

English Version

**Railway applications - Urban guided transport management and
command/control systems - Part 2: Functional requirements
specification
(IEC 62290-2:2025)**

Applications ferroviaires - Systèmes de contrôle/commande
et de gestion des transports guidés urbains - Partie 2:
Spécification des exigences fonctionnelles
(IEC 62290-2:2025)

Bahnwendungen - Betriebsleit- und
Zugsicherungssysteme für den städtischen
schienengebundenen Personennahverkehr - Teil 2:
Funktionale Anforderungsspezifikation
(IEC 62290-2:2025)

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European foreword

The text of document 9/3167/FDIS, future edition 3 of IEC 62290-2, 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 62290-2:2025.

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- latest date by which the national standards conflicting with the (dow) 2028-05-31 document have to be withdrawn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 62290-2:2014 and all of its amendments and corrigenda (if any).

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This document has been prepared under a standardization request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

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Endorsement notice

The text of the International Standard IEC 62290-2:2025 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.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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**Railway applications – Urban guided transport management and
command/control systems –
Part 2: Functional requirements specification**

**Applications ferroviaires – Systèmes de contrôle/commande et de gestion des
transports guidés urbains –
Partie 2: Spécification des exigences fonctionnelles**

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DỰ ÁN TIÊU CHUẨN TC2546

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RAILWAY APPLICATIONS – URBAN GUIDED TRANSPORT
MANAGEMENT AND COMMAND/CONTROL SYSTEMS –****Part 2: Functional requirements specification**

FOREWORD

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IEC 62290-2 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways. It is an International Standard.

This third edition cancels and replaces the second edition published in 2014. This edition constitutes a technical revision.

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

- a) the functions 5.1.4.5 Stopping a train en route, 5.1.5.4 Monitor speed limit at discrete location, 5.5.5 Manage UGTMS transfer tracks, 5.6.4.1 Monitor passenger emergency calls and 6.2.4 Ensure connecting services have been deleted;
- b) the functions 5.5.11 Manage train washing, 5.5.12 Manage non-stopping areas and 6.3.4 Perform progressive shutdown have been added;

- c) many of the requirements have been reworded: changes in their wording could be only minor and editorial, or it could have technical consequences;
- d) some requirements of the second edition have been moved from one function/subfunction to another;
- e) some requirements have been deleted;
- f) some new requirements have been added in the existing functions;
- g) an informative annex giving the reader some user's recommendations about this document has been added;
- h) another informative annex giving some typical performance-related criteria has been also added.
- i) an informative annex providing a summary of applicability of functions and subfunctions (mandatory or optional) depending on GOA has been added.

In order to avoid any disturbance in the use of the document, when functions or requirements of IEC 62290-2:2014 have been deleted, their numberings have been kept on purpose in this document. The expression "Deleted" is indicated at the place of the former headlines of the deleted functions, or at the place of the wording of the deleted requirements. Therefore, the impacts on any existing references or traceability matrices defined previously to this third edition is limited as much as possible.

For readability of the text, just below the headline of functions and subfunctions describing requirements, the description of applicability of this function depending on GOAs is given in bold characters.

For the same reason of readability, some elements of Annex A are in italic and bold characters, when some extracts of the main part of the document are considered for providing additional information to the reader, oriented for the proper use of the document.

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

Draft	Report on voting
9/3167/FDIS	9/3198/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.

A list of all parts in the IEC 62290 series, published 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.

DỰ ÁN TIÊU CHUẨN TC2546

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 main 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) 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.

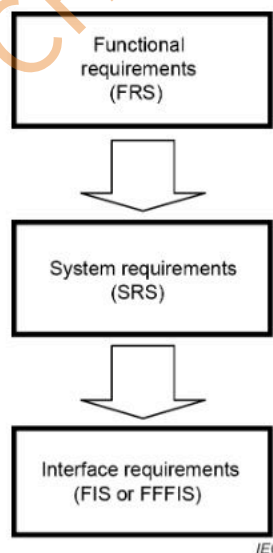


Figure 1 – Three-step process followed by the UGTMS series

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.

DỰ ÁN TIÊU CHUẨN TC2546

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

Part 2: Functional requirements specification

1 Scope

This part of IEC 62290 specifies the functional requirements of UGTMS (urban guided transport management and command/control systems) 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 of trains by onboard UGTMS equipment (reporting trains), and optionally by external wayside (and optionally onboard) device.

In this document, the functional requirements set the framework to which detailed functions are added to define any generic or specific application.

Because of that, although this document is applicable as a basis to define SRS, FIS and FFFIS, elements can be added for a generic or specific application.

NOTE The functional breakdown in this document is consistent with basic functions in IEC 62290-1:2024, Table 1. These basic functions have been refined in this document into a more complete and detailed tree, and the "mandatory/optional" attributes of their subfunctions can be different with those given in IEC 62290-1:2024, Table 1. The functional breakdown which follows Clause 1 is the reference one for the IEC 62290 series.

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*

3 Terms, definitions and abbreviated terms

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

4 Operational concept

4.1 Organisation of operation for urban guided transport

Using infrastructure (guideway and its elements) and trains, the organisation of operation for public transport is structured generally into the following tasks (see Figure 2):

- planning operation (offices for planning operation including timetable, train and staff resources), which is out of the scope of this document;
- operations management and supervision (operations control centre) as described in Clause 6;
- executing train operations, as described in Clause 5;
- maintenance for all facilities and equipment of the transport system, especially infrastructure, trains, UGTMS equipment. Maintenance is out of the scope of this document, but UGTMS supports maintenance as described in 6.9.

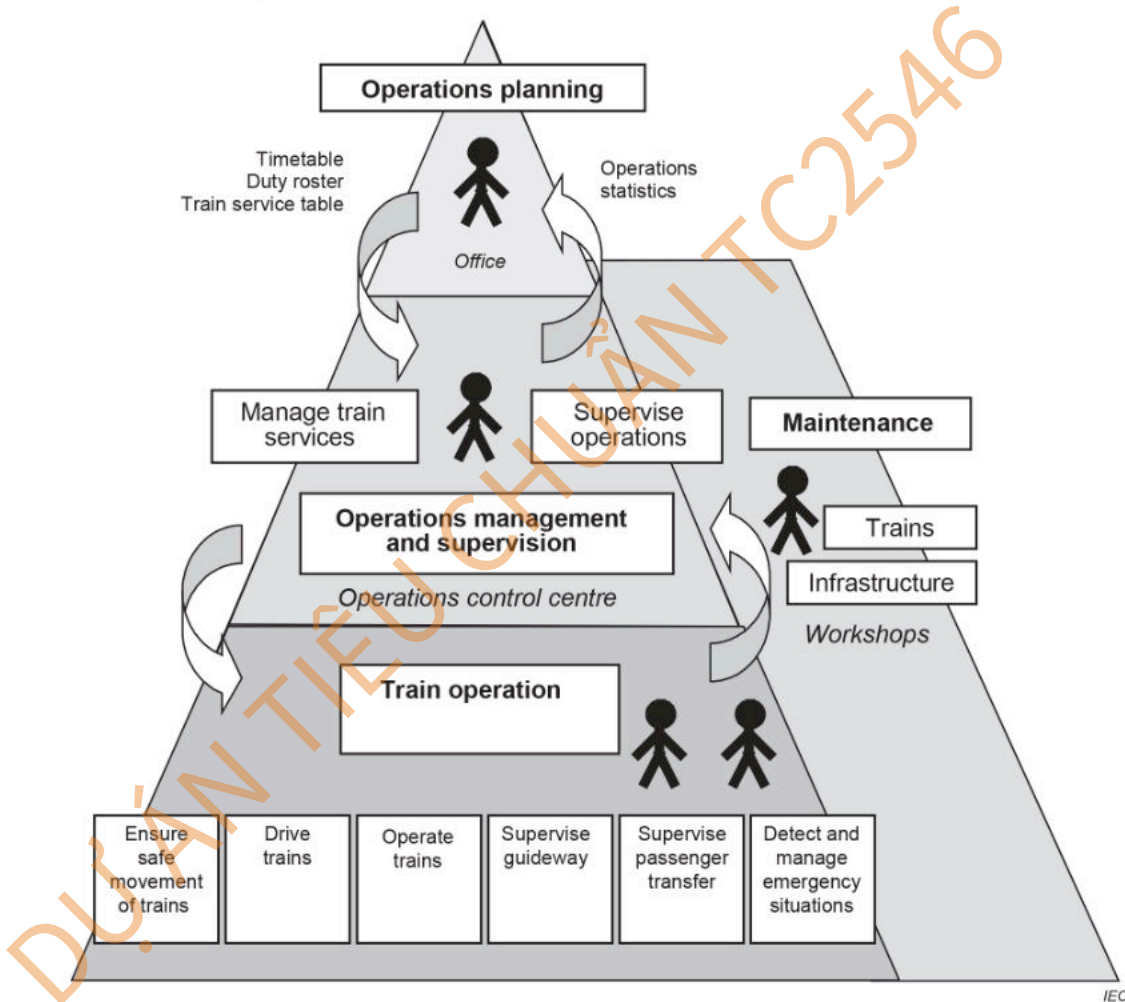


Figure 2 – Organisation of operation

This operations organisation hierarchy provides an overview of UGTMS functions of this document. Train operations are enabled by command-control equipment situated both at the wayside and onboard, which interfaces to the operations control centre (OCC) equipment. Operation management and supervision is carried out from the OCC which provides also the interface to the external operations control HMI to operate and display all functions required by UGTMS.

The task of operations planning contains all necessary measures to prepare operation.

Operations planning provides the operations management and supervision level with all necessary information to execute train operation. Operations management and supervision provides information to operations planning level to enable adjustment of the planning process for operational needs.

Operations management and supervision include all measures which are necessary to ensure operations in normal, perturbed, and failure situations.

The functions to be realised on this level are described in Clause 6.

4.2 Basic operational principles

UGTMS can be applied to a wide range of urban guided transport systems, and the specific UGTMS operational requirements for a given application depend on the required grade of automation. Nevertheless, the following basic operational principles apply for all UGTMS applications.

UGTMS has precise knowledge of the limits of UGTMS territory, which can include both mainline and depot tracks.

UGTMS includes the capability to perform verification checks of the UGTMS onboard equipment prior to entering UGTMS territory. The checks should be performed sufficiently in advance of entry into UGTMS territory to verify the proper operation of the UGTMS onboard equipment, including any UGTMS wayside equipment dependencies.

Under normal circumstances, it should not be necessary for a train to come to a stop when entering or exiting UGTMS territory, unless required for other safety or operational reasons.

UGTMS trains can include passenger trains, non-passenger trains and maintenance trains, and different functional requirements may apply to the different types of train. For example, non-passenger trains and maintenance trains are normally not required to stop at passenger stations on the mainline.

UGTMS trains are capable of operating in various driving modes, depending on the grade of automation and on the operational status of the UGTMS onboard and wayside equipment.

UGTMS ensures a safe route, safe train separation and the safe speed of all UGTMS trains operating in UGTMS territory. Trains can be operated manually by a train operator, or automatically by UGTMS depending on the grade of automation. When operating automatically, some functions (such as door operation) may continue to be the responsibility of the train staff.

Non-operative UGTMS trains that are operating in UGTMS territory operate under the principles described in 4.6.

Commands from staff shall be provided via the interface with the external operations control HMI.

Systems are operated with or without a timetable, for example by using headway regulation only.

The basic system performances of UGTMS can vary, for instance depending on the needs for capacity, headways (see examples of typical system performance criteria in Annex B).

4.3 Principles to ensure safe route

The operational purpose of setting routes is to allow trains to travel to different destinations in the network.

UGTMS permits trains to be manually or automatically routed between any defined origin and destination in accordance with the train service requirements for the line, predefined routing rules, and any UGTMS user-directed service strategy. Where applicable to the specific track configuration, automatic routing supports the proper merging and diverging of trains at junctions, the turnback of trains, the movement of trains from/to depot areas, and the rerouting of trains in response to service disruptions or planned outages.

UGTMS ensures a safe route for all UGTMS trains in all grades of automation.

To prevent train collisions and derailments, train movement is not authorized until the route is set and locked. The route is locked prior to the train entering the route and route locking is maintained while the train is within the route. Routes can be released by manual commands or by movement of trains.

Ensuring a safe route is either a UGTMS function or an external function. In the latter case, an appropriate interface shall be provided.

4.4 Principles to ensure safe separation of trains

The required design and operating headways for the line are as specified by the transport authority. The design headway for a line involves many factors that are outside of UGTMS (e.g. track alignment, gradients, track speed limits, train acceleration and braking rates, station dwell times, terminal track configurations, train operator reaction times, etc.). These factors shall be specified by the transport authority. UGTMS factors contributing to achievable headways include accuracy of train location and train speed determination, resolution of movement authority limits for a given train, frequency at which location reports and movement authorities are updated, data communication delays, and UGTMS equipment reaction times for both UGTMS wayside and UGTMS onboard equipment.

UGTMS provides safe train separation assurance in all grades of automation based on the principle of an instantaneous stop of a preceding train.

To ensure safe train separation, UGTMS establishes an absolute movement authority limit for each train based on the determined location of the train ahead. This absolute movement authority limit represents the limit of movement protection for a following train, with appropriate consideration of the location margin of the preceding train, including location uncertainty and rollback tolerance.

4.5 Principles to ensure safe speed

UGTMS provides overspeed protection in all grades of automation to ensure that the train's actual speed does not exceed its safe speed. The safe speed is derived with consideration of both permanent and temporary speed limits within the train's movement authority as well as any permanent or temporary speed restrictions applicable to the train.

UGTMS ensures that a train does not travel beyond the train protection profile by supervising train movement along the authorized route to a defined target point (see Figure 3). The distance between the target point and movement authority limit is a variable safety distance, as determined by the safe braking model, to ensure that this limit is not exceeded. The safe braking model includes consideration of factors such as location inaccuracy of the following train, train length, allowable overspeed permitted by the UGTMS system, maximum speed measurement error, UGTMS reaction times and latencies, maximum train acceleration rate possible at the time an overspeed condition is detected by UGTMS, worst-case reaction times to disable the propulsion system and apply the emergency brakes following detection of an overspeed condition, and emergency brake rate, etc.

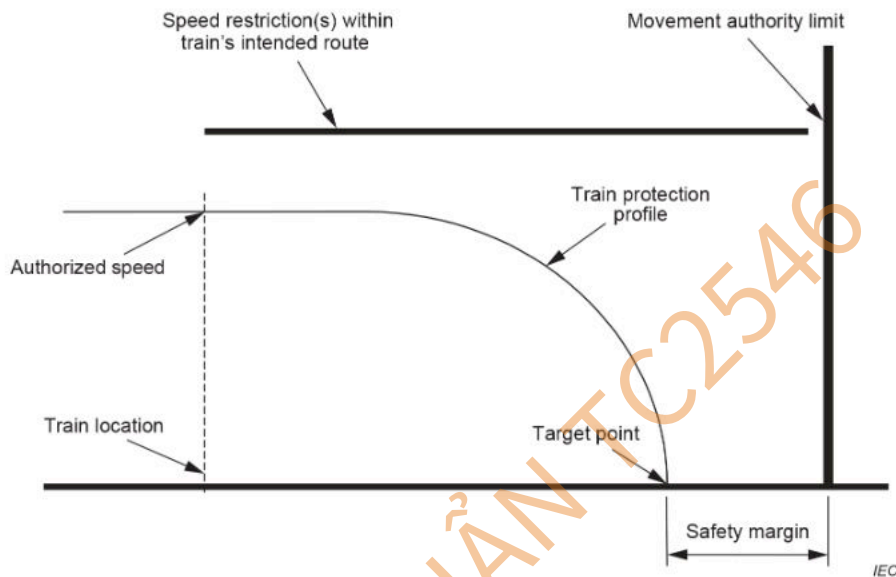


Figure 3 – Train protection profile and speed supervision

According to the safe braking model, any violation of the train protection profile will not result in the train exceeding the movement authority limit.

4.6 Degraded modes of train operation

It is a basic operational principle to continue to move trains with a level of safety potentially degraded in the event of UGTMS equipment failures, possibly at reduced operating speeds or increased operating headways when compared to normal train operations. As a consequence, UGTMS supports degraded modes of operation in the event of failure and continues to provide train protection with reliance on adherence to operating procedures. This is achieved through functional elements of UGTMS itself, through a separate non-UGTMS fall-back wayside signal system (if specified by the transport authority), or through application of the relevant operating procedures, or through a combination of operating procedures with one of the other two methods.

