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LOCALISATION WORKING GROUP (LWG)

Railways Localisation System
High Level Users' Requirements

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Modification history

Version	Date	Modification / Description	Editor
0a-0g		Internal review of LWG	GR
0h	06/12/18	Version for NPM approval	GR
0i	24/12/18	Upgrade after December 18 NPM meeting	GR
0l	18/01/19	Upgrade after THE 15TH of January 2019 meeting with NR, DB and ProRail NPM	DC, GR
1	28/01/2019	Update after January 19 NPMs meeting	DC, GR
1a to 1b		Update after X2R-2 WP3	DC, GR
1c to 1h		Input from mission profiles works and from X2R-2 WP3	SK, DC, GR
2	10/12/2019	Version 2	LWG

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1 List of References and Acronyms

References

PERSPECTIVE	Report on ERTMS Longer Term Perspective, 18/12/2015
RCA_WP	18C044 White Paper Reference CCS Architecture Based on ERTMS
[SS041]	Performance Requirements for Interoperability - Subset-041v. 3.2.0
[SS091]	Safety Requirements for the Technical Interoperability of ETCS in Level 1 and 2 - Subset-091v. 3.6.0
[RCA]	RCA Beta – Architecture Overview

Acronyms

APS-OA	ADVANCED PROTECTION SYSTEM - OBJECT AGREGATION
ATO	AUTOMATIC TRAIN OPERATION
BG	BALISE GROUP
CAPEX	CAPITAL EXPENDITURE
CBA	COST BENEFIT ANALYSIS
CCS	CONTROL COMMAND AND SIGNALLING
CER	COMMUNITY OF EUROPEAN RAILWAYS
CMD	COLD MOVEMENT DETECTOR
CR	CHANGE REQUEST
EC	EUROPEAN COMISSION
EIM	EUROPEAN RAIL INFRASTRUCTURE MANAGER
ERTMS	EUROPEAN RAIL TRAFFIC MANAGEMENT SYSTEM
EUG	ERTMS USERS GROUP
EVC	EUROPEAN VITAL COMPUTER
ERA	EUROPEAN RAIL AGENCY
LS	LOCALISATION SYSTEM
LRBG	LAST RELEVANT BALISE GROUP
MOL	MOBILE OBJECT LOCATOR
LWG	LOCALISATION WORKING GROUP
MOLS	MOBILE OBJECT LOCALISATION SYSTEM

MOT	MOBILE OBJECT TRANSACTOR
NPM	NATIONAL PROGRAMME MANAGERS
OPEX	OPERATIONAL EXPENDITURE
PeLS	PERSONS LOCALISATION SYSTEM
PL	PERSON LOCATOR
PSL	PERSON SUPERVISOR AND LOCATOR
RCA	REFERENCE CCS ARCHITECTURE
SIL	SAFETY INTEGRITY LEVEL
SoM	START OF MISSION
TLS	TRAIN LOCALISATION SYSTEM
VL	VEHICLE LOCATOR

2 Glossary and definitions

2.1.1.1 The following definitions are used in the current document in agreement with [RCA].

2.1.1.2 The Rail Localisation system is the set of functional blocks able to provide “objects” (e.g. trains, coaches, maintenance rolling stock, workers) positioning information along\around the track.

2.1.1.3 Within the Rail Localisation system, the Train Localisation system (TLS) is the subset of functional blocks able to provide “trains” positioning information along the track.

2.1.1.4 The Train Localisation system includes the onboard functional block VL and trackside functional blocks MOT and APS OA (aggregating information also coming from possible trackside occupancy detection devices).

2.1.1.5 Within the Rail Localisation system, the Mobile object Localisation system (MOLS) is the subset of functional blocks able to provide “mobile objects” (it can be used for multiple cases e.g. obstacles, a crane, a train-end, a wagon or coach, a door that swings on the track, etc) positioning information along the track.

2.1.1.6 The Mobile objects Localisation system includes the “onboard” functional block MOL (Mobile object Locator) and trackside functional blocks MOT and APS OA (aggregating information also coming from possible trackside occupancy detection devices).

2.1.1.7 Within the Rail Localisation system, the Persons Localisation system (PeLS) is the subset of functional blocks able to provide “persons” (e.g. workers) positioning information on the surrounding of the track.

