EUROPEAN UNION AGENCY FOR RAILWAYS

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European Union Agency for Railways

Guide for the application of the TSI for the Subsystems Control-Command and Signalling Track-side and On-board

According to Framework Mandate C(2007)3371 final of 13/07/2007

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1. INTRODUCTION

1.1. SCOPE

1.1.1. This document is an annex to the “Guide for the Application of TSIs”. It provides information on the application of Technical Specification for Interoperability for “Control-Command and Signalling” set out as Annex to the Commission Regulation (EU) 2016/919 [1].

1.1.2. This document needs to be read and used only in conjunction with the “Control-Command and Signalling” TSI. It is intended to facilitate its application but it does not substitute for it. The general part of the “Guide for the Application of TSIs” has also to be considered.

1.1.3. Guidance is of voluntary application. It does not mandate any requirement in addition to those set out in the “Control-Command and Signalling” TSI.

1.2. DOCUMENT DESCRIPTION

1.2.1. Chapter 3 provides clarifications for certain concepts and requirements of the Control-Command and Signalling TSI. To facilitate the use, this chapter has the same structure as the TSI: each section of chapter 3 refers to a section of the TSI.

1.2.2. Guidance is not provided where the “Control-Command and Signalling” TSI does not requires further explanations.

1.2.3. Chapter 4 lists the specifications and standards supporting the assessment of compliance with the TSI requirements. The scope of each standard is clarified through the reference to the corresponding basic parameter.

2. REFERENCES, TERMS AND ABBREVIATIONS

2.1. REFERENCE DOCUMENTS

Table 1: Reference documents

Ref. N°	Document Reference	Title	Last Issue
[1]	(EU) 2016/919	Commission Regulation of 27 May 2016 on the technical specification for interoperability relating to the control-command and signalling subsystems of the rail system in the European Union	*OJ L 158 15.6.2016 p. 1*
[2]	(EU) 2016/798	Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety	*OJ L 138 26.5.2016 p. 102*
[3]	(EU) 2016/797	Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the the rail system within the Community (recast)	*OJ L 138 26.5.2016 p. 44*
[4]	2014/30/EU	Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the approximation of the laws of the Member States relating to electromagnetic compatibility (recast)	*OJ L 96 29.3.2014 p 79*
[5]	2014/53/EU	Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to making available on the market of radio equipment and repealing Directive 1995/5/EC	*OJ L 153 22.5.2014 p 62*
[6]	2015/C 014/01	Commission communication in the framework of the implementation of Directive 2004/108/EC of the European Parliament and of the Council on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC	*OJ C 14, 16.01.2015 p. 1*
[7]	2013/C 345/03	Commission communication in the framework of the implementation of the Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community (recast)	*OJ C 345, 26.11.2013 p. 3*
[8]	ERA_ERTMS_0001	ERTMS Change Control Management	2.0
[9]	ERA_ERTMS_028528	Terms of Reference of the “Notified Bodies ad hoc Group for ERTMS”	1.0
[10]	2011/217/EU	Commission Recommendation of 29 March 2011 on the authorisation for the placing in service of structural subsystems and vehicles under Directive 2008/57/EC of the European Parliament and of the Council	*OJ L 95, 8.4.2011 p. 1*
[11]	2015/C 226/07	Commission communication in the framework of the implementation of the Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity	*OJ C 226, 10.07.2015 p. 103*
[12]	ECC/DC(02)O5 as amended 8 March 2013	ECC Decision of 5 July 2002 on the designation and availability of frequency bands for railway purposes in the 876 – 880 and 921 – 925 MHz bands	
[13]	Intentionally deleted		
[14]	ERA_ERTMS_040001	Assignement of values to ETCS variables	1.19

Ref. N°	Document Reference	Title	Last Issue
[15]	2014/897/EU	Commission Recommendation of 5 December 2014 on matters related to the placing in service and use of structural subsystems and vehicles under Directives 2008/57/EC and 2004/49/EC of the European Parliament and of the Council	*OJ L355 12.12.2014 p. 59*
[16]		Baseline Compatibility Assesment Baseline 3 Maintenance Release 1 Final Report	*1.0.0*
[17]		Baseline Compatibility Assesment Baseline 3 Release 2 Final Report	*1.1.0*

2.2. TERMS & ABBREVIATIONS

Table 2: Terms and abbreviations

Abbreviation	Definition
CCS	Control-command and Signalling
EMC	Electromagnetic compatibility
ERATV	European Register of Approved Types of Vehicles
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
GSM	Global System for Mobile Communication
GSM-R	GSM for Railways
MS	Member State
NSA	National Safety Authority
NTC	National Train Control
OB	On-board
RINF	Register of Infrastructure
STM	Specific Transmission Module
TS	Trackside
TSI	Technical Specification for Interoperability

3. CLARIFICATIONS

3.1. FOREWORD

3.1.1. This sections contains clarifications to help readers understanding the TSI Control-Command and Signalling.

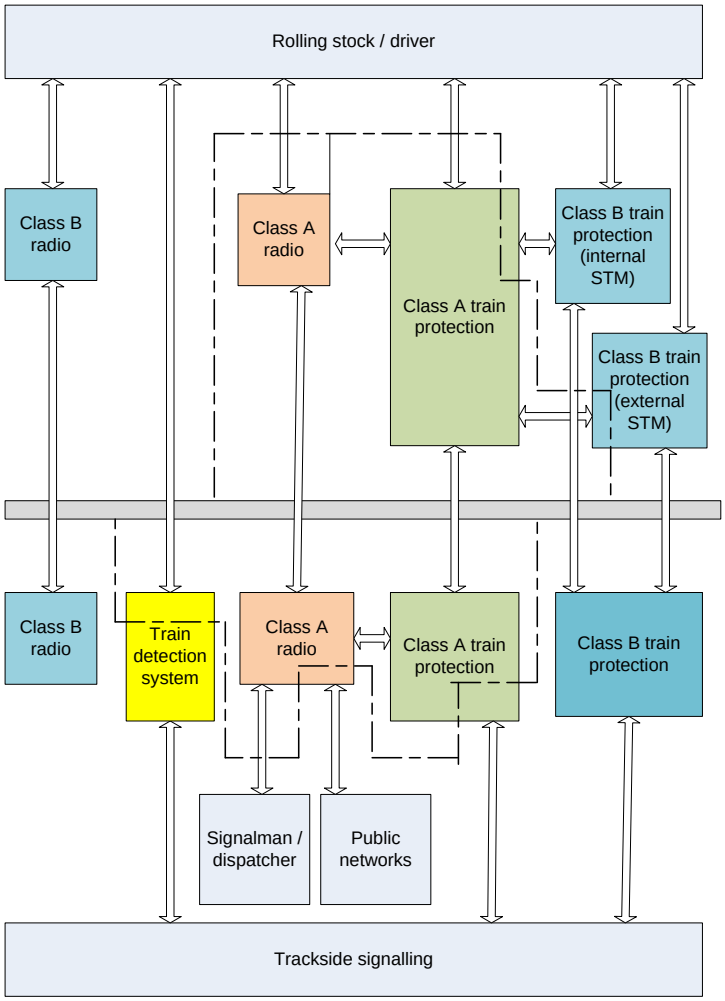
3.1.2. Subjects of clarifications can be added in the future based on return of experience.

3.2. SCOPE OF THE TSI CONTROL-COMMAND AND SIGNALLING

3.2.1. Overview

3.2.1.1. The fig. 1 gives an overview of the scope of the TSI Control-Command and Signalling.

Figure 1: Scope of TSI Control-Command and Signalling



3.2.1.1.1. The picture shows the Control-Command and Signalling subsystems and their interface with rolling stock and operators.

3.2.1.2. The requirements of the TSI apply to the parts within the dotted line; the grey horizontal line separates Control-Command and Signalling On-board and Trackside subsystem.

3.2.1.3. With reference to the description of the composition of the Control-Command and Signalling subsystems provided in chapter 2 of the corresponding TSI, the following considerations should be taken into account.

3.2.2. Scope of TSI Control-Command and Signalling requirements

3.2.2.1. The TSI Control-Command and Signalling does not require full standardisation of all Control-Command and Signalling functions, but only of the ones that are strictly necessary to achieve interoperability while complying with the essential requirements.

3.2.2.2. The TSI Control-Command and Signalling gives harmonised solutions for the functions, performance and interfaces that are relevant for interoperability and makes their implementation mandatory for the on-board (to ensure that vehicles may move uninterrupted throughout the EU) but allows flexibility for their implementation trackside. As a consequence, it is the responsibility of each trackside implementation to define, for example, if shunting operations are allowed/ supervised, if in-fill is required, etc.

3.2.3. TSI Control-Command and Signalling and other regulations

3.2.3.1. Requirements of other European regulations apply to all parts of the Control-Command and Signalling subsystems described in fig. 1, including those within the scope of the TSI Control-Command and Signalling and those outside the scope of the TSI Control-command and Signalling.

3.2.3.2. The TSI Control-Command and Signalling does not address compliance with the requirements of other European regulations. Compliance to other European regulations is specified in the corresponding Directives. This is clarified in chapter 3 of [1] (see also chapter 3.3 of this Application Guide).

3.2.4. ETCS application levels

3.2.4.1. The TSI Control-Command and Signalling allows a choice between the following possibilities for the installation of track-side ETCS:

1. Level 1: intermittent track to train communication;
2. Level 2: continuous track to train and train to track communication;
3. Level 3: as level 2, with train integrity provided on-board.

3.2.4.2. In addition, in the TSI Control-Command and Signalling, level 0 and level NTC are defined for the operation of an ETCS on-board on lines respectively without track-side train protection systems or equipped with legacy systems.

3.2.5. Migration to interoperability

3.2.5.1. The TSI Control-Command and Signalling requires that Class B equipment is progressively be replaced by Class A equipment.

3.2.5.2. The rules to be followed for the migration are specified in chapter 7 of the TSI Control-Command and Signalling. See section 3.7.2 of this Guide.

3.3. ESSENTIAL REQUIREMENTS

3.3.1. Principles

3.3.1.1. The essential requirements are described in chapter 3 of the TSI Control-Command and Signalling, which also provides, for each essential requirement, the link with the corresponding basic parameter(s).

3.3.1.2. The general concept is applied, that compliance with the basic parameters specified in the TSI Control-Command and Signalling ensures that the corresponding essential requirement is respected.

3.3.2. “Safety” and “availability/reliability”

3.3.2.1. The TSI Control-Command and Signalling defines railway specific requirements (i.e., requirements specifically related to design, construction, placing in service, upgrading, renewal, operation and maintenance of the subsystems as well as the professional qualifications and health and safety conditions of the staff who contribute to its operation and maintenance). It does not address general aspects (non “railway specific”) of these essential requirements (e.g., product safety, like protection against fulmination), because they are in the scope of other European regulations.