Degraded modes of train operation should take advantage of the functional capabilities of UGTMS in order to eliminate hazards to passengers and staff while continuing to provide passenger train service. Specifically, degraded modes of train operations in UGTMS territory should address those UGTMS equipment failures that affect all trains operating within a particular area of control or a particular train operating within any area of control.

The management of external sensors related to their failures, resetting or overriding is not handled by UGTMS.

For all functions of UGTMS a non-communicating UGTMS train or a train with inoperative UGTMS onboard equipment shall be handled in the same way as a non-equipped train.

5 Functions for train operation

Clause 5 contains all functions which are necessary for train operation to be provided by UGTMS.

Some of the following functions are mandatory, others are optional. A function's classification is indicated at the beginning of each clause/subclause and may be dependent on grade of automation.

Some specific functions have a condition for being mandatory: this is indicated at the beginning of the corresponding clauses/subclauses by using an expression giving the condition, such as "Mandatory: all GOAs if [...]".

Clause A.1 in Annex A can be considered for getting additional information about the way in which to use the document, with its mandatory or optional functions, having mandatory or optional requirements. Annex A gives advice about options in the document (e.g. possible mutual constraints and relationships between requirements).

Annex C provides a table summarizing the applicability of functions and subfunctions, depending on GOAs.

5.1 Ensure safe movement of trains

Ensuring safe movement of trains is achieved by

- ensuring a safe route for each train, which can be done internally (addressed in 5.1.1) or externally with an interface to an external interlocking (addressed in 5.1.6),
- determining the location of all trains and limits of safe train separation (addressed in 5.1.2),
- determining the actual train speed (addressed in 5.1.5.1) and the maximum allowable train speeds (addressed in 5.1.3),
- authorizing train movement in accordance with the movement authority limit and train protection profile (addressed in 5.1.4), and
- supervising train movement in accordance with the movement authority limit and train protection profile (addressed in 5.1.5).

5.1.1 Ensure safe route

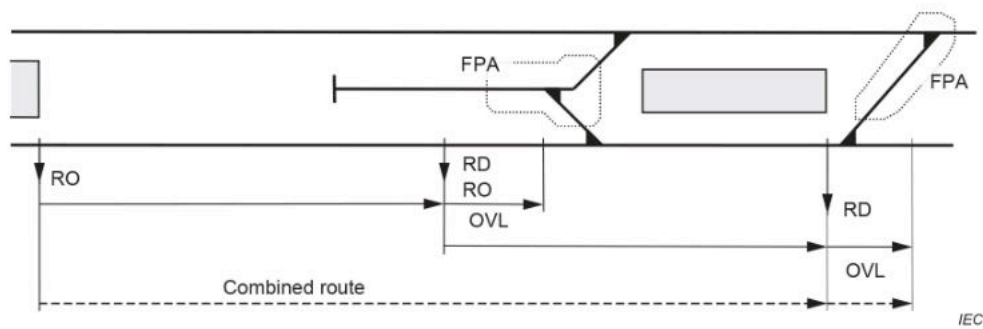
Mandatory: all GOAs if "Ensure safe route" functions are provided by UGTMS

Subclause 5.1.1 contains all functions necessary to command, control and check route elements, set, lock and release routes.

In order to prevent train collision and derailment, a route is to be considered as safe, if all requested elements of the guideway (called "route elements", e.g. points, track sections) are locked in the required position to prevent concurrent use by another train.

A safe route consists of one or more related route elements which are used for

- the area between route origin (RO) to route destination (RD),
- flank protection purposes, and
- the overlap (OVL).

**Key**

RO	route origin
RD	route destination
OVL	overlap
FPA	flank protection area

Figure 4 – Specification of a safe route

A route is seen by UGTMS as a combination of route elements with specified conditions. A route shall be described taking into account the following conditions:

- route origin as a location, where authorization to enter the route shall be given;
- route elements between route origin and route destination, which are to be traversed by the train;
- route elements of the overlap, which are used for safety reasons in case of deviations from an authorized train movement;
- route elements in the flank protection area, which avoid or detect unauthorized flank movement.

An overlap can be replaced by a following safe route building a combined route (see Figure 4).

Lock and release functionality is defined as follows:

Locking a route element means maintaining a route element as it is set.

Releasing a route element means unlocking a locked route element.

Locking a route means locking all route elements of the route.

Releasing a route means releasing all route elements of the route.

5.1.1.1 Set and protect route**5.1.1.1.1 Set route**

Mandatory: all GOAs

This function is intended to set manually a route by command provided via the external operations control HMI or automatically by UGTMS.

#REQ_5.1.1.1.1-1#

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

#REQ_5.1.1.1.1-2#

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).

#REQ_5.1.1.1.1-3#

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

#REQ_5.1.1.1.1-4#

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

#REQ_5.1.1.1.1-5#

Deleted.

#REQ_5.1.1.1.1-6#

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.

#REQ_5.1.1.1.1-7#

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)

#REQ_5.1.1.1.1-8#

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

#REQ_5.1.1.1.1-9#

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.

#REQ_5.1.1.1.1-10#

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

5.1.1.1.2 Supervise route**Mandatory: all GOAs**

This function is intended to supervise that all conditions for the route are still in place.

#REQ_5.1.1.1.2-1#

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

#REQ_5.1.1.1.2-2#

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

#REQ_5.1.1.1.2-3#

Deleted.

#REQ_5.1.1.1.2-4#

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

5.1.1.1.3 Lock route by train**Mandatory: all GOAs**

For a given set route, this function is intended to maintain the lock of the route

- for an approaching train for which the movement authority allows entry into the route, or
- if this train is within the route.

#REQ_5.1.1.1.3-1#

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

#REQ_5.1.1.1.3-2#

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.

#REQ_5.1.1.1.3-3#

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).

5.1.1.2 Release route

Mandatory: all GOAs

This function is intended to release a route and its elements.

#REQ_5.1.1.2-1#

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.

#REQ_5.1.1.2-2#

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

#REQ_5.1.1.2-3#

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

#REQ_5.1.1.2-4#

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.

#REQ_5.1.1.2-5#

Deleted.

#REQ_5.1.1.2-6#

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

5.1.2 Ensure safe separation of trains

This function is intended to determine the location of all trains and the limits of safe train separation.

5.1.2.1 Locate UGTMS reporting trains

This function is intended to locate reporting trains.

5.1.2.1.1 Initialise UGTMS reporting trains location

Mandatory: all GOAs

This function is intended to initialise the location of reporting trains which are

- awakened inside UGTMS territory, or
- entering UGTMS territory, or
- recovering from localisation failures.

#REQ_5.1.2.1.1-1#

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

#REQ_5.1.2.1.1-2#

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

#REQ_5.1.2.1.1-3#

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

#REQ_5.1.2.1.1-4#

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

#REQ_5.1.2.1.1-5#

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)

#REQ_5.1.2.1.1-6#

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

5.1.2.1.2 Determine train orientation

Mandatory: all GOAs

This function is intended to determine the physical orientation of the train relative to the defined orientation of the track.

#REQ_5.1.2.1.2-1#

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

5.1.2.1.3 Determine actual train travel direction

Mandatory: all GOAs

This function determines the actual travel direction of reporting trains.

#REQ_5.1.2.1.3-1#

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

#REQ_5.1.2.1.3-2#

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

5.1.2.1.4 Determine train location

Mandatory: all GOAs

This function is intended to determine the location of all UGTMS reporting trains according to the train orientation and train length.

#REQ_5.1.2.1.4-1#

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

#REQ_5.1.2.1.4-2#

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

#REQ_5.1.2.1.4-3#

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

#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).

#REQ_5.1.2.1.4-5#

Deleted.

#REQ_5.1.2.1.4-6#

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 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.

#REQ_5.1.2.1.4-7#

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

#REQ_5.1.2.1.4-8#

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.

#REQ_5.1.2.1.4-9#

Deleted.

5.1.2.2 Locate non-reporting trains

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

This function is intended to determine the location of non-reporting trains using external train detection devices.

If this function is not provided, strict adherence to operating procedures is recommended to protect the movement of non-operative UGTMS trains.

#REQ_5.1.2.2-1#

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

#REQ_5.1.2.2-2#

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)

5.1.3 Determine permitted speed

This function is intended to determine the safe speed taking into account permanent and temporary speed restrictions (wayside and train).

5.1.3.1 Determine static speed profile

Mandatory: all GOAs

This function determines the static speed profiles, which are based on infrastructure data such as track geometry and quality, infrastructure constraints (tunnels, bridges, platforms, etc.).

#REQ_5.1.3.1-1#

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

#REQ_5.1.3.1-2#

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

5.1.3.2 Determine temporary infrastructure speed restrictions

Optional: all GOAs

This function is intended to set and remove temporary speed restrictions for selected areas by operational commands or as result of system reactions.

#REQ_5.1.3.2-1#

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.

#REQ_5.1.3.2-2#

Deleted.

#REQ_5.1.3.2-3#

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

#REQ_5.1.3.2-4#

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

#REQ_5.1.3.2-5#

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

#REQ_5.1.3.2-6#

A temporary speed restriction set manually shall be released by safety-related command provided via the interface with the external operations control HMI.

#REQ_5.1.3.2-7#

A temporary speed restriction set automatically shall be released by safety-related command provided via the interface with the external operations control HMI if the external condition is no longer detected. (O)

#REQ_5.1.3.2-8#

When a temporary speed restriction is established, the status of the speed restriction including as a minimum the selected speed and covered zone shall be provided to the interface with the external operations control HMI. (O)

5.1.3.3 Determine maximum speed by train type

Optional: all GOAs

This function is intended to determine the maximum permitted speed for each type of train.

#REQ_5.1.3.3-1#

UGTMS shall determine the maximum permitted speed for each type of train.

5.1.3.4 Determine temporary train speed restrictions

Optional: all GOAs

This function is intended to determine temporary train speed restrictions due to train failures and to driving modes.

#REQ_5.1.3.4-1#

UGTMS shall determine speed restrictions based on train conditions detected and provided by the train (e.g. failures).

#REQ_5.1.3.4-2#

UGTMS shall determine speed restrictions based on the driving mode.

5.1.4 Authorize train movement

This function deals with

- the determination of movement authority limit by assignment of limits of safe route, limits of safe train separation and other limits (such as zone of protection),
- the determination of train protection profile by assignment of the movement authority limit and authorized speed, and
- the authorization of train movement by wayside signals.

If a train protection profile with permitted speed greater than zero is established, train movement shall be allowed up to next movement authority limit within its restrictions.

5.1.4.1 Determine movement authority limit

Mandatory: all GOAs

To ensure safe train movement, this function determines for each train its limit of movement authority, which corresponds to the position up to where the train can proceed safely.

#REQ_5.1.4.1-1#

UGTMS shall determine for each train the limit of its movement authority based on the most restrictive of the following:

- limit of safe route;
- limit based on safe train separation;
- limit based on the guideway (e.g. end of track);
- limit based on zones of protection;
- limit based on work zones.

#REQ_5.1.4.1-2#

In the event of a loss of safe route once a movement authority has been issued, UGTMS shall pull back the movement authority limit to the new limit of safe route.

#REQ_5.1.4.1-3#

In case a movement authority accepted by the train exceeds its validity period (e.g. due to data communication failure), UGTMS shall either

- pull back the movement authority limit to the first potential danger point ahead of the train, or
- stop the train immediately.

NOTE The characterization of what is a potential danger point is defined by the transport authority.

5.1.4.2 Determine train protection profile

Mandatory: all GOAs

This function determines the train protection profile for all trains to ensure their limits of movement authority and authorized speeds are never exceeded. The train protection profile terminates at a target point. The train protection profile shall be determined by the applicable safe braking model.

#REQ_5.1.4.2-1#

UGTMS shall determine the train protection profile for each UGTMS-operated train, taking into account the speed profiles, train and infrastructure parameters (e.g. gradients of track, track section lengths, locations of points), and the movement authority limit.

#REQ_5.1.4.2-2#

UGTMS shall allow a train protection profile with reduced or no safety margins in specific areas and at a speed sufficiently slow to reduce the consequences of a collision (shunting in depot, stabling areas, automatic coupling of train units, etc.). (O)

#REQ_5.1.4.2-3#

UGTMS shall calculate the speed limit that results from the most restrictive of all safety-related constraints applied to the UGTMS trains.

#REQ_5.1.4.2-4#

UGTMS shall enforce speed limits for the whole length of the train.

#REQ_5.1.4.2-5#

UGTMS shall authorize train movement for UGTMS-operated trains in accordance with the train protection profile when established.

5.1.4.3 Authorize train movement by wayside signals

Mandatory: all GOAs if wayside signals are used by UGTMS

This function is intended to authorize train movement by wayside signals if conditions of safe route and safe separation are fulfilled.

#REQ_5.1.4.3-1#

UGTMS shall control wayside signals in consistency with movement authorities and supervised routes.

#REQ_5.1.4.3-2#

UGTMS shall transmit the status information (e.g. "signal at danger", "failure status") received from each specific signal to the interface with the external operations control HMI. (O)

#REQ_5.1.4.3-3#

UGTMS shall ensure that the information given to control the wayside signal and the information provided to the interface with the external train HMI are consistent (M for GOA1, M for GOA2, O for GOA3, O for GOA4).

5.1.4.4 Determine a zone of protection**Mandatory: all GOAs**

This function is intended to set and remove zones of protection for selected areas by operational commands or as result of system reactions.

#REQ_5.1.4.4-1#

UGTMS shall automatically set a zone of protection based on input provided by external devices (e.g. emergency stop request from platform), if such external devices are used by UGTMS.

#REQ_5.1.4.4-2#

UGTMS shall apply a zone of protection created by operational command from the interface with the external operations control HMI.

#REQ_5.1.4.4-3#

UGTMS shall provide the zone of protection status, including the covered area and the reason, to the interface with the external operations control HMI.

#REQ_5.1.4.4-4#

UGTMS shall stop by emergency braking all trains present in the zone of protection, except, optionally, for the hazardous situations defined by the transport authority which require trains to leave the zone of protection.

#REQ_5.1.4.4-5#

UGTMS shall prevent trains from entering the zone of protection.

#REQ_5.1.4.4-6#

A zone of protection set manually shall be released by safety-related command provided via the interface with the external operations control HMI.

#REQ_5.1.4.4-7#

A zone of protection set automatically shall be released by safety-related command provided via the interface with the external operations control HMI, if the external condition is no longer detected.

#REQ_5.1.4.4-8#

UGTMS shall provide the zone of protection status, including the covered area and the reason, to the interface with the external train HMI. (O)

5.1.4.5 Deleted

5.1.4.6 Authorize the entry of non-operative UGTMS trains into UGTMS territory

Optional: all GOAs

This function is intended to authorize the entry of non-operative UGTMS trains into the UGTMS territory.

#REQ_5.1.4.6-1#

UGTMS shall authorize the entry through appropriate wayside signals when the conditions (e.g. track section occupancy) defined by the transport authority for entry into UGTMS territory have been fulfilled.

#REQ_5.1.4.6-2#

UGTMS shall detect a non-operative UGTMS train entering a transfer track of the UGTMS territory.

#REQ_5.1.4.6-3#

UGTMS shall report the entrance of a non-operative UGTMS train into a transfer track and into UGTMS territory to the interface with the external operations control HMI.

5.1.5 Supervise train movement

This function is intended to supervise train movement in accordance with train protection profile and other safety-related constraints.

5.1.5.1 Determine actual train speed

Mandatory: all GOAs

This function is intended to determine the actual train speed.

#REQ_5.1.5.1-1#

UGTMS shall detect and determine the actual train speed.

#REQ_5.1.5.1-2#

UGTMS shall take into account the effects of speed measurement inaccuracies.

#REQ_5.1.5.1-3#

UGTMS shall determine the zero-speed status within the predefined tolerances of the speed measurement system.

#REQ_5.1.5.1-4#

UGTMS shall provide the zero-speed status to the interface with the train. (O)

5.1.5.2 Supervise safe train speed

Mandatory: all GOAs

This function is intended to supervise actual speed against the permitted speed of UGTMS trains with respect to the train protection profile.

#REQ_5.1.5.2-1#

UGTMS shall supervise the permitted speed of trains operated by UGTMS to ensure that the trains remain within the train protection profile.