2.1.1.8 The Persons Localisation system includes the functional block PSL (Person Supervisor and Locator) and trackside functional blocks MOT and APS OA.

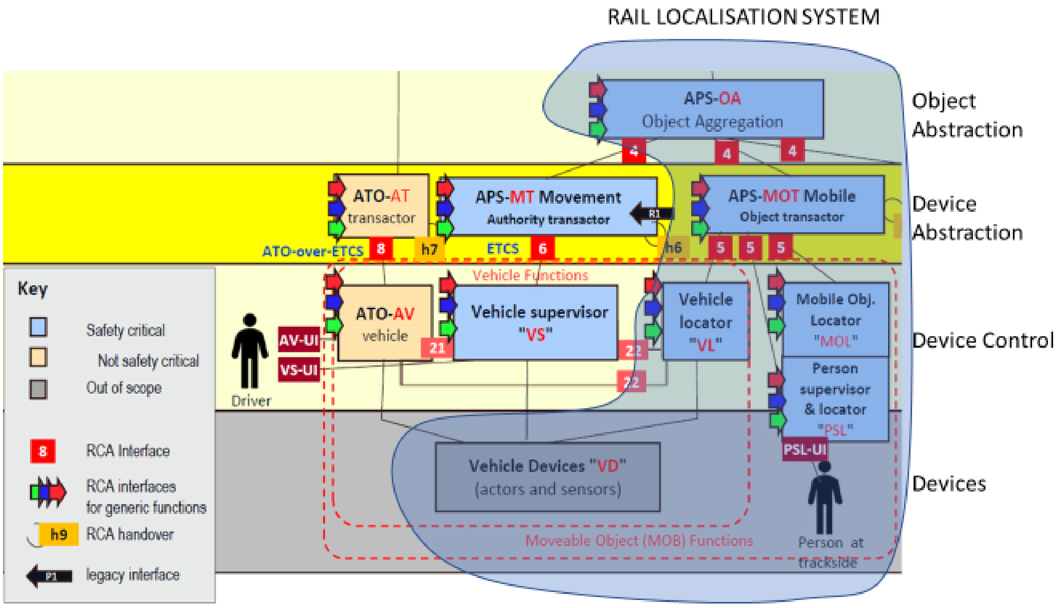

Figure 1: Rail Localisation System. Extract from RCA Architecture Poster, version Beta 1.

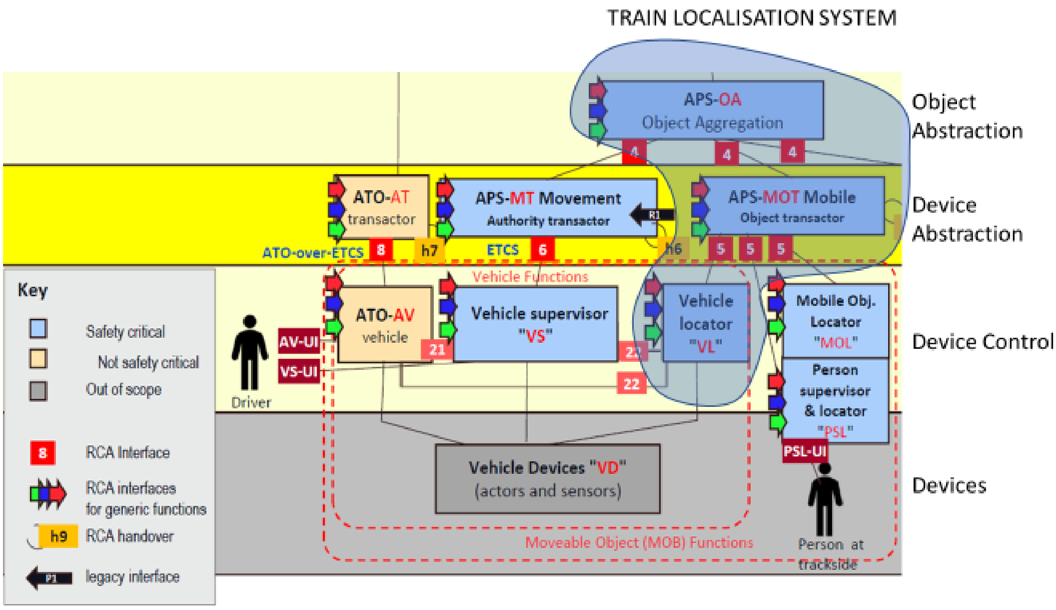

Figure 2: Train Localisation System. Extract from RCA Architecture Poster, version Beta 1.

