, O for GOA4).",

it is reflected by {GOA1: M; GOA2: M; GOA3: M; GOA4: M}, because this requirement is mandatory for all GOAs at least for its 1st bullet point.

6.1.2 Allocation of functional requirements from IEC 62290-2:2024

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 62290-2:2024, 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

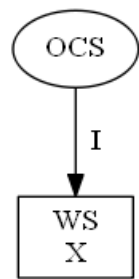
{GOA1: M; GOA2: M; GOA3: M; GOA4: M}

[REQ_5.1.1.1.1-1]

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

UGTMS shall set a route by manual command provided via the interface with the external operations control HMI or 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.					

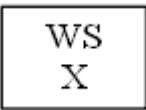


[REQ_5.1.1.1.1-2]

{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, for overlap, and when required, elements related to the protection of the infrastructure (e.g. flood gates, blast doors, rolling shutters).

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.					

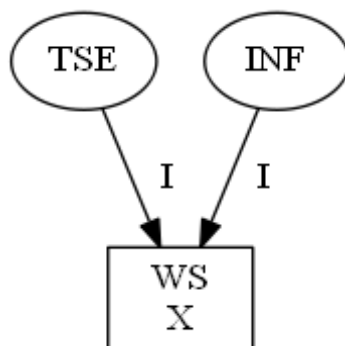


[REQ_5.1.1.1.1-3]

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

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

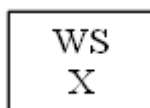
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I INF I	

**[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 blocked against route setting and not used by another route.

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

**[REQ_5.1.1.1.1-5]**

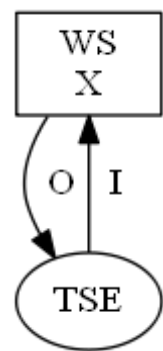
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[REQ_5.1.1.1.1-6]

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

In order to set the route, UGTMS shall move all its movable route elements to the desired position if they are 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.					

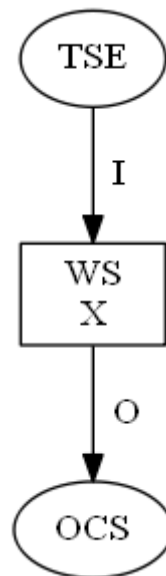


[REQ_5.1.1.1.1-7]

{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 external operations control HMI. (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 by REQ_6.5.1-2.					

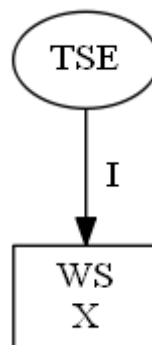
**[REQ_5.1.1.1.1-8]**

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

When all the route elements of the route are confirmed in the required position, the route is set, and UGTMS shall lock it.

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]**

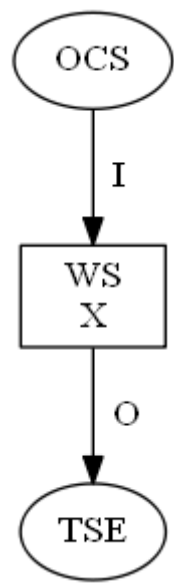
{GOA1: M; GOA2: M; GOA3: M; GOA4: M}

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

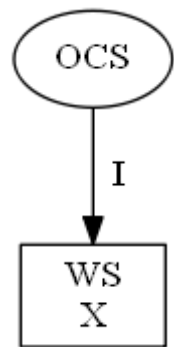


[REQ_5.1.1.1.1-10]

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

UGTMS shall block a movable route element against switching, or unblock, by command provided via the interface with the external 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

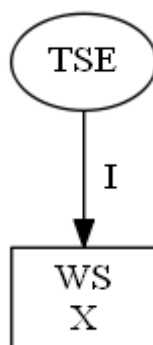
{GOA1: M; GOA2: M; GOA3: M; GOA4: M}

[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.

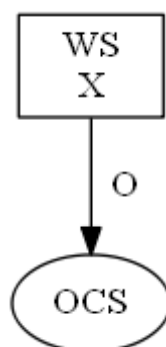
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I	
NOTE TSE I for checking position of route elements.					

**[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 external operations control HMI. (O)

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

**[REQ_5.1.1.1.2-3]**

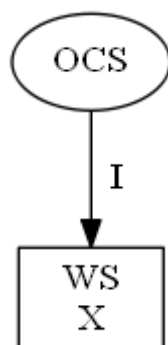
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[REQ_5.1.1.1.2-4]

{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 external operations control HMI. (O)

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



FCN 5.1.1.1.3 – Lock route by train

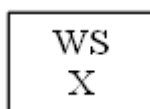
{GOA1: M; GOA2: M; GOA3: M; GOA4: M}

[REQ_5.1.1.1.3-1]

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

A route approach area longer than the operational braking distance shall be determined in front of a route origin.