#REQ_5.1.5.2-2#

In manual driving mode, UGTMS shall provide warning information, triggered by a predefined warning profile that is more restrictive than the train protection profile, to the interface with external train HMI in order to enable the train operator to react and avoid brake intervention triggered by the system. (O)

#REQ_5.1.5.2-3#

In manual driving mode, UGTMS shall trigger service braking in accordance with the warning profile in order to respect the train protection profile and to avoid emergency brake intervention. (O)

#REQ_5.1.5.2-4#

If the determined actual train speed is higher than the speed permitted by the train protection profile, UGTMS shall trigger an emergency brake.

#REQ_5.1.5.2-5#

UGTMS shall provide information about the triggering of emergency brake to the interface with the external operations control HMI. (O)

#REQ_5.1.5.2-6#

UGTMS shall provide one of the two following possibilities for automatic emergency brake release, provided that there are no other conditions for triggering the emergency brake (O):

- during deceleration when the actual determined train speed returns below the train protection profile; or
- when the actual train speed is determined as zero.

#REQ_5.1.5.2-7#

UGTMS shall automatically release emergency brake only if overspeed is not detected a predefined number of times within a predefined time period. (O)

#REQ_5.1.5.2-8#

The emergency brake shall be released by safety-related command provided via the interface with the external operations control HMI if the actual train speed is determined as zero and there is no more condition for triggering the emergency brake. (O)

#REQ_5.1.5.2-9#

The emergency brake shall be released by command provided via the interface with the external train HMI if the actual train speed is determined as zero and there is no more condition for triggering the emergency brake. (O)

#REQ_5.1.5.2-10#

UGTMS shall automatically release the service brake during deceleration if actual determined train speed returns below the warning profile. (O)

#REQ_5.1.5.2-11#

UGTMS shall provide information about the release of emergency brake to the interface with the external operations control HMI. (O for GOA1, O for GOA2, M for GOA3, M for GOA4)

5.1.5.3 Inhibit train stops

Mandatory: all GOAs if train stops are used by UGTMS

This function is intended to avoid UGTMS operating trains to be tripped by train stops.

#REQ_5.1.5.3-1#

UGTMS shall command the inhibition and reactivation of the train stop functionality according to the specified safety conditions (trains with operating UGTMS).

5.1.5.4 Deleted

5.1.5.5 Supervise train rollaway

Optional: GOA1; Mandatory: GOA2, GOA3 and GOA4

This function is intended to supervise the train in case of rollaway.

#REQ_5.1.5.5-1#

UGTMS shall detect an unauthorized movement of the train in case of travel of the train against the authorized direction of travel beyond a predefined distance.

#REQ_5.1.5.5-2#

For a train at standstill, UGTMS shall detect unauthorized motion beyond a predefined distance. (O)

#REQ_5.1.5.5-3#

When rollaway is detected, UGTMS shall apply the emergency brake.

#REQ_5.1.5.5-4#

UGTMS shall provide the necessary information about the detected rollaway to the interface with the external operations control HMI. (O)

#REQ_5.1.5.5-5#

UGTMS shall provide the necessary information about the detected rollaway to the interface with the external train HMI. (O)

#REQ_5.1.5.5-6#

Unless prohibited by the train protection profile, UGTMS shall release the emergency brake provided by 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
- via the interface with the external operations control HMI. (O)

5.1.5.6 React to unauthorized movements of non-operative UGTMS trains**Optional: all GOAs**

This function is intended to react to unauthorized movements of non-operative UGTMS trains in order to prevent collisions.

#REQ_5.1.5.6-1#

UGTMS shall detect unauthorized movement of non-operative UGTMS trains based on inputs from an external device.

#REQ_5.1.5.6-2#

UGTMS shall restrict the movement authority of UGTMS trains that are in conflict with an unauthorized movement of a non-operative UGTMS train when such an unauthorized movement is detected.

#REQ_5.1.5.6-3#

UGTMS shall provide an alarm about the restriction of the movement authority of a train in conflict with the detected unauthorized movement of a non-operative UGTMS train to the interface with the external operations control HMI.

5.1.6 Provide interface with external interlocking**Mandatory: all GOAs if "Ensure safe route" functions are not provided by UGTMS**

This function is intended to provide an interface to an external interlocking if the basic function ensuring safe route and other functions (e.g. authorize train movement by wayside signals, locate non-reporting trains) are not realised inside UGTMS.

In case of upgrading an existing conventional system or providing an additional system, which enables the safe movement of non-UGTMS trains (mixed operation), basic functions to be defined can be realised by an external interlocking. In both cases, UGTMS shall interface to the external interlocking instead of providing the routing functions directly.

- train regulation and energy saving,
- the system response time including the train reaction time, and
- power supply parameters and status (e.g. neutral areas, borders of supply areas, loss of traction power).

#REQ_5.2.1-1#

UGTMS shall determine the operating speed profile in accordance with the following four categories:

- infrastructure data;
- train parameters and statuses;
- train protection profile;
- operational non-safety critical parameters related to stopping points such as stopping points in stations or sidings, authorizations to enter in station, departure conditions.

#REQ_5.2.1-2#

UGTMS shall determine the next operating speed profile which enables the train to stop at the following stopping point (e.g. station stopping point, end of mission or other stopping point) as required by the mission of the train.

#REQ_5.2.1-3#

UGTMS shall determine the operating speed profile to enable the train to stop at the next stopping point (e.g. station stopping point, end of mission or other stopping point) by command provided via the interface with the external operations control HMI (e.g. stop at next station). (O for GOA2, M for GOA3, M for GO4)

#REQ_5.2.1-4#

UGTMS shall choose the most adapted operating speed profile (e.g. tight, coasting) in accordance with the regulation strategy. (O)

#REQ_5.2.1-5#

UGTMS shall provide the operating speed profile to the interface with the external train HMI. (O)

#REQ_5.2.1-6#

UGTMS shall apply load-shedding running of trains in order to limit the power consumption in electrical sections where there is a lack of available power. (O)

5.2.2 Control train movement in accordance with train operating speed profile

Mandatory: GOA2, GOA3 and GOA4

This function is intended to determine and send traction and braking commands to the train to ensure that the train speed follows the train operating profile and to achieve accurate stopping.

#REQ_5.2.2-1#

UGTMS shall command acceleration/deceleration to the train complying with the operating speed profile and the required travel direction.

#REQ_5.2.2-2#

UGTMS shall deliver traction/regenerative braking commands in such a way that unnecessary drawing/delivering of electrical current is avoided whilst the train is traversing a gap between two sections of the conductor rail or catenary. (O)

#REQ_5.2.2-3#

UGTMS shall inhibit traction/regenerative braking commands to the train while the train is running in a non-powered section. (O)

#REQ_5.2.2-4#

Deleted (moved as #REQ_5.2.1-6#).

5.2.3 Stop train in station

5.2.3.1 Stop train at next station

Mandatory: GOA2, GOA3 and GOA4

This function is intended to achieve a comfortable and accurate stop in station.

#REQ_5.2.3.1-1#

UGTMS shall allow the train to stop in the station if the stop is part of the mission and no other command to skip the station has been sent to the train.

#REQ_5.2.3.1-2#

Further to a command modifying the status of a station from "station not to be served" to "station to be served", UGTMS shall command the train to stop in the station if the stop can be achieved through normal service braking.

#REQ_5.2.3.1-3#

UGTMS shall stop the train in the station according to the stopping point determined in the train operating profile.

#REQ_5.2.3.1-4#

When a train that is not serving a station stops in the station, UGTMS shall keep the train doors, and the platform doors if existing, closed. (O)

#REQ_5.2.3.1-5#

If the train overruns the platform stop by a distance higher than an acceptable limit (missed station), the train shall proceed to the next station. (O)

#REQ_5.2.3.1-6#

If the train fails to reach the stopping point at the platform, the train shall jog forward automatically until it is correctly aligned. (O)

#REQ_5.2.3.1-7#

If a train overruns the platform stop by a distance lower than an acceptable limit, UGTMS shall command the train to jog backward the train until it is correctly aligned. (O)

#REQ_5.2.3.1-8#

UGTMS shall command the train to proceed to the next station (unless terminal station) after a limited number of jogs have been attempted without reaching the stopping point. (O)

5.2.3.2 Hold train at station

Optional: GOA1 and GOA2; Mandatory: GOA3 and GOA4

This function is intended to prevent train departure in response to a hold request triggered by UGTMS or provided via the interface with the external operations control HMI. Whether doors are commanded open or closed during a train hold is defined by the transport authority, depending on local conditions (e.g. climate).

#REQ_5.2.3.2-1#

If a hold request for a specific platform track provided via the interface with the external operations control HMI is received, UGTMS shall hold any affected train.

#REQ_5.2.3.2-2#

If a hold request for a specific platform track is triggered by UGTMS (e.g. train regulation, power supply failure ahead), UGTMS shall hold any affected train.

NOTE The release of such hold request is not covered by a requirement as, depending on use cases, the release can be either automatic or manual (possibly in case of fire).

#REQ_5.2.3.2-3#

Once stopped at platform, the train shall not be able to depart until the train hold request set previously by the external operations control HMI is released by command provided via the interface with the external operations control HMI, if no other hold condition exists.

#REQ_5.2.3.2-4#

UGTMS shall provide train hold information to the interface with the external train HMI. (O)

#REQ_5.2.3.2-5#

UGTMS shall provide information about the status of the train hold in station to the interface with the external operations control HMI.

#REQ_5.2.3.2-6#

UGTMS shall hold a specific train at the next station to be served if a hold request for this train via the interface with the external operations control HMI is received. (O)

#REQ_5.2.3.2-7#

UGTMS shall provide train hold information to the interface with the external wayside device (e.g. indicator). (O)

5.2.3.3 Skip station stop

Optional: all GOAs

This function is intended to force trains to skip a station stop.

#REQ_5.2.3.3-1#

UGTMS shall force a train to skip a station, if the stop is not part of the mission, or a command to skip the station has been addressed to the train.

#REQ_5.2.3.3-2#

UGTMS shall limit the speed of the train skipping the station whilst running along the platform. (O)

#REQ_5.2.3.3-3#

UGTMS shall provide skip station status to the interface with the external operations control HMI.

5.3 Supervise guideway

Subclause 5.3 contains functions and requirements in order to prevent collisions with persons, or obstacles on the track or reduce the consequences of a collision.

5.3.1 Prevent collision with obstacles

Subclause 5.3.1 contains functions and requirements which are able to prevent or detect collisions with obstacles present in the guideway.

5.3.1.1 Supervise wayside obstacle detection device

Mandatory: all GOAs if wayside obstacle detection devices are used by UGTMS

This function is intended to supervise external wayside devices in charge of detecting obstacles on the track.

#REQ_5.3.1.1-1#

If an obstacle intrusion is reported from the external device, UGTMS shall establish the corresponding zone of protection.

#REQ_5.3.1.1-2#

UGTMS shall provide the necessary information (e.g. obstacle intrusion status and the wayside location of the obstacle) to the interface with the external operations control HMI.

#REQ_5.3.1.1-3#

UGTMS shall provide information about the detected intrusion to the interface with the external wayside device (e.g. indicator). (O)

#REQ_5.3.1.1-4#

The reaction of the system in case of a detected obstacle intrusion shall be maintained until it is released by operations staff using a safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active.

5.3.1.2 Supervise onboard obstacle detection device

Mandatory: all GOAs if onboard obstacle detection devices are used by UGTMS

This function is intended to supervise external onboard devices in charge of detecting obstacles on the track.

#REQ_5.3.1.2-1#

If an obstacle detection is reported from the external onboard detection device, UGTMS shall immediately trigger an emergency brake application if it is not directly triggered by the train.

#REQ_5.3.1.2-2#

UGTMS shall provide onboard obstacle detection device operational status and information about the detected obstacle, including the specific train identification, as emergency message to the interface with the external operations control HMI.

#REQ_5.3.1.2-3#

The reaction of the system in case of a detected obstacle shall be maintained until it is released by safety-related command provided via the interface with the external operations control HMI (O for GOA1, O for GOA2, O for GOA3, M for GOA4). This can only be done if the external condition having caused the triggering of the detection is no longer active.

#REQ_5.3.1.2-4#

UGTMS shall provide information about the detected obstacle to the interface with the external train HMI. (M for GOA1, M for GOA2, O for GOA3, O for GOA4)

#REQ_5.3.1.2-5#

The reaction of the system in case of a detected obstacle shall be maintained until it is released by safety-related command provided via the interface with the external train HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active. (M for GOA1, M for GOA2, O for GOA3 and O for GOA4)

5.3.2 Prevent collisions with persons on tracks

Subclause 5.3.2 contains functions and requirements which can prevent collisions with persons who mainly could enter from platforms to track areas.

5.3.2.1 Warn passengers to stay away from the platform edge

Optional: all GOAs

This function is intended to warn passengers to stay away from platform edge if a train is in approach to the platform track.

#REQ_5.3.2.1-1#

When a train is approaching a platform, UGTMS shall provide information to external public address system to warn passengers on the platform.

5.3.2.2 React to emergency stop request from platforms

Mandatory: all GOAs if platform emergency stop request devices are used by UGTMS

This function is intended to react to emergency stop requests from platforms initiated by passengers or staff.

#REQ_5.3.2.2-1#

In case of an emergency stop request from a station platform, a zone of protection covering the platform tracks shall be established.

#REQ_5.3.2.2-2#

In case of an emergency stop request from a station platform, UGTMS shall provide information to the external voice communication system to initiate communication between the requesting person and staff in OCC or staff in station. (O)

#REQ_5.3.2.2-3#

In case of an emergency stop request from a station platform, UGTMS shall provide the necessary information (e.g. status and location) to the interface with the external operations control HMI.

#REQ_5.3.2.2-4#

An emergency stop request and the reaction of the system shall be maintained until it is released by safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the request is no longer active.

#REQ_5.3.2.2-5#

In case of an emergency stop request from a station platform, UGTMS shall command the cut-off of the traction power of the concerned area. (O)

5.3.2.3 Supervise platform doors

Mandatory: all GOAs if platform doors are used by UGTMS

This function is intended to supervise the closed and locked status of the platform doors if they are not required to be open.

#REQ_5.3.2.3-1#

If platform doors are detected open when no train is berthed at the station, UGTMS shall immediately establish the corresponding zone of protection.

#REQ_5.3.2.3-2#

In case of platform door unintentionally open, UGTMS shall provide the necessary information (e.g. status and location) to the interface with the external operations control HMI.

#REQ_5.3.2.3-3#

If platform doors are detected open when no train is berthed in the station, UGTMS shall command the cut-off of traction power of the concerned area to the traction power supply system. (O)

5.3.2.4 Supervise platform tracks

Mandatory: all GOAs if platform track detection devices are used by UGTMS

This function is intended to supervise the status of an external platform track detection device to stop the train in case of intrusion of persons.

#REQ_5.3.2.4-1#

In case the status of an external platform track detection device indicates an intrusion, a corresponding zone of protection shall be established.

#REQ_5.3.2.4-2#

The status of a detected intrusion shall be maintained until it is released by safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active.

#REQ_5.3.2.4-3#

In case the status of an external platform track detection device indicates an intrusion, UGTMS shall request the cut-off of traction power of the concerned area. (O)

#REQ_5.3.2.4-4#

Deleted.

#REQ_5.3.2.4-5#

In case of platform track intrusion, UGTMS shall provide the intrusion information (e.g. status and location) to the interface with the external operations control HMI.

#REQ_5.3.2.4-6#

Deleted.

5.3.2.5 Supervise border between platform tracks and other tracks

Mandatory: all GOAs if detection devices for borders of platform tracks are used by UGTMS

This function is intended to supervise the actions of an external device which supervises both borders of platform tracks detecting persons who are intruding the track areas surrounding the platform tracks (e.g. tracks in tunnels connecting the station to another).

#REQ_5.3.2.5-1#

In case of an intrusion message from the external equipment, a predetermined zone of protection covering the whole area towards the next station(s) shall be established.

#REQ_5.3.2.5-2#

In case of detected intrusion, UGTMS shall provide the intrusion information (e.g. status and location) to the interface with the external operations control HMI.

#REQ_5.3.2.5-3#

Deleted.

#REQ_5.3.2.5-4#

The status of a detected intrusion shall be maintained until it is released by safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active.

#REQ_5.3.2.5-5#

In case of intrusion onto the track between stations, UGTMS shall request the cut-off of traction power of the concerned area. (O)

5.3.2.6 Supervise platform end doors

Mandatory: all GOAs if platform end doors are used by UGTMS

This function is intended to supervise the status of an external device which supervises doors on both ends of platforms, detecting unauthorized opening of doors that could lead to an intrusion of persons to tracks between stations.