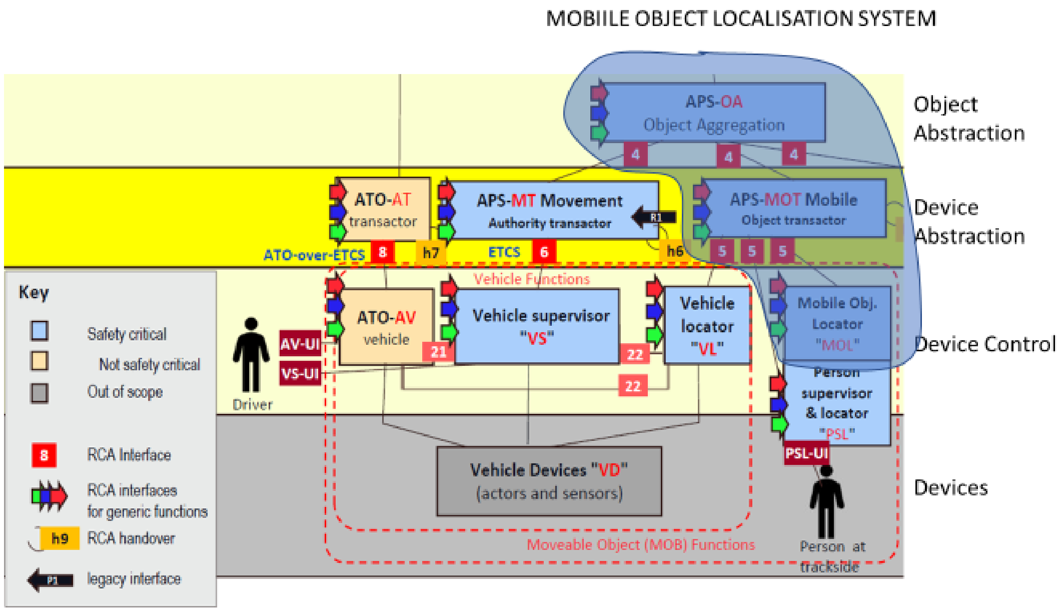

Figure 3: Mobile Object Localisation System. Extract from RCA Architecture Poster, version Beta 1.