3.3.2.2. As far as railway specific aspects are concerned, the Railway Safety Directive [2] applies to the whole system; it is possible to respect both the Interoperability ([3], [10], [15]) and the Safety Directive [2], because:

1. When designing a new trackside Control-Command and Signalling subsystem or when performing a major modification/upgrade of an existing subsystem where the application of the TSI is required in accordance with the provisions of [3], the risk analysis identifies the functions, performance and interfaces to be implemented trackside in order that the overall safety objective for the railway system can be achieved without any exported requirement to the on-board Control-Command and Signalling subsystems, which might contradict or exceed what is specified in the TSI.
2. When designing a new on-board Control-Command and Signalling subsystem or when performing a major modification/upgrade of an existing subsystem where the application of the TSI is required in accordance with the provisions of [3], the risk analysis identifies the requirements for the installation on the rolling stock, in order that the safety requirements specified in the relevant TSIs are met.
3. The provisions of [2] are applied to prove compliance with the essential requirement “safety” defined in the TSI Control-Command and Signalling, when conformity of Interoperability Constituents is checked and EC verification of trackside and on-board subsystem is performed.

4. The EC verifications of the trackside and on-board subsystem prove that all the functions, interfaces and performance required in the subsystems on the basis of the analysis described in bullets 1 and 2 above, are implemented and comply with the requirements specified in the TSI.

3.3.3. "Health" and "Environmental protection"

3.3.3.1. According to the principle stated above, the TSI Control-Command and Signalling specifies no requirements or checks in addition to the ones foreseen by the other regulations applicable for the essential requirements "Health" and "Environmental protection".

3.3.4. "Technical Compatibility"

3.3.4.1. The electromagnetic compatibility between the railway system and the "external world" is part of the "Environmental protection" essential requirements and is fully covered by [4] and [5], together with the harmonised standards [6][1] and [11][2].

3.3.4.2. The "Technical compatibility" essential requirement addresses the interferences between equipment inside the railway system.

3.3.4.3. The Directives [4] and [5] (with the support of the harmonised standards [6] and [11]) cover these aspects, with a relevant exception, i.e., the compatibility between rolling stock and trackside Control-Command and Signalling equipment (e.g., track circuits and axle counters); the Control-Command and Signalling TSI defines therefore requirements and verification procedures for this issue.

3.4. BASIC PARAMETERS

3.4.1. Control-Command and Signalling safety characteristics relevant to interoperability (basic parameter 4.2.1)

3.4.1.1. This basic parameter refers to both the essential requirement "safety" and the essential requirement "availability/reliability". In the scope of the TSI Control-Command and Signalling only the availability/reliability aspects that may negatively affect the system safety are taken into consideration.

3.4.1.2. More stringent availability/reliability requirements for commercial reasons are possible, but, being not part of the essential requirement, they can be managed in the context of contracts between IMs and RUs and not as criteria for authorisation to service or to determine technical compatibility or safe integration.

3.4.1.3. The safety requirements for Control-Command and Signalling subsystems are expressed in terms of technical performances (functions, tolerable hazard rates) of equipment.

3.4.1.4. The safety requirements are enough to ensure the safe integration of Control-Command and Signalling subsystems into the railway system, respecting the safety objective for the service, as determined according to the provisions of [2].

[1] *General EMC requirements*
[2] *Requirements specially applicable to GSM-R, Eurobalise and Euroloop*

3.4.1.5. To achieve interoperability, the TSI requires that every on-board Control-Command and Signalling subsystem fully respects the mandatory requirements. The TSI does not forbid less stringent safety requirements for a track-side Control-Command and Signalling implementation, when they are enough to achieve the safety objective for the service and as far as the safe movement of vehicles equipped with TSI compliant Control-Command and Signalling subsystem is not hindered.

3.4.2. On-board and Track-side ETCS functionality (basic parameters 4.2.2 and 4.2.3)

3.4.2.1. The implementation of certain functions and interfaces specified in the TSI Control-Command and Signalling is optional. These optional functions and interfaces can be used neither as criteria to grant or refuse authorisations nor to define, limit or specify requirements for technical compatibility or safe integration between on-board and trackside subsystems having an EC Declaration of verification. There are exceptions for some specific conditions, listed in the appropriate sections of chapter 4 and summarised in section 7.2.6 of the TSI Control-Command and Signalling and related to on-board implementation of:

1. In-fill (Euroloop and radio in-fill) in Level 1,
2. Radio data transmission in level 2 and 3,
3. Train integrity supervision on-board in level 3,
4. “K interface” for STM.

3.4.3. Mobile communication functions for railways (basic parameter 4.2.4)

3.4.3.1. The TSI Control-Command and Signalling describes the radio communication functions that have to be implemented in the On-board and the Trackside subsystems. These functions have to follow the general principle on which the TSI is based, as expressed in its point 4.1.2, to enable a Trackside subsystem to be compatible with On-board subsystems that are compliant to the TSI. The flexibility that is allowed in the configuration of the Trackside subsystem shall not limit the movement of TSI-compliant On-board subsystems.

3.4.3.2. This implies that the Trackside subsystem has to be configured in a way that any TSI compliant On-board subsystem can use the functionality offered by the Trackside subsystem. In order to provide this capability, the Trackside subsystem requires to set its configuration to allow the GSM-R SIM card integrated in the On-board subsystem, that has to move in the Trackside subsystem, in the GSM-R network. According to the Control-command and Signalling TSI, the Trackside subsystem shall not impose any restriction to an On-board subsystem. This requirement may involve the establishment of roaming agreements between GSM-R network operators, the physical link between GSM-R networks and other configurations in the GSM-R network.

3.4.4. ETCS and GSM-R air gap interfaces (basic parameter 4.2.5)

3.4.4.1. The TSI Control-Command and Signalling specifies technical characteristics of equipment and includes the operational frequency band for the radio communication.

3.4.4.2. To operate GSM-R, it is necessary that MSs allow the use of this frequency band. The most appropriate way is the implementation of the relevant ECC recommendations [12].

3.4.4.3. The TSI specifies that the On-board subsystems shall be protected against interference. This requirement applies at the subsystem level. The Interoperability Constituents (GSM-R voice cab radio and GSM-R EDOR) compliant to the TSI already provide this protection. In point 3.6.5 of this Application Guide, guidance is provided for Interoperability Constituents certified for older TSIs.

3.4.4.4. The TSI indicates that for data communication, the protocols shall comply with what is specified in the Annex A indexes 10, 39 and 40. This means that an On-board Subsystem that is compliant with the Table A 2.3 (set of specifications #3) has to be capable of using both the Circuit Switched and Packet Switched communication modes in order to meet the TSI requirements.Therefore, in this case, the GSM-R SIM card, the EDOR and the ETCS On-board have to enable the use of both Circuit Switched and Packet Switched.

3.4.5. On-board interfaces internal to Control-Command and Signalling (basic parameter 4.2.6)

3.4.5.1. No additional clarification necessary.

3.4.6. Track-side interfaces internal to Control-Command and Signalling (basic parameter 4.2.7)

3.4.6.1. No additional clarification necessary.

3.4.7. Key management (basic parameter 4.2.8)

3.4.7.1. The cryptographic keys are used by the ETCS train to track communication protocol to calculate a code that supports protection against both communication errors and intentional malicious intrusions.

3.4.7.2. The protection against intentional attacks is obtained if the key used to calculate the protection code for the messages is kept confidential.

3.4.7.3. All the technical characteristics of the protocols are completely defined in the mandatory specifications. The requirements for the confidentiality of the keys with respect to risks related to safety of railway operations are not in the scope of the TSI Control-Command and Signalling.

3.4.7.4. The TSI requires the ETCS equipment to comply with the specified interfaces to store, modify and delete keys, while possible requirements for their management are the responsibility of Infrastructure Managers and Railway Undertakings (and

determined, for example, by regulations of authorities responsible for the security of the transport systems).

3.4.7.5. Considering that requirements related to security might become an obstacle to the free movement of trains (like it may happen with national safety rules; see art. 8 of [2]), Member States should communicate them to the European Commission, in order to have a coordinated approach.

3.4.8. ETCS-ID management (basic parameter 4.2.9)

3.4.8.1. The procedures for the allocation of variables are specified in [14]. The allocation can be done through the web-site of the Agency: http://www.era.europa.eu/Document-Register/Pages/ETCS-Variables.aspx.

3.4.9. Track-side train detection systems (basic parameter 4.2.10)

3.4.9.1. For this basic parameter the TSI Control-Command and Signalling makes reference to the specification in its Annex A, Index 77, which defines the parameters of the interface between the train detection systems (which are part of the Control-Command and Signalling track-side subsystem) and other subsystems.

3.4.9.2. This specification is used by the TSI Control-Command and Signalling to define the interface requirements for the design and installation of train detection systems. It is the responsibility of other TSIs to indicate the requirements for the corresponding subsystems.

3.4.9.3. It has to be noted, that some characteristics of rolling stock, relevant for the compatibility with track circuits, can be specified and checked at the level of a single vehicle, while other apply to the complete consist of more vehicles, like, for example, the impedance between wheels and pantograph (section 3.2.2.1 of Index 77) and are therefore related also to the use of vehicles and not only to their authorisation to put in service. The specification Index 77 includes a table indicating which subsystem may be affected by any parameter.

3.4.9.4. Special attention is necessary for the “shunting impedance for track circuits” (see also Annex 1 of this Application Guide).

3.4.9.5. As explained there, some of the elements that contribute to the “shunting impedance” can be managed at the level of a single vehicle. The contact resistance between wheel and rail, however, depends on the interaction of several factors both in static (vehicle at standstill) and dynamic conditions (vehicle is running) and this interaction is not yet fully known.

3.4.9.6. In some Member States rules exist, related to the use of composition of vehicles, to ensure that the resulting consist is detected by the track circuits. Being, at the present state, impossible to harmonise these rules, they are indicated as an open point. The following clarifications have to be taken into account:

1. These rules do not involve technical characteristics of vehicles other than the ones already indicated in the specification Index 77, but only refer to the interaction of these characteristics; for this reason the rules do not apply to the authorisation of a vehicle, but only to its use within a consist;

2. The indication of an open point has not the scope of generating new rules, but only to have the existing ones managed in a transparent way, for manufacturer and operators;

3. As with all open points, the Agency expects that the notified rules will contribute to its clarification and closure.

3.4.9.7. For brake blocks, the requirements of the TSI Control-Command and Signalling are satisfied by the types `approved` according to the provisions stated in the TSI for freight wagons.

3.4.10. Electromagnetic compatibility between rolling stock and Control-Command and Signalling track-side equipment (basic parameter 4.2.11)

3.4.10.1. For explanations related to electromagnetic fields see Annex 2 of this Application Guide.

3.4.11. ETCS DMI (basic parameter 4.2.12)

3.4.11.1. No additional clarification necessary.

3.4.12. GSM-R DMI (basic parameter 4.2.13)

3.4.12.1. No additional clarification necessary.

3.4.13. Interface to data recording for regulatory purposes (basic parameter 4.2.14)

3.4.13.1. No additional clarification necessary.

3.4.14. Visibility of track-side Control-Command and Signalling objects (basic parameter 4.2.15)

3.4.14.1. No additional clarification necessary.

3.4.15. Environmental conditions (basic parameter 4.2.16)

3.4.15.1. The mandatory environmental conditions for some equipment (e.g., debris for Eurobalise) are defined in the corresponding specifications.

3.4.15.2. In addition, chapter 6 of the TSI Control-Command and Signalling, requires that for each interoperability constituent and subsystem the applicable working conditions are indicated.