#REQ_5.3.2.6-1#

In case of a door open message reported from the external equipment and access is not permitted, an unauthorized door opening status shall be triggered, and a predefined zone of protection covering the whole area towards the next station(s) shall be established.

#REQ_5.3.2.6-2#

The unauthorized door opening status shall be maintained until it is released by safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active.

#REQ_5.3.2.6-3#

In order to avoid an unauthorized door opening status and performing a zone of protection, access of authorized person shall be permitted by safety-related command provided via the interface with the external operations control HMI. (O)

#REQ_5.3.2.6-4#

The access permission shall be withdrawn

- when the door is closed,
- after a predefined time (O), or
- by command provided via the interface with the external operations control HMI. (O)

#REQ_5.3.2.6-5#

In case of detection of unauthorized door opening, UGTMS shall provide the platform end door open information (e.g. status and location) to the interface with the external operations control HMI.

5.3.2.7 Supervise emergency exits from guideway

Mandatory: all GOAs if emergency exits from guideway are interfaced with UGTMS

This function is intended to supervise the status of an external device which supervises emergency exits from guideway between stations, detecting opening of these emergency exits that could lead to an intrusion of persons.

#REQ_5.3.2.7-1#

In case of a detection of the opening of an emergency exit reported from the external equipment, an opening of emergency exit status shall be triggered, and a predefined zone of protection shall be established.

#REQ_5.3.2.7-2#

The opening of emergency exit status shall be maintained until it is released by safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active.

#REQ_5.3.2.7-3#

In case of detection of the opening of an emergency exit, UGTMS shall provide information about the emergency exit (e.g. status and location) to the interface with the external operations control HMI.

5.3.3 Protect staff on track by work zone

Optional: GOA1 and GOA2; mandatory: GOA3 and GOA4

This function is intended to establish and subsequently remove work zones in order to protect staff on the track. A work zone is set as long as the protection is required.

#REQ_5.3.3-1#

The required work zone shall be established by specific command provided via the interface with the external operations control HMI.

#REQ_5.3.3-2#

The required work zone shall be released by specific safety-related command provided via the interface with the external operations control HMI.

#REQ_5.3.3-3#

UGTMS shall prevent trains in automatic driving mode from entering an established work zone.

#REQ_5.3.3-4#

The command which establishes the work zone shall include the choice of a selected speed restriction. (O)

#REQ_5.3.3-5#

UGTMS shall prevent trains in manual driving mode from entering an established work zone until entry is authorized by safety-related command provided via the interface with the external operations control HMI, one train after the other. (O)

#REQ_5.3.3-6#

UGTMS shall provide work zone information to the interface with the external train HMI or to the interface with the external wayside device (e.g. indicator), as long as the work zone is established. (M for GOA1, M for GOA2, O for GOA3, O for GOA4)

#REQ_5.3.3-7#

UGTMS shall provide the necessary information about the established work zones to the interface with the external operations control HMI.

#REQ_5.3.3-8#

Releasing an existing work zone shall not remove temporary speed restrictions in force at the same location.

5.4 Supervise passenger transfer

Subclause 5.4 contains all functions and requirements which can ensure a safe passenger transfer taking into account

- door opening at the beginning and door closing at end of passenger transfer,
- the passenger transfer itself, and
- starting conditions after completion of passenger transfer, also including other constraints which are not directly linked to passenger transfer.

5.4.1 Control train and platform doors

5.4.1.1 Authorize door opening

Optional: GOA1, GOA2 and GOA3; Mandatory: GOA4

This function is intended to authorize the opening of train doors and platform doors (if handled by UGTMS), once all conditions which are required to ensure a safe passenger transfer have been met.

#REQ_5.4.1.1-1#

UGTMS shall ensure that only the train doors on the correct side according to train orientation are selected for opening.

#REQ_5.4.1.1-2#

In the presence of platforms on both sides, it shall be possible to select the opening of the doors on both sides. (O)

#REQ_5.4.1.1-3#

UGTMS shall authorize opening of train doors (and corresponding platform doors if handled by UGTMS) on the selected side of the train when the zero-speed status is detected and the train is located within the tolerance of the stopping point as specified by the transport authority.

#REQ_5.4.1.1-4#

UGTMS shall prevent movement of the train when door opening is authorized. (O)

#REQ_5.4.1.1-5#

When a door is detected as open while door opening is not authorized (e.g. manual action), UGTMS shall provide the necessary information (e.g. status and location)

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

#REQ_5.4.1.1-6#

If platform doors are handled by UGTMS, if the length of the platform is greater than the length of the train, only the platform doors facing the opening of the train doors shall be authorized by UGTMS.

#REQ_5.4.1.1-7#

Deleted.

5.4.1.2 Command door opening

Optional: all GOAs

This function is intended to command the opening of train doors and platform doors (if handled by UGTMS) when opening conditions are met.

#REQ_5.4.1.2-1#

UGTMS shall command opening of doors if they are authorized for opening.

#REQ_5.4.1.2-2#

In the presence of platforms on both sides, it shall be possible to command the opening of the doors

- on one side, or
- on both sides. (O)

#REQ_5.4.1.2-3#

If both sides of a train are commanded for door opening, it shall be possible to manage the opening with a time shift between both sides. (O)

#REQ_5.4.1.2-4#

If platform doors are handled by UGTMS, opening of platform and train doors shall be synchronised within a given time tolerance (if required by operations, the time difference between the opening of platform and train doors could include an intentional lag).

#REQ_5.4.1.2-5#

Deleted.

#REQ_5.4.1.2-6#

If platform doors are handled by UGTMS, if a train door is out of service, UGTMS shall indicate to the platform door system which platform door shall not be opened. (O)

#REQ_5.4.1.2-7#

If platform doors are handled by UGTMS, if a platform door is out of service, UGTMS shall indicate to the train which train door shall not be opened. (O)

5.4.1.3 Request door closing

Optional: GOA1, GOA2 and GOA3; Mandatory: GOA4

This function is intended to request the closing of train doors and platform doors (if handled by UGTMS) at stations.

#REQ_5.4.1.3-1#

UGTMS shall request door closing when the departure time has been reached and starting conditions are fulfilled (except train doors closed status and the ability to completely leave the station).

NOTE When the door closing is triggered, the ability to completely leave the station is not always met.

#REQ_5.4.1.3-2#

UGTMS shall request doors to close by command provided via the interface with the external operations control HMI. (not applicable for GOA1, not applicable for GOA2, O for GOA3, O for GOA4)

#REQ_5.4.1.3-3#

UGTMS shall trigger visible and audible warnings informing passengers of impending door closure. (O)

#REQ_5.4.1.3-4#

If platform doors are handled by UGTMS, closing of platform and train doors shall be synchronised within a given time tolerance (if required by operations, the time difference between the closing of platform and train doors could include an intentional lag).

#REQ_5.4.1.3-5#

Deleted.

5.4.1.4 Supervise door closing

Optional: all GOAs

This function is intended to supervise the closing of train doors and platform doors (if handled by UGTMS) at stations.

#REQ_5.4.1.4-1#

If doors are not detected as closed and locked within a predefined time, UGTMS shall repeat door closing command a predefined number of times. (O)

#REQ_5.4.1.4-2#

If the closed and locked status of doors is not obtained within a predefined time, UGTMS shall raise an alarm to the interface with the external operations control HMI.

#REQ_5.4.1.4-3#

UGTMS shall provide information of the closed and locked status of train and platform doors to the interface with the external train HMI (M for GOA1, M for GOA2, O for GOA3, not applicable for GOA4).

5.4.2 Prevent injuries to persons between cars or between platform and train

This function is intended to control external devices and supervise detectors that prevent injuries to persons from falling or detect persons falling. Prevented hazards include falling or being trapped between two cars, and between platform edge and car body.

5.4.2.1 Control gap fillers, movable train steps and similar devices

Mandatory: all GOAs if gap fillers, movable train steps and similar devices are used by UGTMS

This function is intended to control actions of external onboard or wayside gap fillers, movable train steps and similar devices.

#REQ_5.4.2.1-1#

UGTMS shall provide to the interface with the external operations control HMI the operational status of the wayside gap fillers and similar devices.

#REQ_5.4.2.1-2#

For predefined platforms, UGTMS shall request movement of wayside gap fillers and similar devices to the required position. Requests shall be made to the specific interface with the external wayside device.

#REQ_5.4.2.1-3#

UGTMS shall provide to the interface with the external operations control HMI the operational status of the onboard gap fillers, movable train steps and similar devices.

#REQ_5.4.2.1-4#

For predefined platforms, UGTMS shall request movement of onboard gap fillers, movable train steps and similar devices to the required position. Requests shall be made to the specific interface with the train.

5.4.2.2 Supervise detection of persons between cars or between platform and train

Mandatory: all GOAs if devices detecting persons between cars or between platform and train are used by UGTMS

This function is intended to supervise the status of an external device (being possibly onboard or wayside) detecting persons falling through or trapped in the gap between platform and train or between cars during passenger transfer.

#REQ_5.4.2.2-1#

When a detection status is received from the external device, UGTMS shall prevent the train from departing, as safe departure conditions are not fulfilled.

#REQ_5.4.2.2-2#

UGTMS shall provide the detection status of the external device via the interface with the external operations control HMI.

#REQ_5.4.2.2-3#

The detection status of the external device shall be maintained by UGTMS until it is released by operations staff using a safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active.

5.4.3 Ensure train departure

Subclause 5.4.3 contains all functions and requirements ensuring safety-related and non-safety-related starting conditions for a train leaving a platform stop.

5.4.3.1 Authorize train departure (safety-related conditions)

Mandatory: all GOAs

This function is intended to verify all prerequisites for safe station departure.

#REQ_5.4.3.1-1#

UGTMS shall authorize the train to leave the station when the following conditions are met:

- UGTMS has received the confirmation that all train doors and all platform doors (if handled by UGTMS) are closed and locked (O for GOA1, M for GOA2, M for GOA3, M for GOA4);
- the train is not immobilised in the station by emergency braking;
- the start of the train is not inhibited (e.g. by activated onboard passenger alarm device, fire/smoke detection).

#REQ_5.4.3.1-2#

UGTMS shall provide station departure authorization for safety-related conditions to the interface with the external train HMI. (O)

#REQ_5.4.3.1-3#

UGTMS shall provide the reason for which train departure is not authorized for safety-related conditions to the interface

- with the external train HMI (O), and
- with the external operations control HMI. (O)

#REQ_5.4.3.1-4#

UGTMS shall provide station departure authorization for safety-related conditions to the interface with the external wayside device (e.g. indicator). (O)

5.4.3.2 Authorize train departure (operational conditions)

Optional: GOA1 and GOA2; Mandatory: GOA3 and GOA4

This function is intended to verify all prerequisites due to operational constraints in order to authorize station departure.

#REQ_5.4.3.2-1#

UGTMS shall authorize the train to leave the station when the following conditions are met:

- the train is not held in station by the train regulation (including for connecting services (O));
- the dwell time has elapsed;
- the train is able to completely leave the station;
- the train is assigned a mission that is not completed (O for GOA1, O for GOA2, M for GOA3, M for GOA4);
- there is no constraint preventing the train from reaching the next station (e.g. lack of traction power, stranded train). (O)

#REQ_5.4.3.2-2#

UGTMS shall provide station departure authorization for operational conditions to the interface with the external train HMI. (O)

#REQ_5.4.3.2-3#

UGTMS shall provide the reason for which train departure is not authorized for operational conditions to the interface

- with the external train HMI (O), and
- with the external operations control HMI. (O)

#REQ_5.4.3.2-4#

UGTMS shall provide the dwell time information to the interface with the external train HMI. (O)

#REQ_5.4.3.2-5#

UGTMS shall authorize the train to leave the station by a command provided via the interface with the external operations control HMI. (O)

#REQ_5.4.3.2-6#

UGTMS shall provide station departure authorization for operational conditions to the interface with the external wayside device (e.g. indicator). (O)

5.4.3.3 Command train departure

Mandatory: GOA2, GOA3 and GOA4

This function is intended to command a train to leave the station when the required operational and safety conditions are met.

#REQ_5.4.3.3-1#

UGTMS shall command automatically the train to depart as soon as departure is authorized (safety and operational conditions fulfilled). (not applicable for GOA1, O for GOA2, O for GOA3, M for GOA4)

#REQ_5.4.3.3-2#

UGTMS shall command the train to depart upon manual action of the train operator when departure is authorized (safety and operational conditions fulfilled). (not applicable for GOA1, O for GOA2, O for GOA3, not applicable for GOA4)

#REQ_5.4.3.3-3#

Deleted.

5.5 Operate a train

Subclause 5.5 contains all functions and requirements which are necessary to operate a train. In GOA3 and GOA4, this includes UGTMS performing functions which are usually fulfilled by the train operator in lower grades of automation.

5.5.1 Put in or take out of operation

5.5.1.1 Awake trains

Optional: all GOAs

This function is intended to awake trains which are in stabling areas (main line, sidings and depots) before they enter service by the action of the train operator, or by UGTMS or by commands provided via the interface with the external operations control HMI.

#REQ_5.5.1.1-1#

The UGTMS onboard equipment shall be activated by the mission or by a command provided 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 for GOA1, O for GOA2, O for GOA3, M for GOA4).

#REQ_5.5.1.1-2#

UGTMS shall allow trains to enter revenue service only when functions necessary for convenient, reliable and safe revenue service are active, tested and are working according to site specific guidelines and regulations.

5.5.1.2 Set trains to sleep

Optional: all GOAs

This function is intended to set the trains to sleep in stabling areas (main line, sidings and depots) after they leave service by the action of the train operator, or by UGTMS or by commands provided via the interface with the external operations control HMI.

#REQ_5.5.1.2-1#

When the train is set to sleep in its stabling location, the UGTMS onboard equipment shall be de-energised, except for all functions required to awake the train.

#REQ_5.5.1.2-2#

UGTMS shall enable setting the train to sleep by the mission or by a command provided 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 for GOA1, O for GOA2, O for GOA3, M for GOA4)

#REQ_5.5.1.2-3#

Deleted.

5.5.2 Manage driving modes

Mandatory: all GOAs

This function is intended to manage the driving modes of the train, which can be manual or automatic.

#REQ_5.5.2-1#

UGTMS shall manage driving modes, depending on the GOA and the operational status of UGTMS onboard and wayside equipment.

#REQ_5.5.2-2#

In automatic driving mode, UGTMS shall perform all UGTMS functions of the train of the corresponding GOA. (not applicable for GOA1, M for GOA2, M for GOA3, M for GOA4)

#REQ_5.5.2-3#

Deleted.

#REQ_5.5.2-4#

In full supervised manual driving mode, UGTMS shall ensure the protection of the train by application of the train protection profile. (M for GOA1, O for GOA2, O for GOA3, O for GOA4)

#REQ_5.5.2-5#

In partial supervised manual driving mode, UGTMS shall as a minimum enforce the respect of a predefined constant speed limit. (O)

#REQ_5.5.2-6#

Deleted.

#REQ_5.5.2-7#

UGTMS shall manage a transition from one driving mode to the other either automatically, or following an action from the train operator via the interface with the external train HMI. (O)

#REQ_5.5.2-8#

The driving mode in force shall be provided

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

#REQ_5.5.2-9#

UGTMS shall inhibit a designated driving mode on selected sections of the line on reception of a command from the interface with the external operations control HMI. (O)

#REQ_5.5.2-10#

UGTMS shall inhibit a designated driving mode for a selected train on reception of a command from the interface with the external operations control HMI. (O)

#REQ_5.5.2-11#

UGTMS shall perform unattended turnback of the trains (not applicable for GOA1, O for GOA2, not applicable for GOA3, not applicable for GOA4)

- after the train has stopped in pre-defined turnback areas, and
- on receiving a command provided via the interface with the external train HMI, or an external wayside device (e.g. key, button), or the external operations control HMI.

5.5.3 Manage movement of trains after unexpected stops

Mandatory: GOA2, GOA3 and GOA4

This function is intended to manage the movement of trains on the guideway between stations taking into account different operational disturbances leading to stops outside stations.

#REQ_5.5.3-1#

UGTMS shall authorize the train to restart motion in automatic driving mode when the following conditions are met:

- the conditions that caused the train to stop are no longer present;
- the train doors are closed and locked;
- the train is not immobilised in emergency braking.