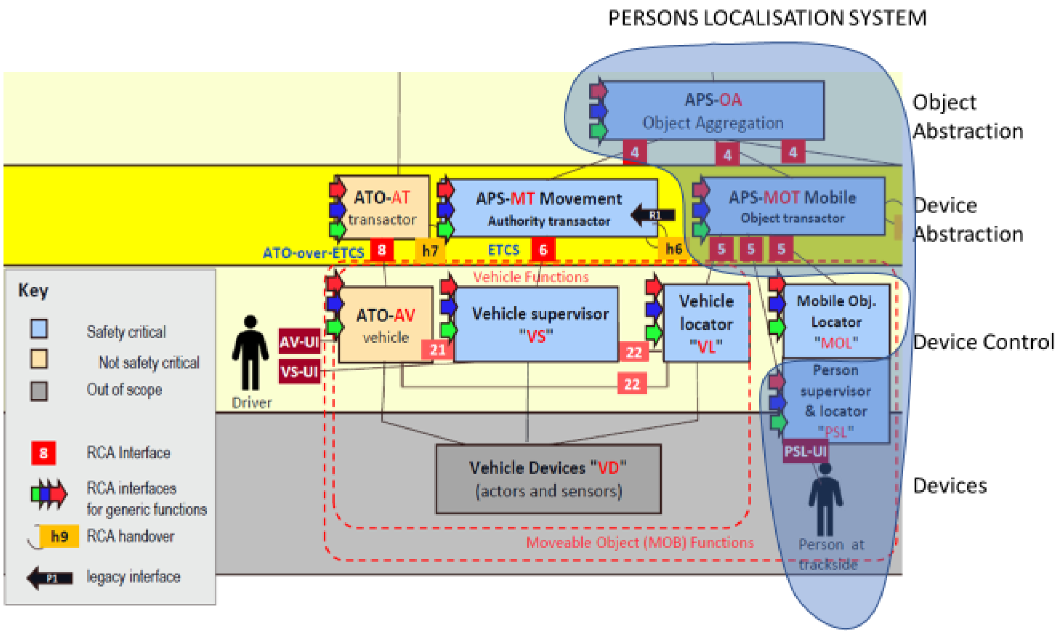

Figure 4: Persons Localisation System. Extract from RCA Architecture Poster, version Beta 1.

2.1.1.9 TLS and MOLS provide the necessary information in order to monitor the occupancy of the tracks within a controlled section by different potentially moving or static elements to protect rail traffic.

2.1.1.10 PeLS provides the necessary information in order to monitor the occupancy of the tracks within a controlled section by different potentially moving or static crew to protect them against possible incoming objects.

3 Scope of the document

3.1.1.1 The purpose of this document is to define railways localisation high level user's requirements in a technology neutral manner.

3.1.1.2 Users' requirements are intended to address the following functionalities to be developed according to an incremental approach:

a) Enhancement (accuracy and cost effectiveness) of onboard odometry for ERTMS application; the scope of the document is to make current ERTMS odometer requirements clearer and better performing to fulfil present and future operational users' needs, without any impact on the existing ERTMS onboard architecture or on the ERTMS working principles

b) Define high level users' requirements of the TLS. TLS is intended to include an independent Vehicle Locator (VL) able to provide continuously the actual position, with the relevant uncertainties, of the vehicle and the entire track occupation or only a part of it (e.g. only the front position). Other vehicle dynamic data will also be provided to different consumers (e.g. EVC, TMS, passengers information, …). The allocation of the TLS requirements to the onboard (VL) and/or trackside is out of scope of this document; in case some requirement is applicable only to the onboard part, VL will be used in place of TLS.

c) Define high level users' requirements of the MOLS. MOLS is intended to include an independent Mobile object Locator (MOL) able to provide continuously the actual position (entire track occupation or only a part of it) with the relevant uncertainties, of a moving or static "object" which can interact with the railway environment. The allocation of the MOLS requirements to the onboard (MOL) and/or trackside is out of scope of this document; in case some requirement is applicable only to the "onboard" part, MOL will be used in place of MOLS.

d) Define high level users' requirements of the localisation function of the Person Supervisor and Locator (PSL) which is included in the PeLS; PSL localisation function is able to provide the localisation of persons (e.g. workers) on the surroundings of the track. The management of these information to close a track or to defend (warn) persons along the track (supervision function) is out of the scope of this specification.

3.1.1.3 Functionalities b), c) and d) described in 3.1.1.2 are only relevant for radio based ERTMS applications in the context of control command and signalling (CCS) domain having ERTMS/ETCS as the control command system including functions envisaged by the ERTMS long term perspective ("game changers") and also considering the evolution of the Reference CCS Architecture – see [RCA_WP] and [RCA].

3.1.1.4 Chapter 5, 6, 7 and 8 of the document define the high level users' requirements related respectively to functionalities a), b), c) and d) described in 3.1.1.2.

4 Problems description

4.1 Introduction

4.1.1.1 Chapter 4.2 addresses issues affecting ERTMS operation with reference to point a) of 3.1.1.2.

4.1.1.2 Chapter 4.3 addresses motivations related to functions b), c) and d) of 3.1.1.2.

4.2 ERTMS domain

4.2.1.1 In the ERTMS domain train localisation is identified as the actual speed and distance to a reference point along the track (the LRBG) with an associated confidence interval.