3.4.16. Functional and technical specification of the interfaces to other subsystems (4.3)

3.4.16.1. No additional clarification needed.

3.4.17. Operating rules (4.4)

3.4.17.1. No additional clarification needed.

3.4.18. Maintenance rules (4.5)

3.4.18.1. No additional clarification needed.

3.4.19. Professional competences (4.6)

3.4.19.1. No additional clarification needed.

3.4.20. Health and safety conditions (4.7)

3.4.20.1. No additional clarification needed.

3.4.21. Registers (4.8)

3.4.21.1. No additional clarification needed.

3.5. INTEROPERABILITY CONSTITUENTS

3.5.1. Principles

3.5.1.1. The TSI Control-Command and Signalling specifies a set of “basic interoperability constituents” and allows their “grouping” to allow flexibility for development and implementation.

3.5.1.2. The TSI only specifies interfaces that are necessary to achieve interoperability; for interfaces between track-side and on-board the TSI requires that their implementation (functions, protocols, electrical and physical aspects) complies with the mandatory specifications.

3.5.1.3. For other interfaces (e.g., between equipment allocated either on-board or track-side) different solutions are acceptable, provided that functional and performance requirements relevant for the achievement of interoperability are respected. These mandatory requirements are part of the basic parameters of the TSI.

3.5.1.4. To support an open market and the management of interoperability constituents during the whole lifetime (including maintenance and upgrade), voluntary

harmonisation of aspects not mandated by the TSI is encouraged; the corresponding standards are listed in chapter 4 of this application guide.

3.5.2. Special considerations

3.5.2.1. The functions implemented in a RBC depend on its integration with track-side signalling, which is not harmonised in the scope of the TSI Control-Command and Signalling (see the consideration in chapter 3.2.2 above).

3.5.2.2. The specifications referenced in and given mandatory status by the TSI only define requirements for the functions implemented in the RBC, in order to achieve interoperability.

3.5.2.3. The necessity of implementing functions (e.g., if and in which conditions to authorise shunting, to send commands to raise / lower pantographs, etc.) depends upon the characteristics of the specific application.

3.5.2.4. As a consequence, different “types” of RBC interoperability constituent will be developed, to interface and cooperate with different track-side signalling functions.

3.5.2.5. The design documentation for the RBC will indicate which functions are implemented.

3.5.2.6. The advantage of defining the RBC as an Interoperability Constituent is twofold:

1. functions, interfaces and performance certified will not require repetitions of testing when the RBC is integrated into a Control-Command and Signalling track-side subsystem

2. the availability on the market of already certified RBCs will support the harmonisation of the overall track-side design, to exploit existing products and reduce the need to search for new technical solutions.

3.6. ASSESSMENT OF CONFORMITY OF THE CONSTITUENTS AND VERIFICATION OF THE SUBSYSTEM

3.6.1. Conformity assessment of ERTMS equipment: operational test scenarios

3.6.1.1. The certification of Track-side subsystems is a critical step to achieve interoperability. In this respect, the operational test scenarios (see definition in point 6.1.2.2 of the TSI Control-Command and Signalling) are a very important tool:

1. an early verification that design and installation of the Trackside subsystem will not require on-board functions or performance conflicting with requirements of the TSI can be done checking the operational test scenarios specified by the applicant. See point 6.1.2.3 of the TSI Control-Command and Signalling;

2. once this check has been successfully passed, the operational test scenarios will be the test cases for the certification of Control-command and Signalling Track-side subsystem.

3.6.1.2. Point 6.5 of the TSI Control-Command and Signalling clarifies how the operational test scenario give the interested Railway Undertakings transparent information about the characteristics of the Track-side subsystems and how they can be the basis for the compatibility checks, that relevant operators (Infrastructure Managers and Railway Undertakings) may need to perform, before railway service is started with a new combination of track-side and on-board Control-command and Signalling subsystems. These checks should ideally only be “documental” checks of EC certificates of verification, but some experimental test of compatibility between on-board and track-side equipment may be necessary, according to the concepts explained below:

1. The “compatibility tests” are not an alternative to the procedures specified in the Directive [2]. Subsystems must in any case be separately certified, and relevant documentation (technical files) must be available, proving that all verifications required in the TSI Control-Command and Signalling (tables of chapter 6) have been successfully performed. Full application of procedures specified in the TSI is necessary to ensure that compatibility tests are performed in a transparent way and that errors detected are clearly understood and corrected;

2. The scope of compatibility tests is therefore a screening, to detect possible systematic errors in products or specifications, not recognised and corrected during the certification process. The possibility that systematic errors appear during the life of equipment (depending on the external conditions and the interactions between them) can never be fully eliminated. When a new “combination” of on-board and track-side subsystems is activated (including the case of a modification of an existing subsystem) a residual risk that previously undetected systematic errors appear cannot be excluded. Ensuring compatibility between two certified subsystems is therefore part of the “normal” supervision of railway operation that a National Safety Authority must carry out during the entire life of subsystems;

3. This normal supervision should be performed “relying on the Safety Management System of operators”. It is recognised, however, that experience in this field is not yet complete and that in particular small Railway Undertakings could find prohibitive to organise themselves with adequate competences and organisation. A possible solution is to allow Notified Bodies to support them in the performance and assessment of tests. While passing the verifications listed in the tables 6.1, 6.2 and 6.3 of the TSI Control-Command and Signalling is sufficient to obtain the corresponding certificates, the documentation supporting such certificates may be progressively extended with annexes indicating which “compatibility tests” have been successfully passed by a subsystem or Interoperability Constituent (e.g. which operational behaviour has been checked, in simulated environment or against real trackside installations, etc.). The compatibility tests do not put in question the certificates of the subsystems – unless errors are detected requiring modifications – but National Safety Authorities may consider them as evidence that a Railway Undertaking or an Infrastructure Manager has taken all precautions for the use of its technical systems.

3.6.1.3. Point 6.5 of the TSI Control-Command and Signalling also clarifies the responsibilities and procedures to follow when product failures or incompatibilities are detected.

3.6.1.4. Flow charts describing the use of operational test scenarios can be found in Annex 3 of this Guide.

3.6.2. Conformity assessment of ERTMS equipment: GSM-R SIM card

3.6.2.1. As indicated in the first row of Table 6.2 of the TSI Control-Command and Signalling, the On-board Subsystem has to be assessed with a GSM-R SIM card that is compliant to the requirements of the TSI. Due to the special characteristics of this Interoperability Constituent, the replacement of a TSI compliant GSM-R SIM card by another TSI compliant GSM-R SIM card does not affect the compliancy to the TSI of the On-board Subsystem. This implies that there is no need to reassess the On-board Subsystem in the case of replacement of a GSM-R SIM card compliant to the TSI with another one also compliant to the TSI.

3.6.2.2. For SIM cards placed on the market after entry into force of Control-command and Signalling TSI specifying the GSM-R SIM card as Interoperability Constituent, compliance with TSI is ensured by the EC Declaration of conformity. Regarding SIM cards placed on the market before the entry into force of that TSI (and therefore without EC Declaration of conformity):

1. where a Notified Body has evidence (e.g. from their previous use or from check of relevant documentation) that they are compliant with the requirements of the TSI, those SIM cards can be used to verify Control-command and Signalling On-board subsystems;

2. where a manufacturer or contracting entity can justify that their use does not affect the compliancy to the TSI of the On-board Subsystem, then, as per the article 110.1 in [15], the replacement of the SIM card can be considered a “substitution in the framework of maintenance”, like in the case of SIM cards holding an EC Declaration of conformity.

3.6.3. Use of harmonised standards

3.6.3.1. This section of the Application Guide refers to the EN 50126, EN 50128, EN 50129 and EN 50159 standards, listed in Annex A, table A3 of the Control-Command and Signalling TSI (and also as harmonised standards in [7]).

3.6.3.2. The concepts of these standards are used:

1. in SUBSET-091 (mandatory specification for the TSI Control-Command and Signalling, see Index 27 of Annex A, tables A 2) to clarify the relationship between quantitative Tolerable Hazard Rates (THRs) and the requirements for the management of systematic failures during the development of a product;

2. in chapter 6 of the TSI Control-Command and Signalling, for the requirements related to the assessment of “RAMS”.

3.6.3.3. Some provisions within the standards are based on the assumption of the organisation of the railways before the entry in force of the different “railway packages” of European Directives, in particular the opening of the market and the separation of train operation from infrastructure management. A statement in Annex A of the TSI Control-Command and Signalling, before table A3, ensures that, where conflicts or possibility of different interpretation exist, the Directives and TSIs take precedence.

3.6.4. Partial fulfilment of TSI requirements

3.6.4.1. Art. 15(7) of [3] states that "*If the relevant TSIs allow, the notified body may issue certificates of conformity for a series of subsystems or certain parts of those subsystems*".

3.6.4.2. The TSI Control-Command and Signalling in section 6.3.2 supports the issuing of certificates for a series of subsystems through the application of the modules.

3.6.4.3. The parts of On-board and, respectively, Track-side Control-Command and Signalling subsystems for which a certificate may be issues are specified in section 2.2 and section 4.1 of the TSI. The corresponding rules for implementations are in section 7.2.1 and the rules for assessment are in section 6.4.1.

3.6.4.4. In addition, following feedback from several stakeholders (applicants, Notified Bodies and National Safety Authorities), some concepts have been further clarified:

1. section 6.1.1.3 of the TSI specifies the conditions under which control-command and signalling interoperability constituents and subsystems, that do not implement all functions, performance and interfaces as specified in Chapter 4 of the TSI, may obtain EC certificates of conformity or, respectively, EC certificates of verification.

2. section 6.4.3 of the TSI specifies the detailed requirements on the issuing and the content of the corresponding certificates.

3.6.4.5. The scope of these provisions is not to open the door to new non-TSI compliant implementations, but to keep under control the situation that occurred in the initial phase of deployment of ETCS and GSM-R. A role is foreseen for the ad hoc group of Notified Bodies chaired by the Agency. The complete scope of work of this group is specified in [9].

3.6.4.6. The concepts stated in section 6.1.1.3 and 6.4.3. do not substantially change the original content of the TSI Control-Command and Signalling, but only provide an improved text for better understanding. For this reason, the amended sections 6.1.1.3 and 6.4.3 may be used also when a previous version of the TSI Control-command and signalling is applied.

3.6.5. Interoperability Constituents certified for an older TSI

3.6.5.1. The TSI Control-Command and signalling (see first row of its Table 6.2) permits the use of Interoperability Constituents that have been certified against older versions of this TSI, provided the Notified Body assesses that the certificate of Verification of the subsystem still ensures compliance with the requirements of the TSI in force.

3.6.5.2. In the case of GSM-R, a new Baseline (Baseline 1) has been introduced in the TSI, replacing the previous one (Baseline 0). The differences between both Baselines for the Interoperability Constituents defined are: for the GSM-R voice cab radio, the protection against interferences; for the GSM-R SIM card to be used in an EDOR, the support of GPRS; for the GSM-R EDOR, the protection against interferences and the support of Packet Switched communication.