#REQ_5.5.3-2#

UGTMS shall restart automatically the train as soon as authorization is granted. (O)

#REQ_5.5.3-3#

After the authorization is granted, UGTMS shall restart train motion following a command provided via the interface

- with the external operations control HMI (O), or
- with the external train HMI (O for GOA2, O for GOA3, not applicable for GOA4).

#REQ_5.5.3-4#

Deleted (moved into 6.4.1 as new #REQ_6.4.1-3#).

#REQ_5.5.3-5#

Depending on conditions to be defined by the transport authority and the elapsed time since a train has stopped unexpectedly, UGTMS shall provide the information about this unexpected stop to the interface with the external operations control HMI. (O)

5.5.4 Manage stabling

Optional: all GOAs

This function is intended to manage the stabling of trains. Stabling is possible in mainline, sidings and depots.

#REQ_5.5.4-1#

UGTMS shall assign trains to designated stabling locations according to the timetable or on receiving commands from the interface with the external operations control HMI.

#REQ_5.5.4-2#

UGTMS shall change the use of a mainline track section for stabling purposes on receiving a command from the interface with the external operations control HMI. (O)

5.5.5 Deleted

5.5.6 Restrict train entry to station

Optional: all GOAs

This function is intended to prevent entry of a train into station when the required operational conditions are not met.

#REQ_5.5.6-1#

UGTMS shall prevent the entry in station to a train serving the station if the train cannot be berthed entirely in station.

#REQ_5.5.6-2#

UGTMS shall prevent entry into a station to a train that is intended to skip the station when the train cannot leave the station entirely. (O)

#REQ_5.5.6-3#

When the entry is prevented, UGTMS shall stop the train at the station entry stopping point in such a way that a train stopped at this point does not foul crossovers. (O)

5.5.7 Change the travel direction

Mandatory: all GOAs

This function is intended to define the conditions and process in order to change the travel direction of a train.

#REQ_5.5.7-1#

UGTMS shall permit a change in travel direction only when the train is detected at standstill.

#REQ_5.5.7-2#

Deleted.

#REQ_5.5.7-3#

Deleted.

5.5.8 Couple and uncouple a train

Optional: all GOAs

This function is intended to couple and uncouple UGTMS trains during operation.

#REQ_5.5.8-1#

Several coupled train units shall be managed by UGTMS as a single train.

#REQ_5.5.8-2#

UGTMS shall determine automatically the length of a train consisting of predefined units. (O for GOA1, O for GOA2, O for GOA3, M for GOA4)

#REQ_5.5.8-3#

UGTMS shall reconfigure automatically each part of the uncoupled train so that they can be operated independently.

5.5.8.1 Couple trains automatically

Optional: GOA3 and GOA4

This function is intended to automatically join two separate trains operated independently, in designated area, to be operated as a single train.

#REQ_5.5.8.1-1#

UGTMS shall perform automatic coupling of trains at designated areas such as sidings, depots, stabling areas and along platforms.

#REQ_5.5.8.1-2#

Before actual automatic coupling, UGTMS shall continuously supervise the train speed, to ensure that it is below the maximum allowable coupling speed, up to the coupling event.

#REQ_5.5.8.1-3#

UGTMS shall perform automatic coupling of compatible trains by command provided via the interface with the external operations control HMI or according to the train mission.

#REQ_5.5.8.1-4#

During automatic coupling, UGTMS shall maintain one train stationary.

5.5.8.2 Uncouple trains automatically

Optional: GOA3 and GOA4

This function allows a train which consists of two or more units to be uncoupled automatically into two separate trains operating independently.

#REQ_5.5.8.2-1#

UGTMS shall perform the automatic uncoupling of trains at designated areas such as sidings, depots, stabling areas and along platforms.

#REQ_5.5.8.2-2#

UGTMS shall perform automatic uncoupling by command provided via the interface with the external operations control HMI or according to the train mission.

NOTE The unit to be uncoupled is given in the command or the mission.

#REQ_5.5.8.2-3#

Prior to automatic uncoupling, UGTMS shall maintain the train stationary.

#REQ_5.5.8.2-4#

During automatic uncoupling, UGTMS shall maintain one train stationary.

#REQ_5.5.8.2-5#

Deleted (moved as new #REQ_5.5.8-3#).

5.5.9 Supervise the status of UGTMS

Subclause 5.5.9 contains all functions and requirements which are necessary to detect failures and conditions which might influence orderly operation due to unavailability of UGTMS equipment.

5.5.9.1 Supervise UGTMS equipment status prior to entering service

Mandatory: all GOAs

This function is intended to perform all necessary tests on equipment during the power on process or prior to entering UGTMS territory.

#REQ_5.5.9.1-1#

When UGTMS equipment is activated (either remotely or by a staff local activation), it shall execute various test procedures to determine whether the equipment (including redundant if any) is capable of operating safely and is fit for service.

#REQ_5.5.9.1-2#

The UGTMS equipment shall perform tests to ensure the safety of UGTMS functions.

#REQ_5.5.9.1-3#

The onboard UGTMS equipment shall perform tests to ensure the safe activation of external equipment necessary for safety. (O for GOA1, O for GOA2, M for GOA3, M for GOA4)

#REQ_5.5.9.1-4#

All tests shall start and run automatically, without requiring any action by staff. (O for GOA1, O for GOA2, M for GOA3, M for GOA4)

#REQ_5.5.9.1-5#

The result of the tests of the UGTMS onboard equipment (including any fault detected) shall be provided to the interface with

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

#REQ_5.5.9.1-6#

The result of the tests of the UGTMS wayside equipment (including any fault detected) shall be provided to the interface with the external operations control HMI.

5.5.9.2 Supervise UGTMS equipment status during operation

Mandatory: all GOAs

This function is intended to perform all necessary tests during operation of the system.

#REQ_5.5.9.2-1#

The status of UGTMS shall be supervised by performing tests during operation, without any impact on the system performances (e.g. no impact on train movement, availability of driving modes).

#REQ_5.5.9.2-2#

Deleted.

#REQ_5.5.9.2-3#

The result of failed tests of the UGTMS onboard equipment (including any fault detected) shall be provided to the interface with

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

#REQ_5.5.9.2-4#

The result of failed tests of the UGTMS wayside equipment shall be provided to the interface with the external operations control HMI.

5.5.9.3 Test emergency braking performance

Optional: all GOAs

This function is intended to perform a dynamic emergency braking test during motion, or static emergency braking test at standstill.

#REQ_5.5.9.3-1#

During the dynamic emergency braking test, UGTMS shall stop the train using the emergency brake and monitor that its braking performance is satisfactory. (O)

NOTE Such type of test is carried out as specified by the transport authority (e.g. once a day, after a train maintenance in workshop). The actions to be taken following such failed test are specified by the transport authority.

#REQ_5.5.9.3-2#

Deleted.

#REQ_5.5.9.3-3#

The result of the emergency braking test shall be provided to the interface with the external train HMI (M for GOA1, M for GOA2, O for GOA3, not applicable for GOA4).

#REQ_5.5.9.3-4#

The result of the emergency braking test shall be reported to the interface with the external operations control HMI.

#REQ_5.5.9.3-5#

UGTMS shall perform a static emergency braking test while at standstill. (O)

NOTE Conditions for triggering such kind of test are specified by the transport authority. The actions to be taken following such failed test are specified by the transport authority.

5.5.9.4 React to detected train equipment failure

Optional: GOA1 and GOA2; Mandatory: GOA3 and GOA4

This function is intended to react to train equipment failures reported by the train impacting operation.

#REQ_5.5.9.4-1#

When a train equipment failure is reported, UGTMS shall inhibit further train movement at the next station or at the destination of journey in accordance with the significance of the failure.

#REQ_5.5.9.4-2#

When the train equipment failure is no longer reported, UGTMS shall resume normal operation automatically.

NOTE The corresponding list of failures for which an automatic resumption of train movement is possible is specified by the transport authority.

#REQ_5.5.9.4-3#

When the train equipment failure is no longer reported, UGTMS shall permit the resumption of operation of the affected train by command issued from the interface

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

NOTE The corresponding list of failures for which a resumption of train movement requires an operator command is specified by the transport authority.

5.5.10 Manage traction power supply on train

Optional: all GOAs

This function is intended to manage traction power supply during train operation (e.g. selection of current collector, AC/DC selection, voltage selection, automatic raising and lowering of pantographs and collector shoes, automatic opening/closing of circuit breakers). This function is for instance applicable if several power systems are fitted for a given line.

#REQ_5.5.10-1#

Deleted.

#REQ_5.5.10-2#

UGTMS shall provide output commands for lowering and raising current collector(s) to the train at predetermined locations.

#REQ_5.5.10-3#

Deleted.

#REQ_5.5.10-4#

UGTMS shall command switching from one power supply system to another (e.g. AC/DC) at predetermined locations.

5.5.11 Manage train washing

Mandatory: GOA3 and GOA4 if the washing machine is used by UGTMS

This function is intended to move the train up to the wash tracks and manage the washing process according to the interface with the external washing machine.

#REQ_5.5.11-1#

UGTMS shall control the train to enter the wash track, and shall launch the train washing process by command provided via the interface with the external operations control HMI or according to the train mission.

#REQ_5.5.11-2#

Before starting the train washing process, UGTMS shall ensure that

- the washing machine is ready for washing, and
- the train is ready for washing, depending on conditions defined by the transport authority (e.g. status provided directly by the train).

#REQ_5.5.11-3#

Once the train has reached the correct position, UGTMS shall command the start of the washing and keep the train stationary at the specified location during washing. (O)

#REQ_5.5.11-4#

Once the train has reached the correct position, UGTMS shall command the start of the washing and control the train movement during washing at the specified speed through the washing machine. (O)

#REQ_5.5.11-5#

In case the washing is done with a moving train, UGTMS shall stop the train immediately based on a command provided via the interface with the external operations control HMI, or when receiving the washing machine status indicating a failure.

#REQ_5.5.11-6#

UGTMS shall consider the train washing process as completed when it receives the completion/cancellation status from the washing machine.

#REQ_5.5.11-7#

After the train washing process is completed, UGTMS shall control the train to exit the wash track by command provided via the interface with the external operations control HMI or according to the train mission.

5.5.12 Manage non-stopping areas

Optional: all GOAs

This function is intended to manage non-stopping areas where it may not be safe or suitable to stop a train.

#REQ_5.5.12-1#

UGTMS shall prevent a train from stopping in a non-stopping area (which are associated for instance to flood gates).

#REQ_5.5.12-2#

UGTMS shall only authorize the train to go through a non-stopping area if it can clear the area completely.

5.6 Ensure detection and management of emergency situations

Subclause 5.6 contains all functions and requirements which are necessary to detect emergency situations and perform adequate reactions taking into account the GOA.

5.6.1 React to detected onboard fire/smoke

Mandatory: all GOAs if onboard fire/smoke detection device is used by UGTMS

This function is intended to supervise an external onboard fire/smoke detection device in order to report the corresponding emergency condition to the OCC and to hold the train at the next station or optionally at the next evacuation point.

#REQ_5.6.1-1#

In case of onboard fire/smoke detection, UGTMS shall hold the train concerned at the next station, or next evacuation point if any.

#REQ_5.6.1-2#

Once the train has reached standstill at this location, UGTMS shall authorize the opening of the doors on the correct side and shall command the opening if the opening command is managed by UGTMS. Restart of the train shall be inhibited.

#REQ_5.6.1-3#

The UGTMS fire/smoke detection status shall be maintained until it is released by operations staff using a safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active.

#REQ_5.6.1-4#

In case of onboard fire/smoke detection, UGTMS shall provide the information (e.g. status and localisation) to the interface with the external operations control HMI.

#REQ_5.6.1-5#

UGTMS shall provide the information about the onboard fire/smoke detection to the interface with the external train HMI. (O)

5.6.2 React to detected derailment

Mandatory: all GOAs if onboard derailment detection device is used by UGTMS

This function is intended to manage the actions of an external onboard derailment detection device in order to report this emergency condition to OCC and to stop the train immediately in case of recognized derailment.

#REQ_5.6.2-1#

UGTMS shall trigger and maintain emergency brake in case of derailment detected by external detector.

#REQ_5.6.2-2#

UGTMS shall establish the corresponding zone of protection on the possibly endangered tracks.
(O)

#REQ_5.6.2-3#

UGTMS shall provide system operational derailment status, including the specific train identification and specific detector, as an emergency message to the interface with the external operations control HMI.

#REQ_5.6.2-4#

The UGTMS derailment detection status shall be maintained until it is released by operations staff using a safety-related command provided via the interface with the external operations control HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active.

5.6.3 React to detected or suspected broken rail

5.6.3.1 React to detected broken rail

Mandatory: all GOAs if broken rail detection device is used by UGTMS

This function is intended to react to the detection of broken rail by an external device.

#REQ_5.6.3.1-1#

When a broken rail is reported by an external detection device, UGTMS shall establish a zone of protection.

#REQ_5.6.3.1-2#

When a broken rail is reported by an external detection device, UGTMS shall provide the information about the detected broken rail to the interface with the external operations control HMI.

5.6.3.2 React to suspected broken rail

Optional: all GOAs when track circuits are used by UGTMS for train detection

This function describes the reaction of UGTMS to suspected broken rail.

#REQ_5.6.3.2-1#

When a broken rail is suspected on a section of track, UGTMS shall establish a zone of protection associated with the track section.

#REQ_5.6.3.2-2#

UGTMS shall suspect a broken rail on a given section of track, if UGTMS has determined there is no train in this section, and the related track circuit reports that a train is present in this section.

#REQ_5.6.3.2-3#

UGTMS shall provide the information about the suspected broken rail to the interface with the external operations control HMI.

5.6.4 Manage passenger requests

Subclause 5.6.4 contains all functions and requirements which are necessary to detect passenger alarms related to emergency situations and perform adequate reactions.

5.6.4.1 Deleted

5.6.4.2 React to passenger alarm device activation

Mandatory: all GOAs if UGTMS is interfaced with an external onboard passenger alarm device

This function is intended to react to the activation of an external onboard passenger alarm device.

#REQ_5.6.4.2-1#

In case of an activation of an onboard passenger alarm device in a running train, UGTMS shall command the stopping of the train in the next safe place (e.g. next station).

#REQ_5.6.4.2-2#

When a train is immobilized in the designated safe place by UGTMS following the activation of an onboard passenger alarm device, UGTMS shall maintain the immobilization until it is released by operations staff using a safety-related command provided via the interface with the external operations control HMI.

#REQ_5.6.4.2-3#

In case of an activation of an onboard passenger alarm device, UGTMS shall provide the necessary information (status, train identification and locality inside train) to the interface with the external operations control HMI.

#REQ_5.6.4.2-4#

In case of an activation of an onboard passenger alarm device, UGTMS shall provide the necessary information (status and locality inside train) to the interface with the external train HMI. (O)

#REQ_5.6.4.2-5#

After the passenger transfer, UGTMS shall stop the train immediately if a passenger alarm device is actuated when the train is in a defined area, and under conditions defined by the transport authority (e.g. the train is expected to stop partially in the station or in the vicinity of the station). (O)

5.6.4.3 React to emergency release of train doors

Mandatory: all GOAs if UGTMS is interfaced with an external train doors emergency release device

This function is intended to manage the actions following the emergency release request of train doors. Such a request is triggered by activating an onboard dedicated device if fitted.

#REQ_5.6.4.3-1#

When an emergency release request of train doors is received and the train is moving, UGTMS shall allow the train to continue its ride to the next safe place (e.g. next station) where UGTMS shall stop and immobilise the train.

#REQ_5.6.4.3-2#

When a train is immobilized in the designated safe place by UGTMS following the activation of an onboard door emergency release device, UGTMS shall maintain the immobilization until it is released using a safety-related command provided via the interface with the external operations control HMI.

#REQ_5.6.4.3-3#

UGTMS shall provide emergency release request of train doors to the interface with the external operations control HMI.

#REQ_5.6.4.3-4#

When an emergency release request of train doors is received and the train is at standstill, UGTMS shall allow the emergency release of the door under conditions defined by the transport authority. (O)

#REQ_5.6.4.3-5#

Once the door has been opened, UGTMS shall prevent the train from restarting until the emergency release request of train doors is reset, in addition to the usual conditions for restarting depending on the location of the safe place (in station or in between stations).