4.2.1.2 Train localisation determination in the ERTMS/ETCS context is currently a weak point [PERSPECTIVE] because of low reliability/performance implying:

- impact on <u>safety</u> (e.g. when release speed is given by trackside the activation of train trip functionality is delayed as longer as the accuracy is lower since emergency brake is triggered by min safe front end)
- impact on <u>operation</u> such as:
  - delays due to unexpected brakings
  - difficulty to approach a target
  - loss of capacity, increase of headways due to the increase of the confidence interval (on high density applications relying on moving block or fixed virtual block)
- impact on <u>direct costs</u> such as:
  - high cost of maintenance due to device failures and to premature wearing because of unexpected brakings
  - high cost of maintenance due to odometry recalibration
  - need to raise the density of balises generating high CAPEX and OPEX

4.3 CCS domain

4.3.1.1 Lifecycle length and cost are currently a weak point of the safe part of CCS systems making railways often less sustainable and competitive than other means of transport. Updates make complete system re-certification compulsory. Updates may be triggered by new specification versions, by technological improvements, by bug fixes but also by the replacement of constituents not available on the market any more.

4.3.1.2 High density populated areas are demanding for higher capacity solutions better exploiting existing infrastructure.

4.3.1.3 The continuous need of improving and maintaining the infrastructure forces the intervention of on-land crew that may need to intervene during operational hours in lines with traffic. In order to secure the operations and the people, it is necessary to announce the area in which these activities are carried on.

4.3.1.4 The multiplication of localisation use cases has led to an anarchic proliferation of localization systems for different applications on the trains, whereas the localisation information is basically of the same nature for all applications.

4.3.1.5 RCA based on ERTMS is proposing an architecture which should enable assets reduction, upgradeability of subsystems, modular safety, flexibility and a more efficient rail traffic management including a safer protection of land-crew for maintenance activities.

4.3.1.6 Aiming at disabling or dismantling track detection systems in the future, “obstacles” localisation function plays a central role as cost reduction and performance enhancement enabler within RCA concept.

4.3.1.7 Additional and more detailed (including business case considerations) motivations related to functions b), c) and d) of 3.1.1.2. are given in [RCA].

5 Enhancement of onboard Odometry for ERTMS application, users’ requirements

5.1 General targets

5.1.1.1 Solutions to improve ERTMS odometry performance shall work under all rail operational conditions, such as:

- slip and slide
- from standstill until maximum speed

Rationale:

a solution is needed under all operational conditions and it has to include events reasonably foreseeable in normal operation;

the difference between nominal and degraded situations shall be clearly defined: slip/slide (voluntary or not) events are normal conditions in the railway environment; they should belong to the nominal conditions of odometry.

5.1.1.2 Solutions to improve ERTMS odometry performance shall work under all rail environmental conditions, such as:

- all weather conditions
- all type of loco environment
- all types of Rail infrastructure (e.g. tunnels, bridges, with or without catenary, concrete track, ballast track, etc.)
- all types of physical environments such as station areas surrounded with high buildings, forests, etc.

Rationale:

a solution is needed under all railways environmental conditions;

under some extreme weather condition (e.g. flooding, very high temperature or wind) performance could be reduced;

the difference between nominal and degraded situations shall be clearly defined: e.g. presence of leaves or snow on the track are examples of normal conditions in the railway environment.

5.1.1.3 Solutions to improve ERTMS odometry performance shall be sustainable that is a positive business case shall be demonstrated along the life cycle in a global perspective, encompassing railway undertakings and infrastructure managers.

Rationale:

it has to be demonstrated that solutions to improve odometry performance will bring benefit in global term along its life cycle considering CAPEX, OPEX, reliability/availability/maintainability, calibration, capacity improvement and train delays decrease, possibly compared with existing solutions in operation performing the same functionalities; the positive business case estimation should be determined starting from the current driving costs railways need to reduce.

5.2 Safety targets

5.2.1.1 Solutions to improve ERTMS odometry performance shall not reduce safety integrity according to current ERTMS standard.

Rationale:

current ERTMS standard on safety [SS091] has to be kept as valid.

5.3 RAM targets

5.3.1.1 Solutions to improve ERTMS odometry performance shall be able to self-diagnose when accuracy targets are not fulfilled and the relevant mitigation/measure shall be identified, provided that safety is not affected.

Rationale:

ERTMS requires odometry error determination to calculate the train confidence interval.