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 beyond the route origin has been given to the 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.					

WS X

[REQ_5.1.1.1.3-3]

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

When the train has entered the route, the route shall be maintained as locked until conditions for releasing it are fulfilled (as described in 5.1.1.2).

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.					

WS X

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}

For automatic route release, UGTMS shall release a route element by element, by 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.					

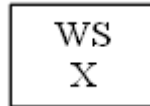
WS X

[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.					

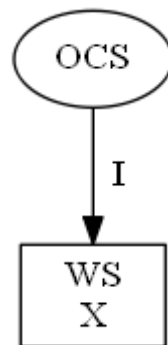


[REQ_5.1.1.2-3]

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

UGTMS shall allow route release by operational command provided via the interface with the external 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 external operations control HMI for a route that is locked, if no train is occupying the route and if it can be ensured that a train in the route approach area, if any, 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

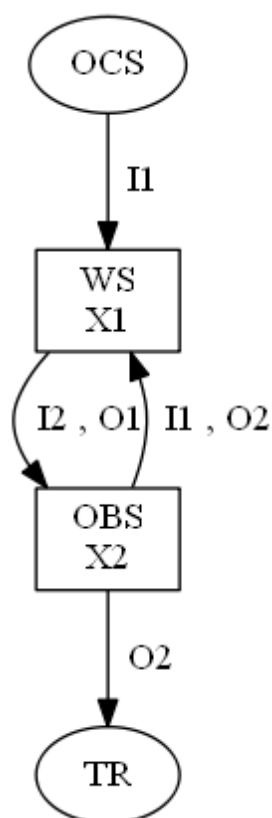
The processing is done by WS and OBS.

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 will not allow the release, as no guarantee 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 a confirmation I1 from OBS indicating whether it can ensure the train will stop 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 reports back to WS O2.

If OBS determines it can stop before the entrance of the route, it sends O2 to the train (but not its HMI) a request for braking.



[REQ_5.1.1.2-5]

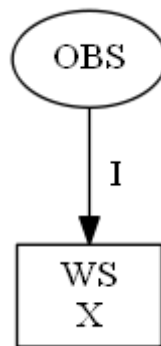
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[REQ_5.1.1.2-6]

{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

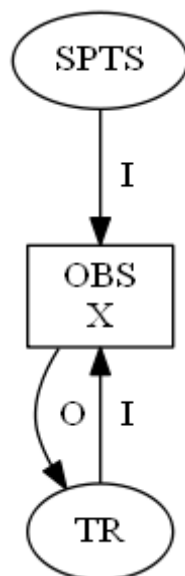
{GOA1: M; GOA2: M; GOA3: M; GOA4: M}

[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)

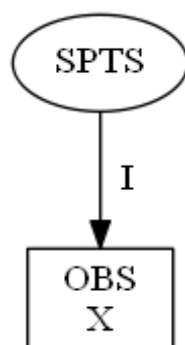
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I		TR I	TR O
NOTE OBS manages the awakening process through exchanges with the train (but not its HMI). OBS manages the initialization on its own, or optionally by using SPTS which provides the location through 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.

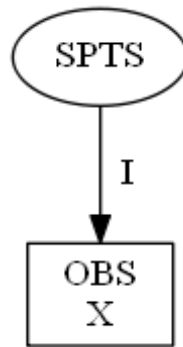
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I			
NOTE SPTS provides the location through dedicated wayside devices on UGTMS territory.					

**[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.					

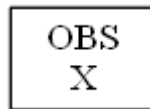


[REQ_5.1.2.1.1-4]

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

UGTMS shall determine the train length of reporting trains. (O for GOA1, O for GOA2, O for GOA3, M for GOA4)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				
NOTE The train length is provided by configuration data.					

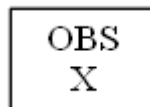


[REQ_5.1.2.1.1-5]

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

UGTMS shall allow manual input of train length data of reporting trains. (O for GOA1, O for GOA2, O for GOA3, not applicable for GOA4)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				
NOTE The input from THMI is provided either by REQ_6.5.2-1 or REQ_6.5.2-2.					

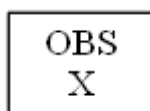


[REQ_5.1.2.1.1-6]

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

UGTMS shall allow initialisation of the train location for reporting trains through a movement of train under manual or automatic driving mode.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X				
NOTE See REQ_5.5.2-4 and REQ_5.5.2-5 for the manual driving mode management. See REQ_5.5.2-2 for the automatic driving mode management.					