5.6.5 React to loss of train integrity

Optional: all GOAs

NOTE 1 This function is optional as there are alternatives to zones of protection, for instance via the use of the external secondary train detection system, or storage of the last known position of the train.

This function is intended to react to the loss of the train integrity provided by the train.

NOTE 2 In case of lost integrity, the resulting parts of the train are stopped by emergency braking activated by the train itself.

The following requirements describe all necessary action if train integrity is lost.

#REQ_5.6.5-1#

When the information about a loss of train integrity is provided to UGTMS, UGTMS shall establish a zone of protection.

#REQ_5.6.5-2#

UGTMS shall provide the necessary information about loss of train integrity to the interface with the external operations control HMI.

#REQ_5.6.5-3#

UGTMS shall provide the necessary information about loss of train integrity to the interface with the external train HMI. (M for GOA1, M for GOA2, O for GOA3, O for GOA4)

#REQ_5.6.5-4#

When the information about a loss of train integrity is provided to UGTMS, UGTMS shall request the cut-off of the traction power of the concerned area. (O)

5.6.6 React to the loss of train doors closed and locked status

Mandatory: all GOAs

This function is intended to react to the loss of the closed and locked status of train doors provided by the train.

#REQ_5.6.6-1#

In case the door closed and locked status is lost and the train is stopped between stations, UGTMS shall command immobilization of the train.

#REQ_5.6.6-2#

In case the door closed and locked status is lost and the train is stopped between stations, UGTMS shall establish a zone of protection. (O)

#REQ_5.6.6-3#

In case the door closed and locked status is lost and the train is stopped between stations, UGTMS shall request the cut-off of the traction power of the concerned area. (O)

6.1.1 Import timetables

Optional: all GOAs

This function is intended to import timetables from a database outside UGTMS.

#REQ_6.1.1-1#

UGTMS shall support import of timetables provided by an operation planning system outside UGTMS.

#REQ_6.1.1-2#

UGTMS shall provide the selected imported timetable to the interface with the external operations control HMI, as a result of an operational command provided via the interface with the external operations control HMI.

6.1.2 Select the timetable

Optional: all GOAs

This function allows the OCC staff to select a timetable from imported timetables or from the ones defined internally by UGTMS, which becomes the operational timetable.

#REQ_6.1.2-1#

It shall be possible to activate a selected timetable by operational command provided via the interface with the external operations control HMI to become the operational timetable.

6.1.3 Modify the operational timetable

Optional: all GOAs

This function is intended to allow the OCC staff to manage the train service by modifying the operational timetable.

#REQ_6.1.3-1#

UGTMS shall modify the operational timetable according to commands provided via the interface with the external operations control HMI (e.g. extra trains for sporting events, movements of engineers' trains).

#REQ_6.1.3-2#

UGTMS shall provide the operational timetable to the interface with the external operations control HMI to be displayed for modification.

#REQ_6.1.3-3#

It shall be possible to modify the timetable with short term changes (for example, terminating a train short of its normal destination) such that recourse to manual route setting is not required.

6.2 Manage the train service

Subclause 6.2 contains all functions which are necessary for management of train service to fulfil the proposed transport offer to customers of the transport undertaking in nominal mode and in cases of operational disturbances with the goal of minimizing deviations from nominal operation.

6.2.1 Manage train missions

Optional: GOA1 and GOA2; mandatory: GOA3 and GOA4

This function is intended to create instructions for the movement of a train from a start location (e.g. start station, transfer track) up to a destination location (e.g. terminus station, transfer track) by assigning missions to a planned train journey, as described in the operational timetable or equivalent UGTMS internal data.

Parameters of train mission should allow the following functions:

- move passenger-less train;
- skip station;
- avoid stopping in station;
- move engineer's (maintenance) train;
- turn back within a station;
- turn back in a siding area;
- modify target station of missions or groups of missions;
- couple and uncouple train;
- set in/set out for a mission;
- exit from and entry to UGTMS territory;
- add trains on demand;
- cancel trains or group of trains;
- modify dwell time.

#REQ_6.2.1-1#

UGTMS shall assign a mission to a train journey either by operational command provided via the interface with the external operations control HMI or automatically from the operational timetable or equivalent UGTMS internal data.

#REQ_6.2.1-2#

UGTMS shall assign a mission to a specific train for every scheduled train journey, and optionally, the train shall be chosen according to criteria defined by the transport authority (e.g. maintenance consideration, mileage of the train).

#REQ_6.2.1-3#

Changes in a mission shall be taken into account as soon as possible if they are applicable considering the current time and location of the train.

#REQ_6.2.1-4#

When all missions assigned to the train are completed, the train shall automatically go into the stand-by state (train stopped, and doors closed). (not applicable for GOA1, not applicable for GOA2, not applicable for GOA3, O for GOA4)

#REQ_6.2.1-5#

UGTMS shall allow the marking of train journeys for trains which have to be sent to sidings or workshop after finishing revenue service. (O)

#REQ_6.2.1-6#

Deleted.

#REQ_6.2.1-7#

Once a mission is assigned to a train, UGTMS shall create a unique train identification number associated to this specific mission.

#REQ_6.2.1-8#

Deleted.

#REQ_6.2.1-9#

Deleted.

#REQ_6.2.1-10#

UGTMS shall allow entry of the train identification by command provided via the interface with the external operations control HMI. (O)

#REQ_6.2.1-11#

UGTMS shall allow modification of all the parameters of the mission (e.g. timings, destination) by commands provided via the interface with the external operations control HMI.

#REQ_6.2.1-12#

It shall be possible to create a mission only by defining the destination of the train journey. (O)

#REQ_6.2.1-13#

Deleted.

6.2.2 Set routes automatically

Optional: GOA1 and GOA2; mandatory: GOA3 and GOA4

This function is intended to set routes automatically by train approach or train mission.

#REQ_6.2.2-1#

Where multiple routes to a given destination are possible, UGTMS shall determine the choice of route by considering the mission, the current time and train location, and optionally the level of priority of the train service.

#REQ_6.2.2-2#

Deleted.

#REQ_6.2.2-3#

Deleted.

#REQ_6.2.2-4#

In order to ensure that no delay to the train is incurred, UGTMS shall automatically trigger route setting sufficiently in advance of the arrival of the train to the route origin or before the scheduled departure of the train (when the train is already at the required departure point).

#REQ_6.2.2-5#

Deleted.

#REQ_6.2.2-6#

UGTMS shall be able to automatically trigger route setting using the information contained in the train mission.

#REQ_6.2.2-7#

Deleted.

#REQ_6.2.2-8#

Deadlocks (trains facing each other where one shall be backed up) shall be prevented.

#REQ_6.2.2-9#

Alternation of platforms (turnback and en-route) shall be managed.

#REQ_6.2.2-10#

Bi-directional use of tracks shall be managed. (O)

#REQ_6.2.2-11#

The diversion of trains around a section of track not available for train operation shall be managed.

6.2.3 Regulate trains

Optional: all GOAs

This function is intended to regulate train service to avoid bunching of trains and to reduce delays of trains in case of disturbances.

#REQ_6.2.3-1#

Regulation shall be based on the current missions.

#REQ_6.2.3-2#

When trains are added to the service, UGTMS regulation shall adapt the missions of trains such that the perturbation to the normal scheduled service is minimised.

#REQ_6.2.3-3#

UGTMS shall propose regulation strategies complying with the operational timetable or a given headway.

#REQ_6.2.3-4#

UGTMS shall detect deviation from timetable or headway.

#REQ_6.2.3-5#

UGTMS shall provide an alarm to the interface with the external operations control HMI when the advance/delay of the train exceeds a predefined value.

#REQ_6.2.3-6#

In case of detected deviation from timetable or headway, UGTMS shall calculate revised timings of the missions for one or more trains, in order to minimise the effects of service perturbations. (O)

6.2.4 Deleted

6.2.5 Manage operational disturbances

Optional: all GOAs

This function is intended to propose a catalogue of measures and assist the resolution of operational disturbances which are recognised by supervising train operation.

#REQ_6.2.5-1#

Priority rules shall be established to manage junctions. When trains are not on schedule, UGTMS shall resolve conflicts automatically using pre-defined junction prioritisation or submit a choice of strategies to the interface with the external operations control HMI.

#REQ_6.2.5-2#

In case of delayed operation which cannot be corrected by train regulation strategies, UGTMS shall propose corrective actions in order to return to regular operation.

#REQ_6.2.5-3#

In case of track sections not available for train running (e.g. failed trains or failed track elements), UGTMS shall identify corrective actions to be proposed to operations staff in order

- to continue operations (e.g. by using a crossover), or
- to maintain service in undisturbed parts of the line (e.g. turn back in defined sidings or platform tracks, shuttle service in different parts of the line).

#REQ_6.2.5-4#

UGTMS shall provide the proposed corrective actions to the interface with the external operations control HMI to be displayed to request operations staff to modify timetable or missions or track elements.

#REQ_6.2.5-5#

Deleted.

6.2.6 Dispatch trains for energy saving

Optional: all GOAs

This function is intended to harmonise the starting of trains in stations on the whole line taking into account the different dwell times, corresponding to results of train regulation, in order to save energy with limited impact on operational service.

#REQ_6.2.6-1#

UGTMS shall coordinate starting of trains in different stations of the line by modifying dwell times in accordance with the actual situation (e.g. delay, regulation) in a way that minimises the instantaneous consumption of electrical power.

#REQ_6.2.6-2#

UGTMS shall coordinate starting of trains in different stations of the line by modifying dwell times in a way that energy of braking trains can be used for starting trains in an optimised way. (O)

6.3 Supervise train operations

Subclause 6.3 contains all functions which are necessary to supervise operation on a whole line or a whole network.

6.3.1 Supervise train tracking

Mandatory: all GOAs

This function is intended to track trains automatically and provide the information related to trains to operations staff.

This comprises information related to the track occupancy (e.g. location of reporting trains, sections of tracks occupied by failed trains) and information related to operations (identification of trains, wrong initialisation of a train, non-communicating trains, delays).

#REQ_6.3.1-1#

UGTMS shall report the position of all trains to the external operations control HMI. This includes

- the location of reporting trains, and
- the track sections occupied by non-reporting trains (if external train detection devices are used by UGTMS).

#REQ_6.3.1-2#

For each train, UGTMS shall provide the fixed unique train related numbers (e.g. train number, unit number, car number) to the interface with the external operations control HMI.

#REQ_6.3.1-3#

UGTMS shall report the information on the train's deviation from schedule to the interface with the external operations control HMI.

#REQ_6.3.1-4#

UGTMS shall store information about deviation from scheduled operation for the time required by the transport authority in order to support operations (e.g. investigation, analysis, elaboration of report).

6.3.2 Supervise trains and wayside equipment

Optional: GOA1 and GOA2; mandatory: GOA3 and GOA4

This function is intended to monitor train and wayside equipment to recognise the current status and, as soon as possible, failures which could lead to possible operational disturbances.

#REQ_6.3.2-1#

UGTMS shall provide all status and failure information of UGTMS onboard equipment with assigned level of priority to the interface with the external train HMI. (M for GOA1, M for GOA2, O for GOA3, O for GOA4)

#REQ_6.3.2-2#

UGTMS shall provide all status and failure information of UGTMS onboard equipment with assigned level of priority to the interface with the external operations control HMI. (O for GOA1, O for GOA2, M for GOA3, M for GOA4)

#REQ_6.3.2-3#

In case of failures of equipment, UGTMS shall provide a proposed operational action to be performed to the relevant HMI interface. (O)

#REQ_6.3.2-4#

UGTMS shall provide all status and failure information of UGTMS wayside equipment and operations control equipment with assigned level of priority to the interface with the external operations control HMI.

#REQ_6.3.2-5#

Deleted (moved to the dedicated subfunction 6.3.4).

#REQ_6.3.2-6#

Deleted (moved to the dedicated subfunction 6.3.4).

#REQ_6.3.2-7#

Deleted (moved to the dedicated subfunction 6.3.4).

#REQ_6.3.2-8#

UGTMS shall provide specified status and failure information provided by interface with the train to the interface with the external operations control HMI.

#REQ_6.3.2-9#

UGTMS shall provide specified status and failure information from external wayside devices (e.g. external interlocking, trackside signalling equipment such as train detection devices) to the interface with the external operations control HMI.

#REQ_6.3.2-10#

UGTMS shall store all information about status, failures and malfunctions for the time required by the transport authority in order to support operations (e.g. investigation, analysis, elaboration of report).

#REQ_6.3.2-11#

Deleted.

6.3.3 Supervise passengers

This function is intended to support staff in supervising passengers in the whole network by using for example audio and video means.

6.3.3.1 Supervise passengers on platforms

Optional: all GOAs

This function is intended to support staff in supervising platforms.

#REQ_6.3.3.1-1#

UGTMS shall provide audio or video interfaces to monitor platforms for passenger security and system protection.

#REQ_6.3.3.1-2#

Deleted.

6.3.3.2 Supervise passengers in trains

Optional: all GOAs

This function is intended to support staff in supervising passengers inside the trains.

#REQ_6.3.3.2-1#

UGTMS shall provide video transmission from trains (inside vehicles) to OCC. (O)

#REQ_6.3.3.2-2#

UGTMS shall provide audio transmission between OCC and trains (inside vehicles) (e.g. emergency call, audio surveillance).

6.3.4 Perform progressive shutdown

Optional: GOA4

This function is intended to perform the progressive shutdown of operations, if for any reason it is no longer possible to control operations from the OCC.

#REQ_6.3.4-1#

UGTMS shall activate the progressive shutdown of the train service, when receiving a specific command provided via the interface with the external operations control HMI, or via a direct activation within UGTMS wayside equipment (e.g. through pushing a button or acting on a selector).

#REQ_6.3.4-2#

When the progressive shutdown is activated, UGTMS shall permit trains to reach the next station, or a dedicated evacuation point, and to be immobilized there.

#REQ_6.3.4-3#

When the progressive shutdown is activated, and when receiving a command provided via the interface with an external wayside equipment device (e.g. key, button), UGTMS shall command the immobilized train to leave the station, or the dedicated evacuation point, independently of the OCC, provided that conditions for safe movement of train are fulfilled in order to permit a following train to berth in such place.

6.4 Control traction power

6.4.1 Monitor traction power supply

Optional: all GOAs

This function is intended to monitor the status of sections of traction power supply provided by the interface to the external traction power supply control equipment.

#REQ_6.4.1-1#

UGTMS shall monitor the status of sections (on/off) provided by the interface with the traction power supply equipment and provide traction power status (on/off) to the interface with the external operations control HMI.

#REQ_6.4.1-2#

UGTMS shall monitor the interface to the external traction power supply equipment and provide status information to the interface with the external operations control HMI.

#REQ_6.4.1-3#

When traction power is lost in a section ahead of the train, UGTMS shall apply the service brake if it is possible to stop the train in advance of the section. (O)

#REQ_6.4.1-4#

When traction power is lost in a section ahead of the train, UGTMS shall hold the train in the preceding station. (O)

6.4.2 Command traction power supply

Optional: all GOAs

This function is intended to command the external traction power supply control equipment by the OCC staff, or locally, either on given sections or on all sections.

#REQ_6.4.2-1#

UGTMS shall command the traction power supply (on/off) on all sections or on designated sections via the interface with the external operations control HMI acting on the external traction power supply control equipment.

6.4.3 Control regenerative braking

Optional: all GOAs

This function is intended to prevent regenerative braking that would feed a traction power supply section that has been cut off in order to protect passengers or staff.

#REQ_6.4.3-1#

UGTMS shall withdraw authorization for regenerative braking on all trains in the area selected by staff provided via the interface with the external operations control HMI.

#REQ_6.4.3-2#

UGTMS shall withdraw authorization for regenerative braking on all trains that could feed a traction power supply section that has been cut off. (O)

6.5 Manage the interface with the HMI

Subclause 6.5 contains all functions and requirements intended to be provided to the interfaces with the HMIs.

The HMIs themselves and the authorization of operations staff are outside UGTMS.

6.5.1 Manage the interface with the operations control HMI

Mandatory: all GOAs

This function is intended to send and receive information of UGTMS and interfaced non-UGTMS equipment to/from the interface with the external operations control HMI.

#REQ_6.5.1-1#

Deleted.

#REQ_6.5.1-2#

UGTMS shall manage information (including operational statuses) to and from the interface with the external operations control HMI.

#REQ_6.5.1-3#

UGTMS shall provide a safe data exchange from/to the interface with the external operations control HMI in order to ensure provision of safety-related commands.