5.3.1.2 ERTMS odometry availability shall be improved.

Rationale:

compared to sensors currently in use, improvements are expected without compromising safety requirements;

this includes possible reduction of physical kits/device trackside and onboard.

5.4 Accuracy targets

5.4.1.1 ERTMS odometry accuracy shall be improved.

Rationale:

with reference to ERTMS standard [SS041] § 5.3, improvements are expected without compromising safety requirements;
this includes reduction of distance-related error.

5.4.1.2 Solutions to improve ERTMS odometry performance shall provide efficient mechanism to calibrate/periodically correct data to keep train position information within accuracy targets during the mission.

Rationale:

maintenance activity for calibrate *is costly and is sensitive action regarding introduction of errors, manual calibration should be avoided; calibrate/periodically correct data mechanism have to be defined to fulfil accuracy targets.*

6 Train Localisation System users requirements

6.1 General targets

6.1.1.1 TLS shall provide train position information (and additional dynamic parameters) continuously to consumers having different requirements in terms of integrity (confidence associated to the uncertainty), accuracy (uncertainty) and respond time.

Rationale:

the kind of data and their format have to be defined starting from an analysis to be performed at system level to fulfil the requirements of the different consumers and having in mind the overall functionalities envisaged;

possible examples (list to be considered nor mandatory neither exhaustive) of consumers of TLS output are:

- *ERTMS/ETCS*
- *TMS*
- *Passengers information system*
- *ATO*

6.1.1.2 TLS shall provide train position information (and additional dynamic parameters) using reference coordinates to allocate the train along the track in a way to fulfil the different consumer's requirements.

Rationale:

the reference coordinates have to be defined to fulfil the requirements of the different consumers.

6.1.1.3 TLS shall work under all rail operational conditions, such as:

- Slip and slide
- From standstill until maximum speed

Rationale:

a TLS solution is needed under all operational conditions and it has to include events reasonably foreseeable in normal operation;

the difference between nominal and degraded situations shall be clearly defined: slip/slide (voluntary or not) events are normal conditions in the railway environment; they should belong to the nominal conditions of the TLS.

6.1.1.4 TLS shall work under all rail environmental conditions, such as:

- all weather conditions
- all type of loco environment
- all types of Rail infrastructure (e.g. tunnels, bridges, with or without catenary, concrete track, ballast track, etc.)
- all types of physical environments such as station areas surrounded with high buildings, forests, etc.

Rationale:

A TLS solution is needed under all railways environmental conditions;

under some extreme weather condition (e.g. flooding, very high temperature or wind) performance could be reduced;

the difference between nominal and degraded situations shall be clearly defined: e.g. presence of leaves or snow on the track are examples of normal conditions in the railway environment.

6.1.1.5 TLS shall be interoperable, independent from applications and interchangeable. External interfaces shall be completely standardised and open to be used by other systems.

Rationale:

TLS external interfaces have to be defined to avoid vendor lock-in and to provide train positioning information to different consumers;

TLS has to be open to technology evolution;

TLS constituents, according to RCA architecture, have to ensure modular certification (modular safety) and minimise system re-certification costs after replacement/upgrade of a constituent;

the interface between VL and the Mobile Object Transactor has to be standardised to guarantee interoperability.

6.1.1.6 TLS shall be sustainable that is a positive business case shall be demonstrated along the life cycle in a global perspective, encompassing railway undertakings and infrastructure managers.

Rationale:

it has to be demonstrated that TLS will bring benefit in global term along its life cycle considering CAPEX, OPEX, reliability/availability/maintainability, calibration, capacity improvement and train delays decrease, possibly compared with existing solutions in *operation performing the same functionalities; the positive business case estimation should be determined starting from the current driving costs railways need to reduce.*

6.1.1.7 TLS security shall be ensured.

Rationale:

robust security process for TLS shall be considered in relation to the overall RCA architecture.

6.1.1.8 Upon start-up, TLS shall reach full operational capability in minimal time with minimal human supervision.

Rationale:

automation is a key factor to increase safety and performance (start-up could happen once in the life of the TLS and VL as well).

6.2 Safety targets

6.2.1.1 TLS safety integrity shall be determined according to the safety relevance of consumers using TLS output.

Rationale:

safety integrity of TLS depends on the consequences a wrong train position information would have on TLS consumers.