3.6.5.3. GSM-R Interoperability Constituents that have been certified against older versions of the TSI will not present the characteristics indicated in 3.6.5.2. However, these Interoperability Constituents can be integrated in On-board Subsystems, when the

resulting subsystem complies with the requirements in the TSI. In particular, the following cases can be expected:

1. A GSM-R voice cab radio or a GSM-R EDOR that do not present protection against interference can be integrated in an On-board Subsystem where an external filtering device is fitted, provided that the resulting subsystem presents the characteristics required in the TSI;

2. A GSM-R voice cab radio or a GSM-R EDOR that do not present protection against interference, when integrated in an On-board Subsystem without an external filtering device, will result in an On-board Subsystem that is not compliant to the TSI requirements;

3. A GSM-R EDOR or GSM-R SIM card that do not support GPRS can be integrated in an On-board Subsystem that is compliant either with the Table A 2.1 (set of specifications #1) or with the Table A 2.2 (set of specifications #2).The resulting subsystem will be compliant to the TSI requirements;

4. A GSM-R EDOR or GSM-R SIM card that do not support GPRS when integrated in an On-board Subsystem that is compliant with the Table A 2.3 (set of specifications #3) will result in an On-board Subsystem that is not compliant to the TSI requirements.

3.7. IMPLEMENTATION OF THE TSI CONTROL-COMMAND AND SIGNALLING

3.7.1. Management of ERTMS specifications

3.7.1.1. Functional enhancement and error correction of the ETCS and GSM-R specifications is managed by the Agency, as system authority, applying its procedures for management of documents and the procedures for ERTMS Change Control Management [8].

3.7.1.2. The application of the principles for system version management ensures that the evolution of the /ETCS and GSM-R specifications respects the conditions and limitations of backward compatibility.

3.7.2. Implementation Rules

3.7.2.1. The TSI Control-Command and Signalling specifies provisions for the management of the legacy systems (defined “Class B” in the TSI) during the transition phase under the responsibility of the relevant Member State. This includes the obligation to ensure that their functionality remains unchanged (with the only exception of modifications necessary to mitigate safety related flaws).

3.7.2.2. Section 7.3 of the TSI Control-Command and Signalling refers to the rules for implementation of GSM-R (on-board and track-side), section 7.5 to the rules for train detection systems (only track-side, rules for vehicles are stated in the corresponding TSIs).

3.7.2.3. Rules for ETCS are stated in chapter 7.4 of the TSI Control-Command and Signalling. It must be taken into account that, where installation of ETCS is not mandatory, a Member State may only require on-board installation of Class B train

protection systems listed in the Technical Document referenced in section 2.2 of the TSI Control-Command and Signalling.

3.7.3. Baseline Compatibility Analysis

3.7.3.1. In order to facilitate transparency and interoperability between the different sets of specifications laid down in the TSI Control-Command and Signalling, a double exercise for checking the compatibility of the B3 MR1 and B3 R2 have been carried out.

3.7.3.2. The first analysis [16] was undertaken by UNISIG and ERTMS Users Group experts and provides the results of checking the delta between the Baseline 2 (B2) and the Baseline 3 Maintenance Release 1 (B3 MR1). The Analysis was performed for the backwards compatibility of each CR included in the B3 MR1 with regards to the B2.

3.7.3.3. The second analysis [17] was undertaken by the Agency in cooperation with the sector organisations (UNISIG and ERTMS Users Group experts) and provides the results of analysing that the Baseline 3 Release 2 (B3 R2) is fully backward/forward compatible with the Baseline 3 Maintenance Release 1 (B3 MR1), but also to check both the backward compatibility between Baseline 3 Release 2 (B3 R2) trains and a Baseline 2 (B2) trackside and the compatibility between a Baseline 3 Release 2 (B3R2) (B3 R2) trackside operated with system version X=1 (i.e. a B3 R2 trackside using only B2 functions) and B2 trains.

3.8. OPEN POINTS

3.8.1. The open points related to Control-Command and Signalling are listed in Annex G of the TSI Control-Command and Signalling.

3.8.2. According to art 13 and 14 of [3] the Member States notify national rules for the management of open points, until they are completely solved with an update of the TSI.

3.8.3. However, a Control-Command and Signalling Track-side or On-board subsystem where a National Rule is applied:

1. usually does not allow interoperability, and
2. might also be incompatible with future Control-Command and Signalling subsystems where the harmonised solution for the open point is applied

3.8.4. It is therefore advisable to limit as much as possible the negative effects of applying national rules in the implementation of Control-Command and Signalling subsystems. For this reason the Members States are invited, before deciding the rules to be notified, to check the “Notes” in Annex G and, if necessary, contact the Agency, to gather information about the scope of the open point and the state of the work for its solution.

3.8.5. Moreover, art 8 of [2] requires Member States to submit draft safety rules to the European Commission for examination; the European Commission will monitor strictly the introduction of any new rule in order to prevent further barriers from being created.

4. SUPPORTING SPECIFICATIONS AND STANDARDS

4.1. FOREWORD

4.1.1. The requirement for compliance with TSI Control-Command and Signalling is supported by a set of specifications and standards, to promote an open market and to facilitate the management of equipment during the whole lifetime (including maintenance and upgrade).

4.2. USE OF THE SPECIFICATIONS AND STANDARDS

4.2.1. The specifications and standards in the tables of this chapter have been listed by the Agency, after a check of their scope and content with the cooperation of experts from the working parties (reference to Agency regulation) and with the opinion of Notified Bodies and National Safety Authorities. See [8].

4.2.2. The application of the specifications and standards listed in this Application Guide remains voluntary, as they refer to aspects of the Subsystems where the adoption of solutions that are not harmonised does not prejudice interoperability (provided the solution respects functional and performance requirements specified in the relevant basic parameters).

4.2.3. These specifications and standards shall not be confused with the specifications listed in the Annex A of the TSI Control-Command and Signalling, which are essential part of the definition of the basic parameters and are therefore mandatory.

4.3. REFERENCES

4.3.1. Table 3 indicates for each basic parameter (chapter 4 of the TSI Control-Command and Signalling) the corresponding harmonised standards and/or informative specifications, which can support the development of interoperability constituents and subsystems and their certification.

Table 3: References

Reference in chapter 4 of TSI Control-Command and Signalling	No (see table 4 or 5)
4.1	
4.1a	45
4.1b	
4.1c	
4.2.1	
4.2.1 a	19, 20, 21, 22, 23, 24, 43, 44, 47, 53, 55
4.2.1 b	1
4.2.2	
4.2.2.a	
4.2.2.b	9, 10, 11, 12, 13, 14, 15, 16, 17, 39, 40, 41, 42, 50, 51
4.2.2.c	
4.2.2.d	
4.2.2.e	
4.2.2.f	54, 55

Reference in chapter 4 of TSI Control-Command and Signalling	No (see table 4 or 5)
4.2.3	
4.2.3 a	
4.2.3 b	9, 10, 11, 12, 13, 14, 15, 16, 17, 39, 40, 41, 42, 50, 52
4.2.3 c	
4.2.4	
4.2.4 a	
4.2.4 b	
4.2.4 c	
4.2.4 d	
4.2.4 e	5, 37
4.2.4 f	58
4.2.4 g	
4.2.4 h	
4.2.4 j	
4.2.5	
4.2.5 a	
4.2.5 b	
4.2.5 c	
4.2.5 d	57
4.2.5 e	
4.2.6	
4.2.6 a	3, 7, 8
4.2.6 b	
4.2.6 c	
4.2.6 d	
4.2.6 e	
4.2.6 f	4
4.2.7	
4.2.7 a	56
4.2.7 b	
4.2.7 c	
4.2.7 d	
4.2.7 e	
4.2.8	
4.2.8 a	
4.2.9	
4.2.9 a	
4.2.9 b	
4.2.10	
4.2.10 a	
4.2.11	
4.2.11 a	H3, 48, 49
4.2.12	
4.2.12 a	25, 27, 28, 29, 30, 34

Reference in chapter 4 of TSI Control-Command and Signalling	No (see table 4 or 5)
4.2.13	
4.2.13 a	25, 27, 28, 29, 30, 34
4.2.14	
4.2.14 a	
4.2.15	
4.2.15 a	
4.2.16	H1, H2, 2

4.4. HARMONISED STANDARDS

4.4.1. The following standards are referenced in [7].

Table 4: Harmonised standards

No	Reference	Document Name	Version	Notes
H1	EN 50125-1	Railway applications — Environmental conditions for equipment — Part 1: equipment on board rolling stock	1999	
H2	EN 50125-3	Railway applications — Environmental conditions for equipment — Part 3: equipment for signalling and telecommunications	2003	
H3	EN 50238	Railway applications — Compatibility between rolling stock and train detection systems	2003	

4.5. INFORMATIVE SPECIFICATIONS

4.5.1. The following Tables list the informative specifications that are relevant for each of the Table A 2.1, A 2.2 or A 2.3 of the Control-Command and Signalling TSI,

4.5.2. In the “Notes” column of the following tables some of the informative specifications are related to a mandatory specification, identified through the Index in the tables of Annex A of the TSI Control-Command and Signalling.

Table 5.1: List of supporting informative specifications related to Table A-2.1 of CCS TSI

No.	Set of specifications #1 (ETCS baseline 2 and GSM-R baseline 1)			
	Reference	**Document Name**	**Version**	**Notes**
1	02S126	RAM requirements (chapter 2 only)	6	Index 28
2	97S066	Environmental conditions	5	
3	SUBSET-074-1	Methodology for testing FFFIS STM	1.0.0	Index 36
4	97E267	Odometer FFFIS	5	Index 44
5	O_2475	ERTMS GSM-R QoS test specification	3.0	Index 33
6	Intentionally deleted			

7	SUBSET-074-3	FFFIS STM Test specification traceability of test cases with specific transmission module FFFIS	1.0.0	Index 36
8	SUBSET-074-4	FFFIS STM Test specification traceability of testing the packets specified in the FFFIS STM application layer	1.0.0	Index 36
9	SUBSET 076-0	ERTMS/ETCS Class 1, test plan	2.3.3	Index 37
10	SUBSET 076-2	Methodology to prepare features	2.3.0	Index 37
11	SUBSET 076-3	Methodology of testing	2.3.1	Index 37
12	SUBSET 076-4-1	Test sequence generation: methodology and rules	1.0.2	Index 37
13	SUBSET 076-4-2	ERTMS/ETCS Class 1 states for test sequences	1.0.2	Index 37
14	SUBSET 076-5-3	Onboard data dictionary	2.3.0	Index 37
15	SUBSET 076-5-4	SRS v.2.3.0 traceability	2.3.3	Index 37
16	SUBSET 076-6-1	UNISIG test database	2.3.3	Index 37
17	SUBSET 076-6-4	Test cases coverage	2.3.3	Index 37
18	Intentionally deleted			
19	SUBSET 077	UNISIG causal analysis process	2.2.2	Index 27
20	SUBSET 078	RBC interface: failure modes and effects analysis	2.4.0	Index 27
21	SUBSET 079	MMI: failure modes and effects analysis	2.2.2	Index 27
22	SUBSET 080	TIU: failure modes and effects analysis	2.2.2	Index 27
23	SUBSET 081	Transmission system: failure modes and effects analysis	2.3.0	Index 27
24	SUBSET 088	ETCS Application levels 1 and 2 — safety analysis	2.3.0	Index 27
25	TS50459-1	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface Part 1 — Ergonomic principles of ERTMS/ETCS/GSM-R information	2005	Index 33 and Note 1
26	Intentionally deleted			
27	TS50459-3	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface Part 3 — Ergonomic arrangements of ERTMS/GSM-R information	2005	Index 33 and Note 1
28	TS50459-4	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface Part 4 — Data entry for the ERTMS/ETCS/GSM-R systems	2005	Index 33 and Note 1
29	TS50459-5	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface Part 5 — Symbols	2005	Index 33 and Note 1