#REQ_6.5.1-4#

Deleted.

6.5.2 Manage the interface with the train HMI

Mandatory: GOA1 and GOA2; optional: GOA3 and GOA4

This function is intended to send and receive information relevant to train operation to and from the external train HMI.

#REQ_6.5.2-1#

UGTMS shall provide cab signal information (e.g. maximum allowed speed, driving mode and door opening authorization) and receive commands (e.g. driving mode selection) to/from the external train HMI.

#REQ_6.5.2-2#

UGTMS shall provide a safe data exchange from/to the interface with the external train HMI in order to ensure provision of safety-related commands (M for GOA1, M for GOA2, O for GOA3, O for GOA4).

6.6 Provide interface with the communication system for passengers and staff

Mandatory: all GOAs if UGTMS is interfaced to an external voice communication system

This function is intended to provide interface with an external voice communication system, which allows communication between staff and between passengers and staff, by utilising the UGTMS data communication system in a way to be specified in detail by needs of transport authorities and the communication system.

#REQ_6.6-1#

UGTMS shall transport bidirectional voice communication between interfaces with onboard and wayside communication devices and interfaces with communication devices at the OCC or other locations as determined by transport authority.

#REQ_6.6-2#

Deleted.

6.7 Provide interface with the passenger information system

Mandatory: all GOAs if UGTMS is interfaced to an external passenger information system

This function is intended to provide an interface with the external wayside passenger information system and the external onboard passenger information system.

#REQ_6.7-1#

UGTMS shall interface with the external passenger information system to trigger information such as train arrival, next station information.

6.8 Provide interface with passenger surveillance system

Mandatory: all GOAs if UGTMS is interfaced to an external passenger surveillance system

This function is intended to provide automatically, or by the external operations control HMI, information and commands to the interface with external CCTV surveillance systems.

#REQ_6.8-1#

UGTMS shall provide information to the interface with external video surveillance systems in order to activate specific cameras in accordance with a reported event (e.g. location of intrusion detection in platform).

#REQ_6.8-2#

UGTMS shall provide commands to the interface with external video surveillance systems in order to activate specific cameras as result of a command provided via the interface with the external operations control HMI.

6.9 Support maintenance

Mandatory: all GOAs if UGTMS is interfaced to an external maintenance system

This function is intended to provide all information about failures, malfunctions and status information of UGTMS and non-UGTMS equipment to the external maintenance system.

#REQ_6.9-1#

UGTMS shall identify any failed UGTMS replaceable unit.

#REQ_6.9-2#

UGTMS shall provide failure and status information of UGTMS equipment and interfaced non-UGTMS equipment to the external maintenance system.

#REQ_6.9-3#

All onboard related data shall include information related to the train location at the time the event took place. (O)

#REQ_6.9-4#

UGTMS shall calculate the number of run kilometres travelled by a train or receive it from the train and provide it to the external maintenance system. (O)

6.10 Manage train and staff resources**6.10.1 Assign train to operation needs****Optional: all GOAs**

This function is intended to provide knowledge about the fleet of trains available in the network or on the line to satisfy the needs of daily operation regarding maintenance constraints.

The train providing service for a particular day is formed from one or more uniquely identifiable units (a unit comprises a number of semi-permanently coupled cars). Trains are formed to meet the demands of the timetable.

#REQ_6.10.1-1#

UGTMS shall provide a list of trains which are available for mission assignment during a given period of operation taking into account the needs of maintenance for each train.

6.10.2 Assign or reassign train staff**Optional: GOA1, GOA2 and GOA3**

This function is intended to provide knowledge about available train staff and allow the OCC staff to assign train staff to a given train.

The duties and working times of a train crew are detailed within the duty roster (outside of UGTMS). The roster shall contain details of the crew identities and linkages to the train mission information held within the planned timetable.

#REQ_6.10.2-1#

UGTMS shall import planned duty roster data to create associations between train staff and missions.

#REQ_6.10.2-2#

In order to meet current operational needs, UGTMS shall provide knowledge about available train staff, and assign train staff (using train staff identification) to trains or modify the planned duty roster by commands provided via the interface with the external operations control HMI.

#REQ_6.10.2-3#

UGTMS shall receive the unique train staff identification from the external train HMI. (O)

#REQ_6.10.2-4#

In case of discrepancy between the staff identity entered on the external train HMI and the staff identity of the duty roster, an alarm shall be sent to the interface with the external operations control HMI. (O)

#REQ_6.10.2-5#

UGTMS shall transmit modifications of crewing arrangements to the duty roster system. (O)

DỰ ÁN TIÊU CHUẨN TC2546

Annex A (informative)

Advice to the reader about options in the document, for functions and requirements

A.1 General statement

This document provides a list of UGTMS requirements split into mandatory and optional functions.

The functions to use in a given UGTMS project are defined by the GOA.

Therefore, depending on the GOA of this project, it implies the use of some functions seen as mandatory for this GOA; and, within each of these functions, every requirement described as mandatory for this GOA will have to be applied.

The functions (and requirements) which are described as optional for this GOA will be selected on a case-by-case basis, according to the specific needs of the UGTMS project.

Options are hence to be considered at two levels.

The 1st level is at the function one: an optional function can be activated.

As said above, it means then the automatic application of requirements as mandatory in this optional function.

But, for the optional requirements of this selected optional function, only a part of them could be selected. This is then the 2nd level of option.

Therefore, this is an important task for the project management to do this selection of options, at the level of functions, and at the level of requirements.

Most of the functions characterized as mandatory are to be considered with no condition. But some specific functions have a condition to be mandatory (this condition being generally related to the use or not of an external equipment by UGTMS).

A.2 Indications provided for information in this document

In what follows, parts in italic font are extracts from the main part of this document, for which additional information is provided, oriented for the proper use of this document.

5.1.1 *Ensure safe route*

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

This function 5.1.1 has only to be considered as mandatory if it is decided to make UGTMS ensure such kind of function. In other words, if in a project, the existing interlocking is kept and therefore will ensure such function, then UGTMS has not to do it, and this function 5.1.1 is not needed.

In that case, only the interface with such external interlocking is to be ensured, as described in function 5.1.6.

Depending on the application of 5.1.1 (seen as mandatory or optional according to the possible use or not of an external interlocking), it means that related subfunctions of 5.1.1 will apply or not.

If 5.1.1 is not applied, then all related subfunctions of 5.1.1 will not apply.

If 5.1.1 applies, then the related subfunctions will apply depending on their applicability (possibly affected by GOA), as described in each of them.

For instance, when 5.1.1 applies, 5.1.1.1 applies.

#REQ_5.1.2.1.1-4#

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

And #REQ_5.1.2.1.1-5#

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)

There exists no specific dependency between these two requirements in subfunction 5.1.2.1.1 for GOA1 to 3.

Only one of these two optional requirements might be selected, or both, depending on the UGTMS project.

5.1.2.2 Locate non-reporting trains

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

This subfunction has only to be considered as mandatory for all GOAs if devices permitting the detection of train occupancy in track sections are installed and used by UGTMS (for ensuring the detection of non-equipped or failed trains for instance).

5.1.4.3 Authorize train movement by wayside signals

Mandatory: all GOAs if wayside signals are used by UGTMS

This subfunction has only to be considered as mandatory for all GOAs if wayside signals are deployed along the line and are used by UGTMS: possibly for managing non-equipped trains, or for degraded situations.

#REQ_5.1.5.2-6#

UGTMS shall provide one of the two following possibilities for automatic emergency brake release, provided that there are no other conditions for triggering the emergency brake (O):

- **during deceleration when the actual determined train speed returns below the train protection profile; or**
- **when the actual train speed is determined as zero.**

When applying this requirement, only one of these two exclusive bullets has to be considered.

#REQ_5.1.5.2-6#

UGTMS shall provide one of the two following possibilities for automatic emergency brake release, provided that there are no other conditions for triggering the emergency brake (O):

- **during deceleration when the actual determined train speed returns below the train protection profile; or**
- **when the actual train speed is determined as zero.**

And #REQ_5.1.5.2-8#

The emergency brake shall be released by safety-related command provided via the interface with the external operations control HMI if the actual train speed is determined as zero and there is no more condition for triggering the emergency brake. (O)

And #REQ_5.1.5.2-9#

The emergency brake shall be released by a command provided via the interface with the external train HMI if the actual train speed is determined as zero and there is no more condition for triggering the emergency brake. (O)

There exists a dependency between these three optional requirements.

First preliminary remark is that these requirements being all optional, none of them is requested to be selected in a given project.

Depending on the approach followed for an automatic release of emergency brake in #REQ_5.1.5.2-6#, a consistent choice has to be made for the two other optional requirements.

If the approach of the 1st bullet in #REQ_5.1.5.2-6# is selected, then #REQ_5.1.5.2-8# and #REQ_5.1.5.2-9# should not be selected.

5.1.5.3 Inhibit train stops

Mandatory: all GOAs if train stops are used by UGTMS

This subfunction has only to be considered as mandatory for all GOAs if train stops devices (punctual control systems) are installed and interfaced with UGTMS.

#REQ_5.1.5.5-2#

For a train at standstill, UGTMS shall detect unauthorized motion beyond a predefined distance. (O)

This requirement is described as optional as generally, especially with current trains, it is actually covered by the train itself.

5.1.6 Provide interface with external interlocking

Mandatory: all GOAs if "Ensure safe route" functions are not provided by UGTMS

This function has only to be considered as mandatory for all GOAs if an external interlocking is ensuring the functions listed in "Ensure safe route".

If no external interlocking is interfaced with UGTMS, this function 5.1.6 is not selected.

#REQ_5.2.3.1-5#

If the train overruns the platform stop by a distance higher than an acceptable limit (missed station), the train shall proceed to the next station. (O)

And #REQ_5.2.3.1-7#

If a train overruns the platform stop by a distance lower than an acceptable limit, UGTMS shall command the train to jog backward the train until it is correctly aligned. (O)

There exists no specific dependency between these two optional requirements.

Only one of these two optional requirements might be selected, or both, depending on the UGTMS project.

5.3.1.1 Supervise wayside obstacle detection device

Mandatory: all GOAs if wayside obstacle detection devices are used by UGTMS

This function has only to be considered as mandatory for all GOAs if external wayside obstacle detection devices are interfaced with and used by UGTMS.

5.3.1.2 Supervise onboard obstacle detection device

Mandatory: all GOAs if onboard obstacle detection devices are used by UGTMS

This function has only to be considered as mandatory for all GOAs if external onboard obstacle detection devices are interfaced with and used by UGTMS.

#REQ_5.3.1.2-3#

The reaction of the system in case of a detected obstacle shall be maintained until it is released by safety-related command provided via the interface with the external operations control HMI (O for GOA1, O for GOA2, O for GOA3, M for GOA4). This can only be done if the external condition having caused the triggering of the detection is no longer active.

And #REQ_5.3.1.2-5#

The reaction of the system in case of a detected obstacle shall be maintained until it is released by safety-related command provided via the interface with the external train HMI. This can only be done if the external condition having caused the triggering of the detection is no longer active. (M for GOA1, M for GOA2, O for GOA3 and O for GOA4)

At least one of these two optional requirements for GOA3 systems has to be selected, depending on the UGTMS project.

5.3.2.2 React to emergency stop request from platforms

Mandatory: all GOAs if platform emergency stop request devices are used by UGTMS

This function has only to be considered as mandatory for all GOAs if external platform emergency stop request devices are interfaced with and used by UGTMS.

5.3.2.3 Supervise platform doors

Mandatory: all GOAs if platform doors are used by UGTMS

This function has only to be considered as mandatory for all GOAs if platform doors are installed and used by UGTMS.

5.3.2.4 Supervise platform tracks

Mandatory: all GOAs if platform track detection devices are used by UGTMS

This function has only to be considered as mandatory for all GOAs if external platform track detection devices are interfaced with and used by UGTMS.

5.3.2.5 Supervise border between platform tracks and other tracks

Mandatory: all GOAs if detection devices for borders of platform tracks are used by UGTMS

This function has only to be considered as mandatory for all GOAs if external borders of platform tracks detection devices are interfaced with and used by UGTMS.

5.3.2.6 Supervise platform end doors

Mandatory: all GOAs if platform end doors are used by UGTMS

This function has only to be considered as mandatory for all GOAs if platform end doors are installed and used by UGTMS.

5.3.2.7 Supervise emergency exits from guideway

Mandatory: all GOAs if emergency exits from guideway are interfaced with UGTMS

This function has only to be considered as mandatory for all GOAs if emergency exits from guideway are interfaced with UGTMS.

5.4.2.1 Control gap fillers, moveable train steps and similar devices

Mandatory: all GOAs if gap fillers, movable train steps and similar devices are used by UGTMS

This function has only to be considered as mandatory for all GOAs if gap fillers, movable train steps and similar devices are installed and interfaced with UGTMS.

5.4.2.2 Supervise detection of persons between cars or between platform and train

Mandatory: all GOAs if devices detecting persons between cars or between platform and train are used by UGTMS

This function has only to be considered as mandatory for all GOAs if devices detecting persons between cars or between platform and train are installed and interfaced with UGTMS.

#REQ_5.4.3.3-1#

UGTMS shall command automatically the train to depart as soon as departure is authorized (safety and operational conditions fulfilled). (Not applicable for GOA1, O for GOA2, O for GOA3, M for GOA4)

And #REQ_5.4.3.3-2#

UGTMS shall command the train to depart upon manual action of the train operator when departure is authorized (safety and operational conditions fulfilled). (Not applicable for GOA1, O for GOA2, O for GOA3, not applicable for GOA4)

For GOA2 and GOA3 systems, one of these two requirements has to be activated.

For GOA2 systems, if FCN 5.4.1.3 is activated, #REQ_5.4.3.3-2# has to be activated.

#REQ_5.5.1.1-1#

The UGTMS onboard equipment shall be activated by the mission or by a command provided 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 for GOA1, O for GOA2, O for GOA3, M for GOA4).***

The application of this requirement is mandatory if the function 5.5.1.1 is activated (the function being optional for all GOAs).

For GOA3 systems, at least one of these two interfaces has to be used when applying this requirement, if the requirement via a command is activated.

#REQ_5.5.1.2-2#

UGTMS shall enable setting the train to sleep by the mission or by a command provided 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 for GOA1, O for GOA2, O for GOA3, M for GOA4).***

The application of this requirement is mandatory if the function 5.5.1.2 is activated (the function being optional for all GOAs). For GOA3 systems, a choice for activating either the 1st bullet or the second one, or possibly both, will have to be made, if the requirement via a command is activated. For other GOAs, at least the mandatory command for one interface or the other, depending on the GOA, will apply. And the other may also apply, depending on the project.

#REQ_5.5.2-11#

UGTMS shall perform unattended turnback of the trains (not applicable for GOA1, O for GOA2, not applicable for GOA3, not applicable for GOA4)

- ***after the train has stopped in pre-defined turnback areas, and***
- ***on receiving a command provided via the interface with the external train HMI, or an external wayside device (e.g. key, button), or the external operations control HMI.***

In the 2nd bullet of this requirement, at least one of three possible options has to be considered (nothing being against implementing two options, or even the three ones).

#REQ_5.5.3-2#

UGTMS shall restart automatically the train as soon as authorization is granted. (O)

And #REQ_5.5.3-3#

After the authorization is granted, UGTMS shall restart train motion following a command provided via the interface

- **with the external operations control HMI (O), and**
- **with the external train HMI (O for GOA2, O for GOA3, not applicable for GOA4).**

The application of these two optional requirements is exclusive, only one has to be selected in a project based on UGTMS.

#REQ_5.5.9.1-5#

The result of the tests of the UGTMS onboard equipment (including any fault detected) shall be provided to the interface with

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

For GOA3 systems, a choice for activating either the 1st bullet or the second one, or possibly both will have to be made, if the requirement via a command is activated.

#REQ_5.5.9.2-3#

The result of failed tests of the UGTMS onboard equipment (including any fault detected) shall be provided to the interface with

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

For GOA3 systems, a choice for activating either the 1st bullet or the second one, or possibly both, will have to be made, if the requirement via a command is activated.

#REQ_5.5.9.3-1#

During the dynamic emergency braking test, UGTMS shall stop the train using the emergency brake and monitor that its braking performance is satisfactory. (O)

NOTE 1 Such type of test is carried out as specified by the transport authority (e.g. once a day, after a train maintenance in workshop). The actions to be taken following such failed test are specified by the transport authority.