6.3 RAM targets

6.3.1.1 TLS reliability/availability/maintainability shall be determined considering the overall architecture (all consumers using TLS output).

Rationale:

to be considered the impact of reliability/availability of TLS on all the consumers.

6.3.1.2 When compared to the current ERTMS localisation as jointly performed by balises and odometry, the TLS shall bring significant improvements in availability.

Rationale:

compared to sensors currently in use, improvements are expected without compromising safety needs;

this includes reduction of physical kits/device trackside and onboard.

6.3.1.3 TLS shall be able to self-diagnose when accuracy targets are not fulfilled and the relevant mitigation/measure shall be identified in a way that safety is not affected.

Rationale:

self-diagnostic capability is necessary to minimise maintenance activities and consequences the failure of accuracy targets would have on TLS consumers.

6.3.1.4 TLS capability to predict situation where TLS is failing to fulfil accuracy targets and the relevant mitigation/measure shall be described.

Rationale:

predictability capability is necessary to minimise the consequences the failure of accuracy targets would have on TLS consumers.

6.4 Accuracy targets

6.4.1.1 When compared to the current ERTMS localisation as jointly performed by balises and odometry, the TLS shall bring significant improvements in accuracy.

Rationale:

compared to sensors currently in use, improvements are expected without compromising safety requirements;

this includes reduction of distance-related error as well as the possibility to increase the number of reset of train confidence interval with a limited number of physical trackside kits (e.g. balises).

6.4.1.2 The TLS shall be track-selective.

Rationale:

as the TLS encapsulates the complete localisation function, it also has to centralise the logic for track-selectivity which means to be also able to distinguish a diverging track from a straight track over a switch.

6.4.1.3 TLS shall provide efficient mechanism to periodically calibrate data to keep train position information (and additional dynamic parameters) within accuracy targets during the mission.

Rationale:

maintenance activity for calibration is costly and is sensitive action regarding introduction of errors, manual calibration should be avoided; calibrate data mechanism have to be defined to fulfil accuracy targets.

7 Mobile object localisation system users requirements

7.1 General targets

7.1.1.1 The MOLS shall provide continuously position information (and additional dynamic parameters) of different kinds of mobile/static “objects” e.g. wagons, coaches, working machinery with the goal to protect them against possible converging objects/trains

Rationale:

Any object suitable to occupy a piece of track means a potential risk to the operation. Locating these objects to protect other moving objects in the tracks is responsibility of the MOLS.

7.1.1.2 MOLS shall provide object position information (and additional dynamic parameters) using reference coordinates to allocate the object along the track.

Rationale:

the reference coordinates have to be defined.

7.1.1.3 MOLS shall work under all rail operational conditions, such as:

- vibrations
- from standstill until maximum speed

Rationale:

a MOLS solution is needed under all operational conditions and it has to include events reasonably foreseeable in normal operation;

the difference between nominal and degraded situations shall be clearly defined.

7.1.1.4 MOLS shall work under all rail environmental conditions, such as:

- all weather conditions
- all type of wagon/coach environment
- all types of Rail infrastructure (e.g. tunnels, bridges, with or without catenary, concrete track, ballast track, etc.)
- all types of physical environments such as station areas surrounded with high buildings, forests, etc.

Rationale:

A MOLS solution is needed under all railways environmental conditions;

under some extreme weather condition (e.g. flooding, very high temperature or wind) performance could be reduced;

the difference between nominal and degraded situations shall be clearly defined.

7.1.1.5 MOLS shall be interoperable, independent from applications and interchangeable. External interfaces shall be completely standardised.

Rationale:

MOLS interfaces have to be defined to avoid vendor lock-in;

MOLS has to be open to technology evolution;

MOLS constituents, according to RCA architecture, have to ensure modular certification (modular safety) and minimise system re-certification costs after replacement/upgrade of a constituent;

the interface between MOL and MOT has to be standardised to guarantee interoperability.

7.1.1.6 MOLS shall be sustainable that is a positive business case shall be demonstrated along the life cycle in a global perspective, encompassing railway undertakings and infrastructure managers.