FCN 5.1.2.1.2 – Determine train orientation

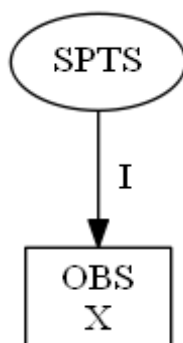
{GOA1: M; GOA2: M; GOA3: M; GOA4: M}

[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

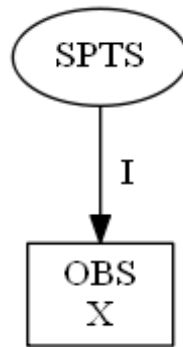
{GOA1: M; GOA2: M; GOA3: M; GOA4: M}

[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			



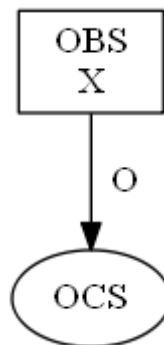
[REQ_5.1.2.1.3-2]

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

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

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

NOTE The output to OHMI is provided by REQ_6.5.1-2.



FCN 5.1.2.1.4 – Determine train location

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

[REQ_5.1.2.1.4-1]

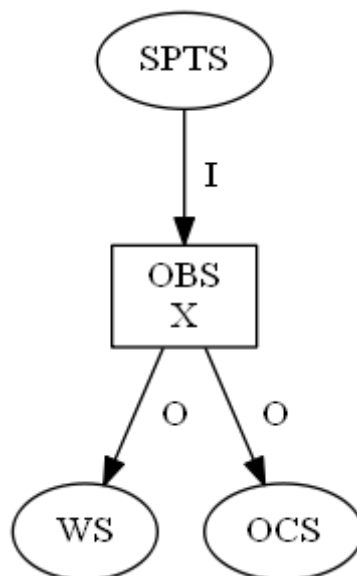
{GOA1: M; GOA2: M; GOA3: M; GOA4: M}

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

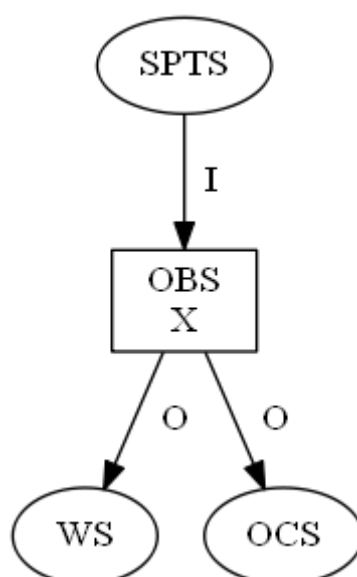
- After having initialized the train location (REQ_5.1.2.1.1-1 or REQ_5.1.2.1.1-2 or REQ_5.1.2.1.1-3 or REQ_5.1.2.1.1-4 or REQ_5.1.2.1.1-6) the travel distance is measured using input information from UGTMS onboard sensors (e.g. odometers, radar sensors, accelerometers, etc.).
- To keep the travel distance within acceptable accuracy, it can be corrected when a wayside SPTS device is detected.
- 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.

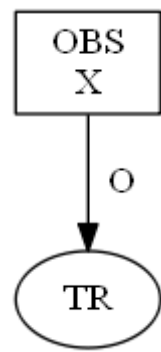
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	SPTS I	WS O OCS O		
NOTE The uncertainty can be provided as separate data or included in the location as described in REQ_5.1.2.1.4-1.					

**[REQ_5.1.2.1.4-3]**

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

UGTMS shall immediately stop the UGTMS train by applying the emergency brake when it has detected a train location failure.

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).					



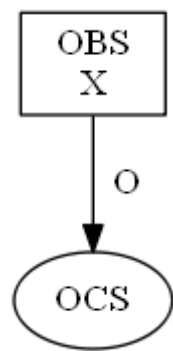
[REQ_5.1.2.1.4-4]

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

UGTMS shall provide the information about the train location failure of reporting trains to the interface

- with the external operations control HMI, and
- with the external train HMI. (M for GOA1, M for GOA2, O for GOA3, O for GOA4).

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X		OCS O		
NOTE The output to OHMI is provided by REQ_6.5.1-2. The output to THMI is provided by REQ_6.5.2-1.					



[REQ_5.1.2.1.4-5]

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[REQ_5.1.2.1.4-6]

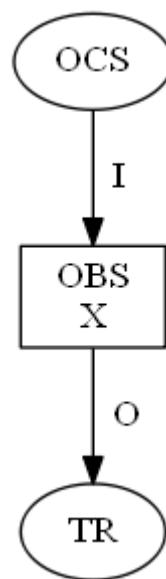
{GOA1: M; GOA2: M; GOA3: O; GOA4: O}

Following loss of train localisation, in order to permit re-initialisation of train localisation, UGTMS shall release the emergency brake after receiving a safety-related command via the interface

- with the external train HMI, (M for GOA1, M for GOA2, O for GOA3, O for GOA4), and
- with the external operations control HMI. (O)

NOTE 1 The application of such requirement is not mandatory for GOA3 and GOA4: this allows for the automatic release of the emergency brake, following a check done by UGTMS of conditions for making the release.