And #REQ_5.5.9.3-5#

UGTMS shall perform a static emergency braking test while at standstill. (O)

NOTE 2 Conditions for triggering such kind of test are specified by the transport authority. The actions to be taken following such failed test are specified by the transport authority.

At least one of these two requirements has to be applied if the optional function 5.5.9.3 is selected.

#REQ_5.5.9.4-2#

When the train equipment failure is no longer reported, UGTMS shall resume normal operation automatically.

NOTE 3 The corresponding list of failures for which an automatic resumption of train movement is possible is specified by the transport authority.

And #REQ_5.5.9.4-3#

When the train equipment failure is no longer reported, UGTMS shall permit the resumption of operation of the affected train by command issued from the interface

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

NOTE 4 The corresponding list of failures for which a resumption of train movement requires an operator command is specified by the transport authority.

These two mandatory requirements can be both activated, as they depend on their respective list of failures, to be defined accordingly by the transport authority.

#REQ_5.5.11-3#

Once the train has reached the correct position, UGTMS shall command the start of the washing and keep the train stationary at the specified location during washing. (O)

And #REQ_5.5.11-4#

Once the train has reached the correct position, UGTMS shall command the start of the washing and control the train movement during washing at the specified speed through the washing machine. (O)

One (and only one) of these two optional requirements has to be selected in an application of UGTMS, depending on the type of washing machine with which UGTMS is interfaced.

5.6.1 React to detected onboard fire/smoke

Mandatory: all GOAs if onboard fire/smoke detection device is used by UGTMS

This function has only to be considered as mandatory for all GOAs if onboard fire/smoke detection devices are installed and interfaced with UGTMS.

5.6.2 React to detected derailment

Mandatory: all GOAs if onboard derailment detection device is used by UGTMS

This function has only to be considered as mandatory for all GOAs if onboard derailment detection devices are installed and interfaced with UGTMS.

5.6.3.1 React to detected broken rail

Mandatory: all GOAs if broken rail detection device is used by UGTMS

This function has only to be considered as mandatory for all GOAs if broken rail detection devices are installed and interfaced with UGTMS.

5.6.3.2 React to suspected broken rail

Optional: all GOAs when track circuits are used by UGTMS for train detection

This function has to be considered as optional for all GOAs if broken detection devices are not installed or interfaced with UGTMS, and if track circuits are used by UGTMS as train detection devices. Otherwise, this function does not apply.

5.6.4.2 React to passenger alarm device activation

Mandatory: all GOAs if UGTMS is interfaced with an external onboard passenger alarm device

This function has only to be considered as mandatory for all GOAs if external onboard passenger alarm devices are installed and interfaced with UGTMS.

5.6.4.3 React to emergency release of train doors

Mandatory: all GOAs if UGTMS is interfaced with an external train doors emergency release device

This function has only to be considered as mandatory for all GOAs if external train doors emergency release devices are installed and interfaced with UGTMS.

#REQ_5.6.6-7#

When a train is immobilized by UGTMS following the loss of door closed and locked status, UGTMS shall maintain the immobilization until it is released by a safety-related command provided via the interface with

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

At least one of these two optional requirements for GOA3 systems has to be selected, depending on the UGTMS project.

6.6 Provide interface with the communication system for passengers and staff

Mandatory: all GOAs if UGTMS is interfaced to an external voice communication system

This function has only to be considered as mandatory for all GOAs if the external voice communication system is interfaced with UGTMS.

6.7 Provide interface with the passenger information system

Mandatory: all GOAs if UGTMS is interfaced to an external passenger information system

This function has only to be considered as mandatory for all GOAs if the external passenger information system is interfaced with UGTMS.

6.8 Provide interface with passenger surveillance system

Mandatory: all GOAs if UGTMS is interfaced to an external passenger surveillance system

This function has only to be considered as mandatory for all GOAs if the external passenger surveillance system is interfaced with UGTMS.

6.9 Support maintenance

Mandatory: all GOAs if UGTMS is interfaced to an external maintenance system

This function has only to be considered as mandatory for all GOAs if the external maintenance system is interfaced with UGTMS.

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Annex B (informative)

Typical system performance criteria

Table B.1 provides examples of performance criteria seen as essential in the design of UGTMS systems for their effective performance.

Table B.1 – Examples of performance criteria seen as essential for a UGTMS application

Reference	Nature of criterion	Criterion	Definition
UGTMS-01	Safety	Minimum distance between a stopped train and an obstacle	Expressed in metres. Safety margin used to ensure that, in any case, the train stops before a given obstacle (other train, buffer stop, faulty point, etc.). ^a
UGTMS-02	Capacity	Maximum number of units per depot	Corresponds to the number of UGTMS equipped units able to be present in the depot.
UGTMS-03	Capacity	Maximum number of units on the guideway during peak hours	Corresponds to the number of UGTMS equipped units able to be present on the main line.
UGTMS-04	Safety	Maximum location uncertainty	Expressed in metres (corresponding values are given using the symbol \pm). Defines the maximum error in localisation at the moment it is computed by UGTMS.
UGTMS-05	Capacity	Maximum line speed	Expressed in km/h. Maximum operational speed for trains on the line.
UGTMS-06	Capacity	Technical headway for normal non-mixed traffic operations	Expressed in seconds. Time between two successive trains travelling at full speed passing the same point on the guideway (not taking into account dwell times or any aspect related to operations, but only the capacity that can be reached from a technical point of view).
UGTMS-07	Capacity	Design headway for normal non-mixed traffic operations	Expressed in seconds. Headway including dwell times, allowed by UGTMS design if all related conditions are fulfilled (characteristics of inter-stations, of turn back area, of trains, etc.), including the system technical reaction time, and when all conditions of operations are ideal.
UGTMS-08	Capacity	Operating headway for normal non-mixed traffic operation	Expressed in seconds. Headway corresponding to the design headway plus operations margins.
UGTMS-09	Availability	Stopping accuracy in station without platform doors	Expressed in metres. Corresponding values are given using the symbol \pm . Deviation between the theoretical operational stopping point and the actual one.

Reference	Nature of criterion	Criterion	Definition
UGTMS-10	Availability	Stopping accuracy in station with platform doors	Expressed in metres. Corresponding values are given using the symbol \pm Deviation between the theoretical operational stopping point and the actual one.
UGTMS-11	Availability	Maximum time to set a route	Expressed in seconds. Maximum time needed to set a route (including related commands and positioning of related wayside equipment).
^a This value applies for a train at standstill.			

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Annex C

(informative)

Summary of applicability of functions and subfunctions depending on GOAs

Table C.1 lists all functions and subfunctions and indicates if this function/subfunction is applicable for a given GOA.

If not applicable, it indicates n/a, and if applicable, it indicates M if this function is mandatory, O if optional, M_IF if mandatory based on a condition, O_IF if optional based on a condition.

If a function X is optional or mandatory based on a condition or optional based on a condition, the consideration of related subfunctions depends on the activation of the function X in an application of UGTMS in a project. If X is not activated, all related subfunctions have to be ignored for the related project.

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Table C.1 – Mandatory and optional functions/subfunctions according to GOA

Reference of the function or subfunction from IEC 62290-2	Headline of the function or subfunction from IEC 62290-2:	GOA1	GOA2	GOA3	GOA4
5	Functions for train operation				
5.1	Ensure safe movement of trains				
5.1.1	Ensure safe route	M_IF	M_IF	M_IF	M_IF
5.1.1.1	Set and protect route				
5.1.1.1.1	Set route	M	M	M	M
5.1.1.1.2	Supervise route	M	M	M	M
5.1.1.1.3	Lock route by train	M	M	M	M
5.1.1.2	Release route	M	M	M	M
5.1.2	Ensure safe separation of trains				
5.1.2.1	Locate UGTMS reporting trains				
5.1.2.1.1	Initialise UGTMS reporting trains location	M	M	M	M
5.1.2.1.2	Determine train orientation	M	M	M	M
5.1.2.1.3	Determine actual train travel direction	M	M	M	M
5.1.2.1.4	Determine train location	M	M	M	M
5.1.2.2	Locate non-reporting trains	M_IF	M_IF	M_IF	M_IF
5.1.3	Determine permitted speed				
5.1.3.1	Determine static speed profile	M	M	M	M
5.1.3.2	Determine temporary infrastructure speed restrictions	O	O	O	O
5.1.3.3	Determine maximum speed by train type	O	O	O	O
5.1.3.4	Determine temporary train speed restrictions	O	O	O	O
5.1.4	Authorize train movement				
5.1.4.1	Determine movement authority limit	M	M	M	M
5.1.4.2	Determine train protection profile	M	M	M	M
5.1.4.3	Authorize train movement by wayside signals	M_IF	M_IF	M_IF	M_IF

Reference of the function or subfunction from IEC 62290-2	Headline of the function or subfunction from IEC 62290-2:	GOA1	GOA2	GOA3	GOA4
5.1.4.4	Determine a zone of protection	M	M	M	M
5.1.4.5	Deleted				
5.1.4.6	Authorize the entry of non-operative UGTMS trains into UGTMS territory	O	O	O	O
5.1.5	Supervise train movement				
5.1.5.1	Determine actual train speed	M	M	M	M
5.1.5.2	Supervise safe train speed	M	M	M	M
5.1.5.3	Inhibit train stops	M_IF	M_IF	M_IF	M_IF
5.1.5.4	Deleted				
5.1.5.5	Supervise train rollaway	O	M	M	M
5.1.5.6	React to unauthorized movements of non-operative UGTMS trains	O	O	O	O
5.1.6	Provide interface with external interlocking	M_IF	M_IF	M_IF	M_IF
5.2	Drive train				
5.2.1	Determine operating speed profile	n/a	M	M	M
5.2.2	Control train movement in accordance with train operating speed profile	n/a	M	M	M
5.2.3	Stop train in station				
5.2.3.1	Stop train at next station	n/a	M	M	M
5.2.3.2	Hold train at station	O	O	M	M
5.2.3.3	Skip station stop	O	O	O	O
5.3	Supervise guideway				
5.3.1	Prevent collision with obstacles				
5.3.1.1	Supervise wayside obstacle detection device	M_IF	M_IF	M_IF	M_IF
5.3.1.2	Supervise onboard obstacle detection device	M_IF	M_IF	M_IF	M_IF
5.3.2	Prevent collisions with persons on tracks				
5.3.2.1	Warn passengers to stay away from the platform edge	O	O	O	O
5.3.2.2	React to emergency stop request from platforms	M_IF	M_IF	M_IF	M_IF
5.3.2.3	Supervise platform doors	M_IF	M_IF	M_IF	M_IF

Reference of the function or subfunction from IEC 62290-2	Headline of the function or subfunction from IEC 62290-2:	GOA1	GOA2	GOA3	GOA4
5.3.2.4	Supervise platform tracks	M_IF	M_IF	M_IF	M_IF
5.3.2.5	Supervise border between platform tracks and other tracks	M_IF	M_IF	M_IF	M_IF
5.3.2.6	Supervise platform end doors	M_IF	M_IF	M_IF	M_IF
5.3.2.7	Supervise emergency exits from guideway	M_IF	M_IF	M_IF	M_IF
5.3.3	Protect staff on track by work zone	O	O	M	M
5.4	Supervise passenger transfer				
5.4.1	Control train and platform doors				
5.4.1.1	Authorize door opening	O	O	O	M
5.4.1.2	Command door opening	O	O	O	O
5.4.1.3	Request door closing	O	O	O	M
5.4.1.4	Supervise door closing	O	O	O	O
5.4.2	Prevent injuries to persons between cars or between platform and train				
5.4.2.1	Control gap fillers, movable train steps and similar devices	M_IF	M_IF	M_IF	M_IF
5.4.2.2	Supervise detection of persons between cars or between platform and train	M_IF	M_IF	M_IF	M_IF
5.4.3	Ensure train departure				
5.4.3.1	Authorize train departure (safety-related conditions)	M	M	M	M
5.4.3.2	Authorize train departure (operational conditions)	O	O	M	M
5.4.3.3	Command train departure	n/a	M	M	M
5.5	Operate a train				
5.5.1	Put in or take out of operation				
5.5.1.1	Awake trains	O	O	O	O
5.5.1.2	Set trains to sleep	O	O	O	O
5.5.2	Manage driving modes	M	M	M	M
5.5.3	Manage movement of trains after unexpected stops	n/a	M	M	M
5.5.4	Manage stabling	O	O	O	O
5.5.5	Deleted				

Reference of the function or subfunction from IEC 62290-2	Headline of the function or subfunction from IEC 62290-2:	GOA1	GOA2	GOA3	GOA4
5.5.6	Restrict train entry to station	O	O	O	O
5.5.7	Change the travel direction	M	M	M	M
5.5.8	Couple and uncouple a train	O	O	O	O
5.5.8.1	Couple trains automatically	n/a	n/a	O	O
5.5.8.2	Uncouple trains automatically	n/a	n/a	O	O
5.5.9	Supervise the status of UGTMS				
5.5.9.1	Supervise UGTMS equipment status prior to entering service	M	M	M	M
5.5.9.2	Supervise UGTMS equipment status during operation	M	M	M	M
5.5.9.3	Test emergency braking performance	O	O	O	O
5.5.9.4	React to detected train equipment failure	O	O	M	M
5.5.10	Manage traction power supply on train	O	O	O	O
5.5.11	Manage train washing	n/a	n/a	M_IF	M_IF
5.5.12	Manage non-stopping areas	O	O	O	O
5.6	Ensure detection and management of emergency situations				
5.6.1	React to detected onboard fire/smoke	M_IF	M_IF	M_IF	M_IF
5.6.2	React to detected derailment	M_IF	M_IF	M_IF	M_IF
5.6.3	React to detected or suspected broken rail				
5.6.3.1	React to detected broken rail	M_IF	M_IF	M_IF	M_IF
5.6.3.2	React to suspected broken rail	O_IF	O_IF	O_IF	O_IF
5.6.4	Manage passenger requests				
5.6.4.1	Deleted				
5.6.4.2	React to passenger alarm device activation	M_IF	M_IF	M_IF	M_IF
5.6.4.3	React to emergency release of train doors	M_IF	M_IF	M_IF	M_IF
5.6.5	React to loss of train integrity	O	O	O	O
5.6.6	React to the loss of train doors closed and locked status	M	M	M	M
6	Functions for operation management and supervision				

Reference of the function or subfunction from IEC 62290-2	Headline of the function or subfunction from IEC 62290-2:	GOA1	GOA2	GOA3	GOA4
6.1	Manage the daily timetable				
6.1.1	Import timetables	O	O	O	O
6.1.2	Select the timetable	O	O	O	O
6.1.3	Modify the operational timetable	O	O	O	O
6.2	Manage the train service				
6.2.1	Manage train missions	O	O	M	M
6.2.2	Set routes automatically	O	O	M	M
6.2.3	Regulate trains	O	O	O	O
6.2.4	Deleted				
6.2.5	Manage operational disturbances	O	O	O	O
6.2.6	Dispatch trains for energy saving	O	O	O	O
6.3	Supervise train operations				
6.3.1	Supervise train tracking	M	M	M	M
6.3.2	Supervise trains and wayside equipment	O	O	M	M
6.3.3	Supervise passengers				
6.3.3.1	Supervise passengers on platforms	O	O	O	O
6.3.3.2	Supervise passengers in trains	O	O	O	O
6.3.4	Perform progressive shutdown	n/a	n/a	n/a	O
6.4	Control traction power				
6.4.1	Monitor traction power supply	O	O	O	O
6.4.2	Command traction power supply	O	O	O	O
6.4.3	Control regenerative braking	O	O	O	O
6.5	Manage the interface with the HMI				
6.5.1	Manage the interface with the operations control HMI	M	M	M	M
6.5.2	Manage the interface with the train HMI	M	M	O	O
6.6	Provide interface with the communication system for passengers and staff	M_IF	M_IF	M_IF	M_IF

Reference of the function or subfunction from IEC 62290-2	Headline of the function or subfunction from IEC 62290-2:	GOA1	GOA2	GOA3	GOA4
6.7	Provide interface with the passenger information system	M_IF	M_IF	M_IF	M_IF
6.8	Provide interface with passenger surveillance system	M_IF	M_IF	M_IF	M_IF
6.9	Support maintenance	M_IF	M_IF	M_IF	M_IF
6.10	Manage train and staff resources				
6.10.1	Assign train to operation needs	O	O	O	O
6.10.2	Assign or reassign train staff	O	O	O	n/a

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