30	TS50459-6	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface Part 6 — Audible information	2005	Index 33 and Note 1
31	Intentionally deleted			
32	Intentionally deleted			
33	Intentionally deleted			
34	ERA/ERTMS/0155560	ERTMS/ETCS Driver Machine Interface	2.3	Note 1
35	Intentionally deleted			
36	Intentionally deleted			
37	SUBSET-093	GSM-R Interfaces — Class 1 requirements	2.3.0	Index 33
38	Intentionally deleted			
39	SUBSET-076-5-1	ERTMS ETCS Class 1 feature list	2.3.3	Index 37
40	ERA/ERTMS/040063	Test sequences evaluation and validation	1.2.0	Index 37
41	SUBSET-076-6-8	Generic train data for test sequences	1.0.1	Index 37
42	SUBSET-076-6-10	Test sequence viewer (TSV)	3.2.2	Index 37
43	04E083	Safety requirements and requirements to safety analysis for interoperability for the control-command and signalling subsystem	1.0	Index 27
44	04E084	Justification report for the safety requirements and requirements to safety analysis for interoperability for the control-command and signalling subsystem	1.0	Index 27
45	ERA/ERTMS/003205	Traceability of changes to ETCS FRS	1.0	Index 1
46	Intentionally deleted			
47	SUBSET-113	Report from UNISIG Hazard Log	Reserved	Index 27
48	TS 50238-2	Railway applications – Compatibility between rolling stock and train detection systems – Part 2: Compatibility with track circuits	2010	Index 77
49	TS 50238-3	Railway applications –Compatibility between rolling stock and train detection systems - Part 3: Compatibility with axle counters	2010	Index 77
50	ERA/ERTMS/040054	ETCS Engineering guidelines	1.0.0	Index 4
51	ERA/ERTMS/040055	ETCS DMI objects - START / STOP conditions	1.0.0	Index 4 and Index 6
52	ERA/ERTMS/040022	Baseline 2 requirements for implementation of braking curves functionality	5.0	Index 4
53	Intentionally deleted			
54	Intentionally deleted			
55	Intentionally deleted			
56	Intentionally deleted			

57	Intentionally deleted			
58	O-2875	ERTMS/GSM-R Quality of Service test specification for EIRENE QoS requirements Voice and non-ETCS data	1.0	Index 33

Note 1: This specification is related to the ergonomics aspects of the DMI. The DMI is an open point in the ETCS Baseline 2. Concerning the ETCS DMI, Index 6 of TSI Control-Command and Signalling Appendix A provides the details of the mandatory specification harmonised for the ETCS B3 MR1 and R2. With regards to the GSM-R DMI, this Index provides additional information to implement the mandatory requirements of the EIRENE SRS.

Table 6.2: List of supporting informative specifications related to Table A-2.2 of CCS TSI

No.	Set of specifications #2 (ETCS baseline 3 Maintenance Release 1 and GSM-R baseline 1)			
	Reference	**Document name**	**Version**	**Notes**
1	02S126	RAM requirements (chapter 2 only)	6	Index 28
2	97S066	Environmental conditions	5	
3	SUBSET-074-1	Methodology for testing FFFIS STM	3.0.0	Index 36
4	97E267	Odometer FFFIS	5	Index 44
5	O_2475	ERTMS GSM-R QoS test specification	3.0	Index 33
6	Intentionally deleted			
7	SUBSET-074-3	FFFIS STM Test specification traceability of test cases with specific transmission module FFFIS	3.0.0	Index 36
8	SUBSET-074-4	FFFIS STM Test specification traceability of testing the packets specified in the FFFIS STM application layer	3.0.0	Index 36
9	SUBSET 076-0	ERTMS/ETCS test plan and methodology	Reserved	Index 37
10	Intentionally deleted			
11	Intentionally deleted			
12	Intentionally deleted			
13	Intentionally deleted			
14	Intentionally deleted			
15	Intentionally deleted			

16	SUBSET 076-6-1	test database	Reserved	Index 37
17	Intentionally deleted			
18	Intentionally deleted			
19	SUBSET 077	UNISIG causal analysis process	3.0.0	Index 27
20	SUBSET 078	RBC interface: failure modes and effects analysis	3.3.3	Index 27
21	SUBSET 079	MMI: failure modes and effects analysis	3.13.0	Index 27
22	SUBSET 080	TIU: failure modes and effects analysis	3.0.12	Index 27
23	SUBSET 081	Transmission system: failure modes and effects analysis	3.4.3	Index 27
24	SUBSET 088	ETCS Application levels 1 and 2 — safety analysis	3.5.4	Index 27
25	TS50459-1	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 1 — Ergonomic principles of ERTMS/ETCS/GSM-R information	2005	only for Index 33 Note 2
26	Intentionally deleted			
27	TS50459-3	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 3 — Ergonomic arrangements of ERTMS/GSM-R information	2005	only for Index 33 Note 2
28	TS50459-4	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 4 — Data entry for the ERTMS/ETCS/GSM-R systems	2005	only for Index 33 Note 2
29	TS50459-5	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 5 — Symbols	2005	only for Index 33 Note 2
30	TS50459-6	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 6 — Audible information	2005	only for Index 33 Note 2
31	Intentionally deleted			
32	Intentionally deleted			
33	Intentionally deleted			
34	Intentionally deleted			
35	Intentionally deleted			
36	Intentionally deleted			

37	SUBSET-093	GSM-R Interfaces — Class 1 requirements	2.3.0	Index 33
38	Intentionally deleted			
39	Intentionally deleted			
40	ERA/ERTMS/040063	Test sequences evaluation and validation	Reserved	Index 37
41	Intentionally deleted			
42	Intentionally deleted			
43	04E083	Safety requirements and requirements to safety analysis for interoperability for the control-command and signalling subsystem	1.0	Index 27
44	04E084	Justification report for the safety requirements and requirements to safety analysis for interoperability for the control-command and signalling subsystem	1.0	Index 27
45	Intentionally deleted			
46	Intentionally deleted			
47	SUBSET-113	Report from UNISIG Hazard Log	Reserved	Index 27
48	TS 50238-2	Railway applications – Compatibility between rolling stock and train detection systems – Part 2: Compatibility with track circuits	2010	Index 77
49	TS 50238-3	Railway applications – Compatibility between rolling stock and train detection systems – Part 3: Compatibility with axle counters	2010	Index 77
50	Intentionally deleted			
51	ERA/ERTMS/040055	ETCS DMI objects - START / STOP conditions	1.1.0	Index 4 and Index 6
52	Intentionally deleted			
53	SUBSET-118	Functional Safety Analysis of ETCS DMI for ETCS Auxiliary Hazard	1.3.0	Index 27
54	SUBSET-119	Train Interface FFFIS	0.1.13	Index 81
55	SUBSET-120	FFFIS Train Interface - Safety analysis	0.2.11	Index 82
56	SUBSET-129	FIS for the RBC/RBC Handover involving a Baseline 2 RBC	0.0.3	Index 12
57	Intentionally deleted			
58	O-2875	ERTMS/GSM-R Quality of Service test specification for EIRENE QoS requirements Voice and non-ETCS data	1.0	Index 33

Note 2: With regards to the GSM-R DMI, this Index provides additional information to implement the mandatory requirements of the EIRENE SRS.

Table 7.3: List of supporting informative specifications related to Table A-2.3 of CCS TSI

No.	Set of specifications #3 (ETCS baseline 3 Release 2 and GSM-R baseline 1)			
	Reference	**Document name**	**Version**	**Notes**
1	02S126	RAM requirements (chapter 2 only)	6	Index 28
2	97S066	Environmental conditions	5	
3	SUBSET-074-1	Methodology for testing FFFIS STM	3.1.0	Index 36
4	97E267	Odometer FFFIS	5	Index 44
5	O_2475	ERTMS GSM-R QoS test specification	Reserved	Index 33 and Note 3
6	Intentionally deleted			
7	SUBSET-074-3	FFFIS STM Test specification traceability of test cases with specific transmission module FFFIS	3.1.0	Index 36
8	SUBSET-074-4	FFFIS STM Test specification traceability of testing the packets specified in the FFFIS STM application layer	3.1.0	Index 36
9	SUBSET 076-0	ERTMS/ETCS test plan and methodology	Reserved	Index 37
10	Intentionally deleted			
11	Intentionally deleted			
12	Intentionally deleted			
13	Intentionally deleted			
14	Intentionally deleted			
15	Intentionally deleted			
16	SUBSET 076-6-1	test database	Reserved	Index 37
17	Intentionally deleted			
18	Intentionally deleted			
19	SUBSET 077	UNISIG causal analysis process	3.0.0	Index 27
20	SUBSET 078	RBC interface: failure modes and effects analysis	3.4.0	Index 27
21	SUBSET 079	MMI: failure modes and effects analysis	3.14.0	Index 27
22	SUBSET 080	TIU: failure modes and effects analysis	3.2.0	Index 27

23	SUBSET 081	Transmission system: failure modes and effects analysis	3.5.0	Index 27
24	SUBSET 088	ETCS Application levels 1 and 2 — safety analysis	3.6.0	Index 27
25	TS50459-1	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 1 — Ergonomic principles of ERTMS/ETCS/GSM-R information	2005	only for Index 33 Note 4
26	Intentionally deleted			
27	TS50459-3	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 3 — Ergonomic arrangements of ERTMS/GSM-R information	2005	only for Index 33 Note 4
28	TS50459-4	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 4 — Data entry for the ERTMS/ETCS/GSM-R systems	2005	only for Index 33 Note 4
29	TS50459-5	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 5 — Symbols	2005	only for Index 33 Note 4
30	TS50459-6	Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — driver machine interface - Part 6 — Audible information	2005	only for Index 33 Note 4
31	Intentionally deleted			
32	Intentionally deleted			
33	Intentionally deleted			
34	Intentionally deleted			
35	Intentionally deleted			
36	Intentionally deleted			
37	SUBSET-093	GSM-R Interfaces — Class 1 requirements	Reserved	Index 33 and Note 3
38	Intentionally deleted			
39	Intentionally deleted			

40	ERA/ERTMS/040063	Test sequences evaluation and validation	Reserved	Index 37
41	Intentionally deleted			
42	Intentionally deleted			
43	04E083	Safety requirements and requirements to safety analysis for interoperability for the control-command and signalling subsystem	1.0	Index 27
44	04E084	Justification report for the safety requirements and requirements to safety analysis for interoperability for the control-command and signalling subsystem	1.0	Index 27
45	Intentionally deleted			
46	Intentionally deleted			
47	SUBSET-113	Report from UNISIG Hazard Log	Reserved	Index 27
48	TS 50238-2	Railway applications – Compatibility between rolling stock and train detection systems – Part 2: Compatibility with track circuits	2010	Index 77
49	TS 50238-3	Railway applications – Compatibility between rolling stock and train detection systems – Part 3: Compatibility with axle counters	2010	Index 77
50	Intentionally deleted			
51	ERA/ERTMS/040055	ETCS DMI objects - START / STOP conditions	Reserved	Index 4 and Index 6
52	Intentionally deleted			
53	SUBSET-118	Functional Safety Analysis of ETCS DMI for ETCS Auxiliary Hazard	1.4.0	Index 27
54	SUBSET-119	Train Interface FFFIS	Reserved	Index 81
55	SUBSET-120	FFFIS Train Interface – Safety analysis	Reserved	Index 82
56	SUBSET-129	FIS for the RBC/RBC Handover involving a Baseline 2 RBC	Reserved	Index 12
57	SUBSET-116	Eurobalise On-board equipment susceptibility test specification	1.1.0	Index 9

58	O-2875	ERTMS/GSM-R Quality of Service test specification for EIRENE QoS requirements Voice and non-ETCS data	1.0	Index 33

Note 3: a new version of this document is being prepared, where the values indicated are assigned to the corresponding subsystem / Interoperability Constituent. Until this version is available, the documents indicated in Set#1 and Set#2 can be used for the Circuit Switched mode of communication.