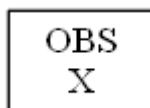
Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	OBS X	OCS I			TR O
NOTE The processing is done by OBS with inputs coming from – OCS via an operator command (the input from/output to OHMI is provided by REQ_6.5.1-3), or – THMI provided by REQ_6.5.2-2.					

**[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.					

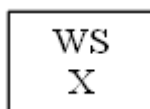


[REQ_5.1.2.1.4-8]

{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 optionally 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]

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FCN 5.1.2.2 – Locate non-reporting trains

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

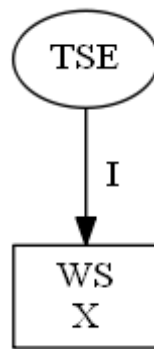
Mandatory: all GOAs if external train detection devices are used by UGTMS

[REQ_5.1.2.2-1]

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

UGTMS shall determine the location of non-reporting trains based on inputs received from external train detection devices.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X			TSE I	
NOTE The location of the reporting trains is provided to WS by REQ_5.1.2.1.4-1, this information being required in order to distinguish the occupation of non-reporting trains from reporting ones.					

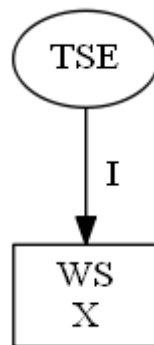
**[REQ_5.1.2.2-2]**

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

A track section shall be determined to be logically non-occupied only if an adjacent track section has been detected occupied before the considered track section has reported unoccupied. (O)

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

NOTE TSE I for adjacent track sections to be taken into account.

**FCN 5.1.3 – Determine permitted speed****FCN 5.1.3.1 – Determine static speed profile**

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

[REQ_5.1.3.1-1]

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

UGTMS shall determine the maximum permitted speed for all guideway locations.

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X1 OBS X2				

NOTE The maximum permitted speed for all guideway locations is actually pre-calculated (done offline), and then considered as a configuration data. These data are then used possibly by WS and/or OBS.



[REQ_5.1.3.1-2]

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

UGTMS shall allow the determination of different speed profiles for different types of trains and for different driving modes. (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
	WS X1 OBS X2				
NOTE The different speed profiles for different types of trains and for different driving modes are actually pre-calculated (done offline), and then considered as a configuration data. These data are then used possibly by WS and/or OBS.					



FCN 5.1.3.2 – Determine temporary infrastructure speed restrictions

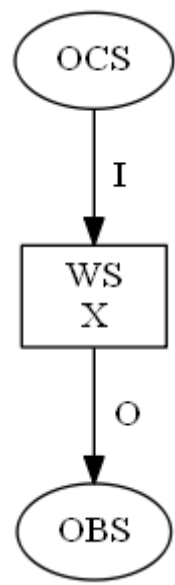
{GOA1: O; GOA2: O; GOA3: O; GOA4: O}

[REQ_5.1.3.2-1]

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

UGTMS shall set a zone of temporary speed restriction by operational command provided via the interface with the external operations control HMI, including a selected speed limit and the concerned area of the track.

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



[REQ_5.1.3.2-2]

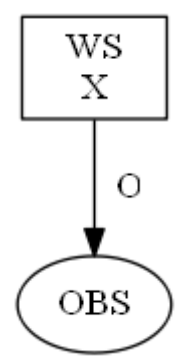
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[REQ_5.1.3.2-3]

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

In case several speed restrictions can be set at the same location, UGTMS shall enforce the lowest speed restriction.

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

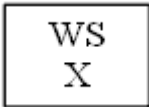


[REQ_5.1.3.2-4]

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

Setting a new temporary speed restriction shall not remove existing speed restrictions set at the same location. (O)

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



[REQ_5.1.3.2-5]

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

UGTMS shall automatically create speed restrictions based on statuses provided by external devices (e.g. bad weather detectors). (O)

Option	Processing	Internal inputs	Internal outputs	External inputs	External outputs
A	WS X1		OBS O1	TSE I1 SE I1 INF I1	
B	WS X3 OCS X2	OCS I3	WS O2 OBS O3	TSE I2 SE I2 INF I2	
This requirement can be implemented in two ways (the options defined for the allocation of this requirement are not design options decided for UGTMS, but resulting from the design of the external environment and how it is connected to UGTMS): Option A: NOTE 1 The sensors provide directly the inputs to WS. Option B: NOTE 2 The sensors provide the information to OCS, which defines the speed restriction to be created by WS. OCS sends this information to WS. NOTE 3 WS creates speed restrictions.					