Note 4: With regards to the GSM-R DMI, this Index provides additional information to implement the mandatory requirements of the EIRENE SRS.

ANNEX 1: BASIC PARAMETER 4.2.10 - SHUNTING IMPEDANCE FOR TRACK CIRCUITS

A track circuit is a section of the railway line, separated by the adjacent sections by means of insulated joints or “impedance bonds”; a signal is fed at one side of it and, in normal conditions, reaches the receiver at the opposite side.

If an axle of a vehicle “shunts” the rails, the level of the signals at the receiver is lowered below a threshold, indicating that the section is occupied.

To design a track circuit it is therefore necessary to determine the “shunting impedance”, i.e., the maximum impedance between the rails causing the signal at the receiver become lower than the threshold value.

Such “shunting impedance” is given by the impedance between the surface of the wheels of a vehicle and the “contact impedance” between the surfaces of the wheels and the surfaces of the rails.

Many factors contribute to the contact impedance (non exhaustive list):

1. Axle load (i.e., the force pressing the wheel surface against the rail surface)
2. Traction current (a current flowing at the contact surface may decrease the impedance between the wheel and the rail)
3. Dimension of the contact surface between wheels and rails
4. Rust on the surface of the wheels
5. Rust on the surface of the rails
6. Pollution on the surface of the wheels
7. Pollution on the surface of the rails

The factors 3, 4 and 5 are influenced by the dynamics of train movement, i.e., the relative displacement of wheels and rails during the movement, the speed and the train weight.

As far as factor 6 and 7 are concerned, while some sources of pollution are typical for trackside (e.g., leaves on rails), other sources may deposit an isolating film both on wheels and rails:

1. Brake blocks (composite types)
2. Sanding
3. Flange lubrication (on-board devices)
4. Flange lubrication (trackside devices)

The different contributions are represented in Figure A1-1.

Today many different types of track circuits are in service, operating at different frequencies and with different sensitivity for shunting impedance.

Some factors can be determined accurately and maintained during the vehicle life, like the values of impedance between the surfaces of wheels (clean) and of the axle load: they are therefore harmonised as interface parameters between rolling stock and trackside Control-Command and Signalling equipment in the TSI.

Similarly, being powered with electric traction is a permanent feature of a vehicle.

Other factors are more complex to manage:

1. Some depend on the interaction between a vehicle and a specific infrastructure, like the dimension of the contact surface.

2. Some are vehicle characteristics (affecting all infrastructures where the vehicle runs), and can be kept under control with operational rules related to vehicle movements (like rust on wheels).
3. Some are trackside characteristics, only affecting one infrastructure, and can be kept under control with operational rules related to vehicle movements (like rust on rails).
4. Some are originated trackside and affect both vehicles and infrastructures, creating isolating layers on wheels and rail surfaces (like trackside flange lubrication).
5. Some are originated on-board and affect both vehicles and infrastructures, creating isolating layers on wheels and rail surfaces (like on-board flange lubrication, brake blocks and sanding).

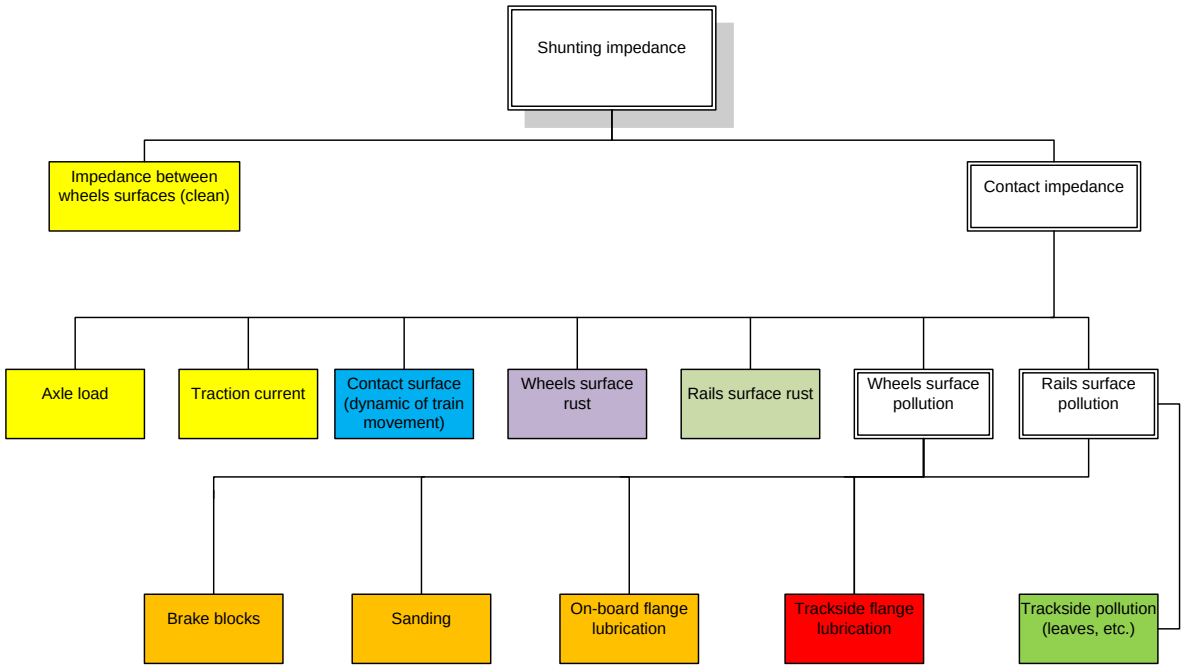


Figure A1-1: contributions to the “shunting impedance” (non exhaustive list)

Only technical requirements on the interface between wheels and rails are specified in the TSI and it is indicated where operational rules can be necessary.

ANNEX 2: BASIC PARAMETER 4.2.11 - ELECTROMAGNETIC FIELDS

General principles

The proposed frequency management principle is based upon the integration of known Axle Counter immunity levels, coupled with rolling stock emissions, for compatibility purposes, to enable current and future interoperability.

The frequency management of intra system (between Axle Counters) and inter system (between Axle Counters and rolling stock) compatibility requirements is based upon the list of known Axle Counters currently in use. The rolling stock emission limits and the evaluation parameters have been determined from the known in-band susceptibility threshold limits for Axle Counters, which includes a 9 dB margin pertinent to the correct bandwidths of operation of the respective Axle Counter, established from laboratory tests.

The frequency management proposes three distinct frequency bands. These ranges have been established from known technologies and encompass the differences in manufacture, to allow for flexibility and compatibility between Axle Counters when mounted close to each other on the infrastructure.

Rolling stock emission requirements

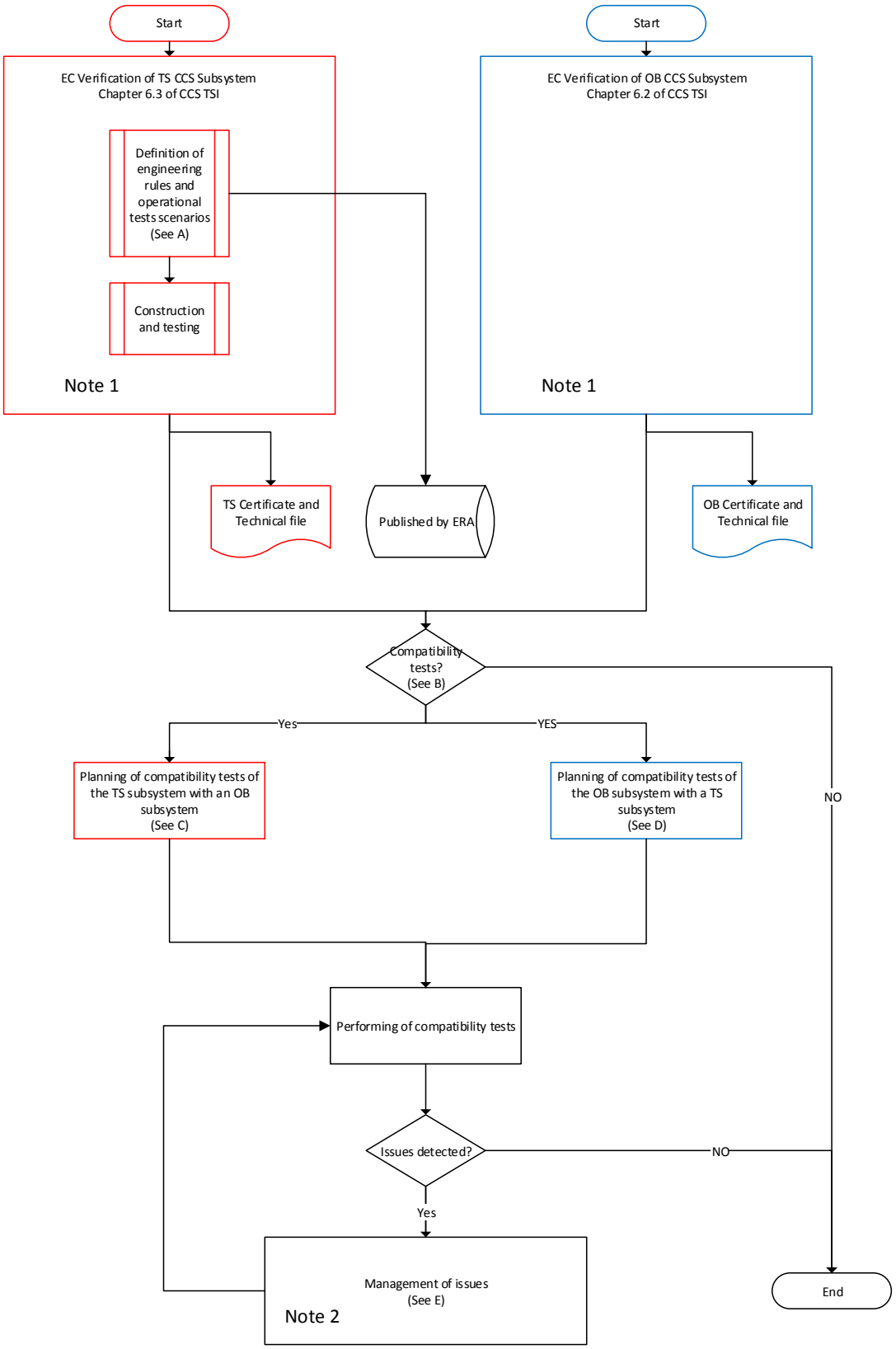
The general coupling mechanisms and principal electromagnetic phenomena for emissions and immunity are adequately described in EN50121-1 Annexe A. For the purposes of the proposed frequency management in respect of the compatibility between rolling stock and axle counters, particular attention is drawn to the pulsed switching circuits in operation on modern railway vehicles. These can produce higher levels of harmonics and transients in return currents than previously seen on railway vehicles containing less complex technologies. Nevertheless, they can be considered as the main source of interference to Axle Counters. Critical to this are the short rise-time pulses with high repetition rates.

Pulsed oscillating magnetic fields at or near the Axle Counter sensor position are generated by common-mode currents underneath the railway vehicles, flowing in uncontrolled paths. As a consequence, the qualification of rolling stock emitted magnetic field levels is highly dependant upon the filter bandwidth used for the qualification for evaluation.

In-band emission limits for the three frequency bands and the corresponding evaluation parameters including frequency range, bandwidth and integration time have been optimised for due consideration of both rolling stock and Axle Counters. Out of band emission limits are defined as a result of practical experience with max emissions envelope of magnetic field levels for existing rolling stock and considerations for compatibility with the EMC Directive.

ANNEX 3: FLOW CHARTS RELATED TO OPERATIONAL TEST SCENARIOS

The flow chart below shows an overview of the processes.



The red parts are related to checks of the Trackside Control-command and Signalling subsystem, while the blue ones are related to the On-board subsystem.

IMs and RUs may agree to cooperate and perform jointly compatibility tests.

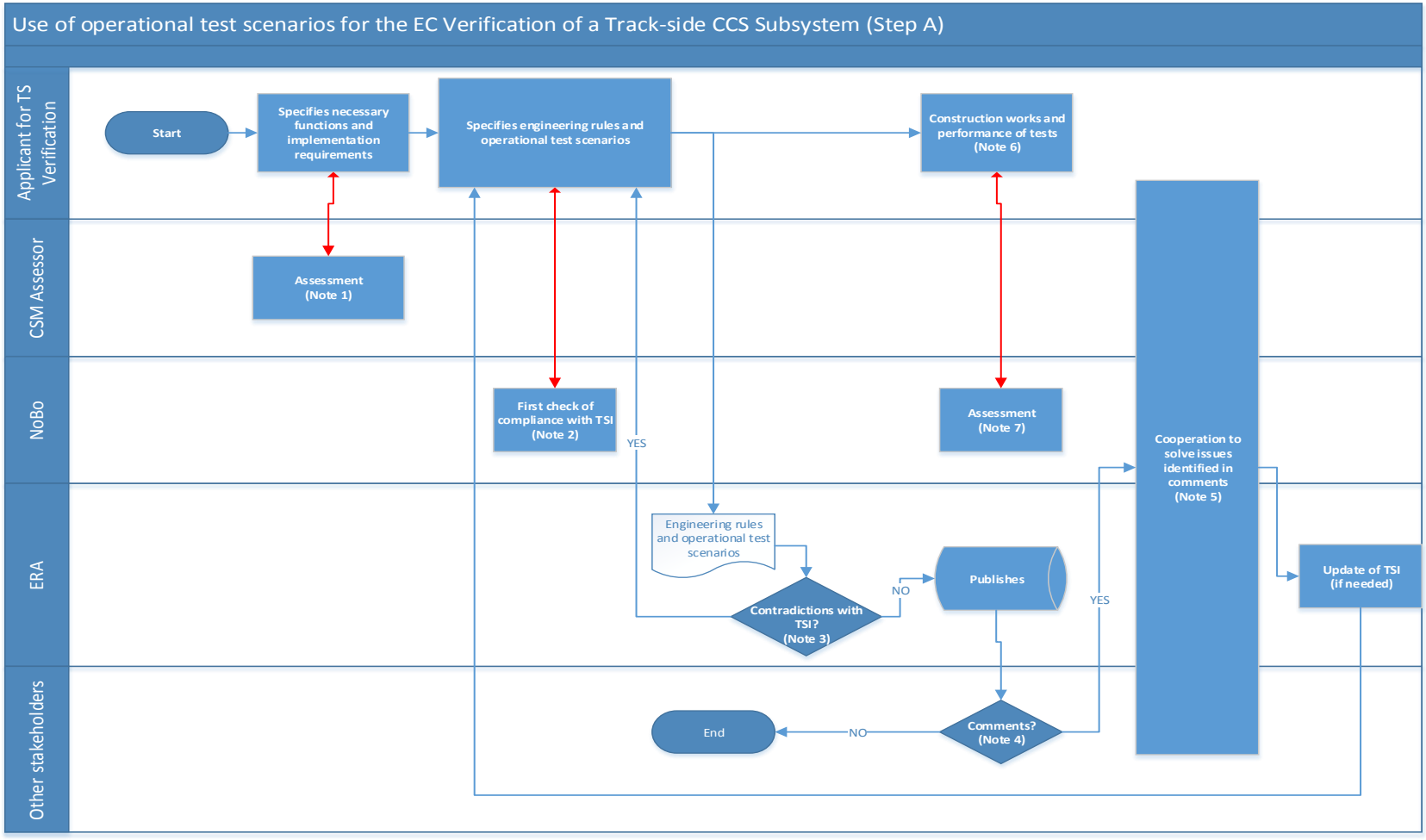
Black parts may require cooperation of IMs, RUs, applicants for Trackside and applicants for On-board, as better described in the detailed flow charts for each step.

Note 1:
The tests according to the last row of table 6.2 and, respectively, table 6.3 of TSI Control-Command and Signalling are part of the EC Verification process, including possible updates of the Technical Files due to the results of additional tests under operational conditions.

Note 2:
This activity may result in updates of certificates of ICs and/or subsystems.

The flow charts of the following pages describe in details the steps A, B, C, D and E, indicated in the “overview”.
In these charts, red arrow mean cooperation between the relevant entities.

Step A



This flow chart shows how the publication/check of operational test scenarios is integrated in the EC Verification process.

The start point is the same (beginning of the project design). The management of operational tests scenarios ends when all possibly received comments are answered and the operational test scenarios are the ones that will used for subsystem test.

Note 1:
According to the TSI Control-Command and Signalling (6.1.1.3, bullet 1), the EC Verification of a Track-side Control-command and Signalling Subsystem starts after the decision of the applicant related to the functions that must be implemented. This decision is supported by the safety assessment related to the safe integration of the Control-command and Signalling Track-side subsystem in the technical and operational environment.
The CSM assessor is also involved during the whole project development, to assess the appropriate management of identified hazards and their closure, according to the principles of the CSM Regulation. This activity is not shown in the flow chart, which focuses on the use of operational test scenarios.

Note 2:
The involvement of the Notified Body and the share of work with the applicant is according to the selected module for the EC Verification. At this stage, it has to be checked that all functions required by the application are specified in accordance with specifications referenced in the TSI.

Note 3:
The Agency checks that the operational test scenarios respect the requirements specified in section 6.1.2.3 of the TSI, and especially that there are no exported requirements to on-board.

Note 4:
If there are comments on compliance with TSI and impacts on interoperability.

Note 5:
The Agency coordinates the solutions of issues identified through received comments (according to TSI Control-Command and Signalling 6.1.2.3, bullet 2 of the second list of requirements). This does not change the responsibility of applicants and NoBos for the EC Verification of the subsystem.

Note 6:
It is important that operational test scenarios are specified and checked as soon as possible, to avoid difficult and expensive re-working when the project is already at advanced stage.
The TSI does not require that the project is halted waiting for comments, anyway, if, during project development, changes in the engineering rules and/or operational tests scenarios are necessary, the updated ones must be published.

Note 7:
The involvement of the NoBo and the share of work with the applicant is according to the selected module for the EC Verification. The checks to be performed are the ones listed in table 6.3 of the TSI Control-Command and Signalling.

Step B

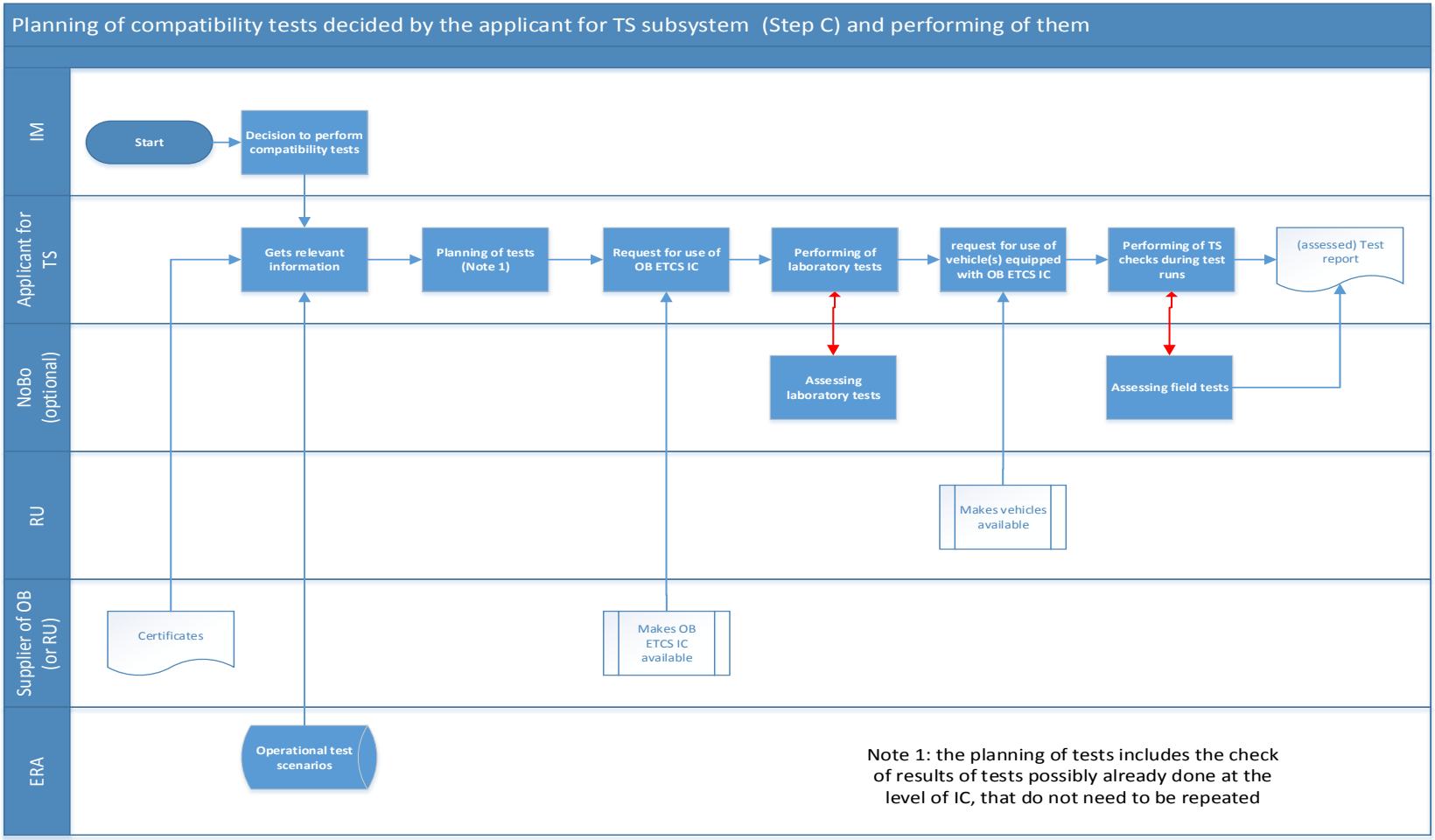
Note: according to the situation, decision to perform compatibility tests may be taken by an IM (e.g. if a trackside subsystem, where existing vehicles are already operating, has been modified), by a RU (e.g. if a new vehicle starts operation on an existing route) or jointly by both, whenever doubts about the appropriate cooperation between an on-board and a trackside CCS subsystem exist.

Each interested operator can select the checks that are relevant for its subsystem, making reference to the published operational test scenarios for the relevant trackside subsystem, and selecting which tests can be done in a laboratory and which on-site.

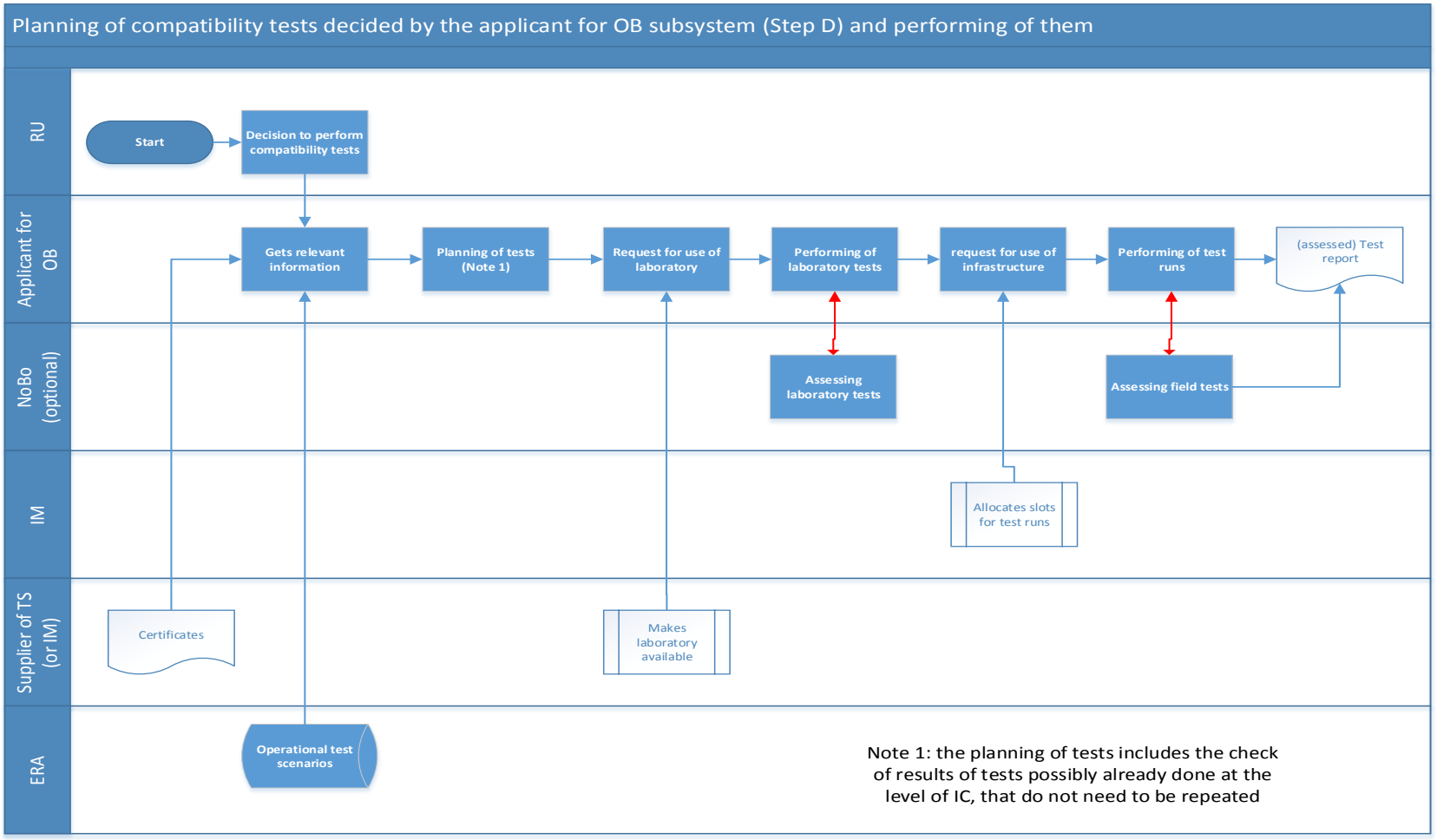
The following flow charts (step C and step D) show, respectively, the activities of the applicant for trackside and of the applicant for on-board, to decide the tests that are relevant for the own subsystem and to support tests decided by the other party.

Cooperation between applicant for trackside and applicant for on-board can reduce efforts and costs, optimizing test planning and execution, and avoiding repetitions.

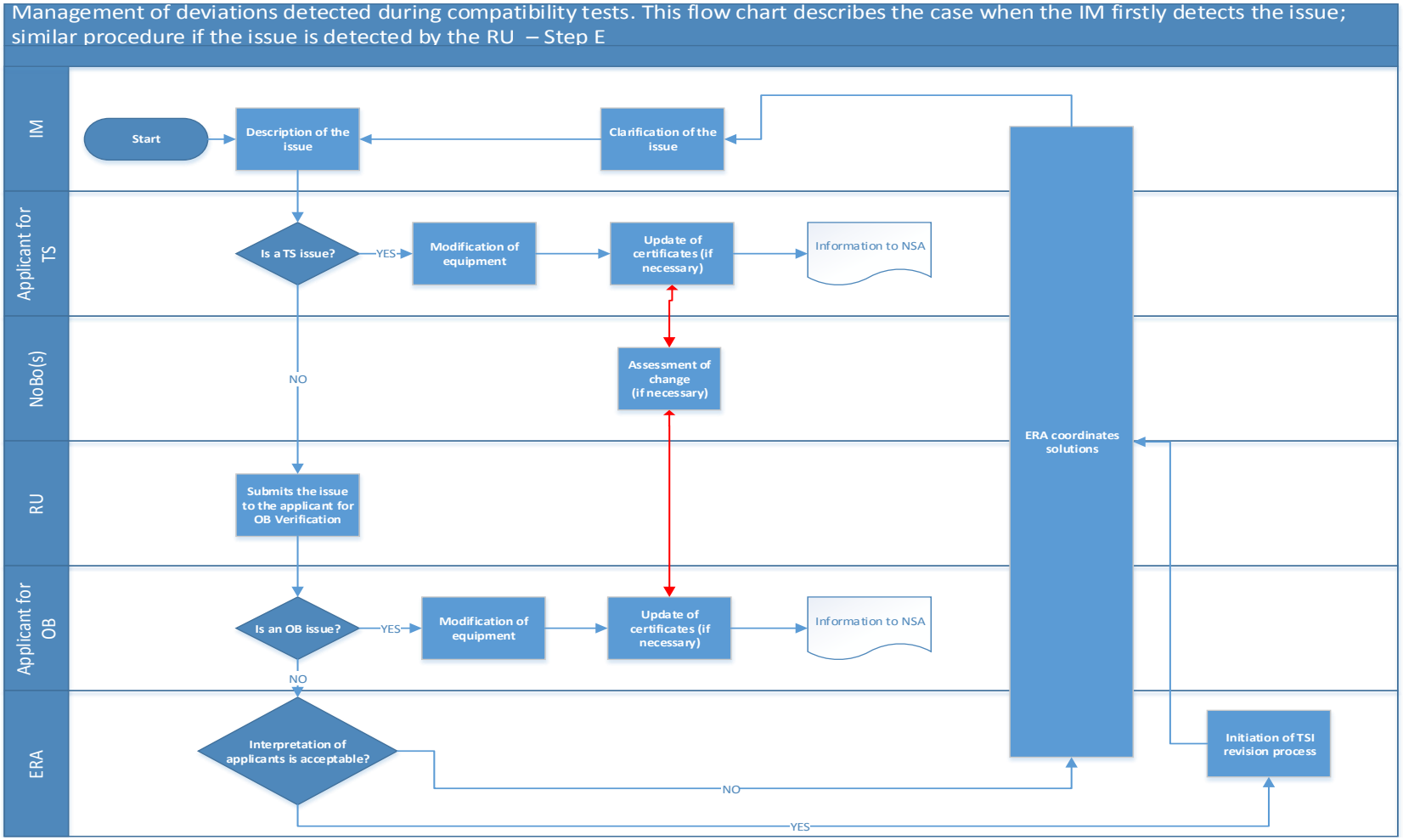
Step C


Planning of compatibility tests decided by the applicant for TS subsystem (Step C) and performing of them
IM
Applicant for TS
NoBo (optional)
RU
Supplier of OB (or RU)
ERA
Start
Decision to perform compatibility tests
Gets relevant information
Planning of tests (Note 1)
Request for use of OB ETCS IC
Performing of laboratory tests
request for use of vehicle(s) equipped with OB ETCS IC
Performing of TS checks during test runs
(assessed) Test report
Assessing laboratory tests
Assessing field tests
Makes vehicles available
Certificates
Makes OB ETCS IC available
Operational test scenarios
Note 1: the planning of tests includes the check of results of tests possibly already done at the level of IC, that do not need to be repeated

Step D


Planning of compatibility tests decided by the applicant for OB subsystem (Step D) and performing of them
RU
Applicant for OB
NoBo (optional)
IM
Supplier of TS (or IM)
ERA
Start
Decision to perform compatibility tests
Gets relevant information
Planning of tests (Note 1)
Request for use of laboratory
Performing of laboratory tests
request for use of infrastructure
Performing of test runs
(assessed) Test report
Assessing laboratory tests
Assessing field tests
Allocates slots for test runs
Certificates
Makes laboratory available
Operational test scenarios
Note 1: the planning of tests includes the check of results of tests possibly already done at the level of IC, that do not need to be repeated

Step E


Management of deviations detected during compatibility tests. This flow chart describes the case when the IM firstly detects the issue; similar procedure if the issue is detected by the RU – Step E
IM
Applicant for TS
NoBo(s)
RU
Applicant for OB
ERA
Start
Description of the issue
Clarification of the issue
Is a TS issue?
YES
Modification of equipment
Update of certificates (if necessary)
Information to NSA
NO
Assessment of change (if necessary)
ERA coordinates solutions
Submits the issue to the applicant for OB Verification
Is an OB issue?
YES
Modification of equipment
Update of certificates (if necessary)
Information to NSA
NO
Interpretation of applicants is acceptable?
NO
YES
Initiation of TSI revision process