Rationale:

it has to be demonstrated that MOLS will bring benefit in global term along its life cycle considering CAPEX, OPEX, reliability/availability/maintainability, calibration, capacity improvement possibly compared with existing solutions in operation performing the same functionalities; the positive business case estimation should be determined starting from the current driving costs railways need to reduce.

7.1.1.7 MOLS security shall be ensured.

Rationale:

robust security process for MOLS shall be considered in relation to the overall RCA architecture.

7.1.1.8 Upon start-up, MOLS shall reach full operational capability in minimal time with minimal human supervision.

Rationale:

automation is a key factor to increase safety and performance (start-up could happen once in the life of the MOLS and MOL as well).

7.2 Safety targets

7.2.1.1 MOLS safety integrity shall be determined according to the use of the information provided and the possible additional provisions envisaged.

Rationale:

safety integrity of MOLS depends on the consequences a wrong object position information would have and on the presence of possible additional provisions to be considered (e.g. train detection systems).

7.3 RAM targets

7.3.1.1 MOLS reliability/availability/maintainability shall be determined considering the overall architecture (all consumers using MOLS output).

Rationale:

to be considered the impact of reliability/availability of MOLS on the overall architecture.

7.3.1.2 When compared to the current objects locator, the MOLS shall bring improvements in availability (or at least the same level of availability) considering the overall architecture.

Rationale:

compared to device currently in use (e.g. track circuits and axle counters), improvements are expected without compromising safety requirements;

this includes reduction of physical kits/device trackside and onboard.

7.3.1.3 MOLS shall be able to self-diagnose when accuracy targets are not fulfilled and the relevant mitigation/measure shall be identified in a way that safety is not affected.

Rationale:

self-diagnostic capability is necessary to minimise maintenance activities and consequences of MOLS failures.

7.3.1.4 MOLS capability to predict situation where MOLS is failing to fulfil accuracy targets and the relevant mitigation/measure shall be described.

Rationale:

predictability capability is necessary to minimise the consequences of MOLS failures.

7.4 Accuracy targets

7.4.1.1 When compared to the current objects locators, the MOLS shall bring significant improvements in accuracy/resolution.

Rationale:

compared to device currently in use (e.g. track circuits and axle counters), improvements are expected without compromising safety requirements.

7.4.1.2 The MOLS shall be track-selective.

Rationale:

as the MOLS encapsulates the complete localisation function, it also has to centralise the logic for track-selectivity which means to be also able to distinguish a diverging track from a straight track over a switch.

7.4.1.3 MOLS shall provide efficient mechanism to calibrate/periodically correct data to keep object position information (and additional dynamic parameters) within accuracy targets.

Rationale:

maintenance activity for calibrate *is costly and is sensitive action regarding introduction of errors, manual calibration should be avoided; calibrate/periodically correct data mechanism have to be defined to fulfil accuracy targets.*

8 Persons localisation system users requirements

8.1 General targets

8.1.1.1 PeLS shall be able to locate people working on the surroundings of the track with the goal.

Rationale:

any moving object in the tracks can be dangerous for people working in the surrounds of the tracks. PeLS is responsible for locating people providing the information to protect them (defence mechanisms such as to block a track or to defend/warn persons along the track is out of the scope of this specification).

8.1.1.2 PeLS shall provide person position information using reference coordinates to allocate the person along the track.

Rationale:

the reference coordinates have to be defined.

8.1.1.3 PeLS shall work under all rail environmental conditions, such as:

- all weather conditions
- all types of Rail infrastructure (e.g. tunnels, bridges, with or without catenary, concrete track, ballast track, etc.)
- all types of physical environments such as station areas surrounded with high buildings, forests, etc.

Rationale:

a PeLS solution is needed under all railways environmental conditions;

under some extreme weather condition (e.g. flooding, very high temperature or wind) performance could be reduced.

8.1.1.4 PeLS shall be interoperable and interchangeable. External interfaces shall be completely standardised.

Rationale:

PeLS interfaces have to be defined to avoid vendor lock-in and to provide person positioning information;

PeLS has to be open to technology evolution;

PeLS constituents, according to RCA architecture, have to ensure modular certification (modular safety) and minimise system re-certification costs after replacement/upgrade of a constituent;

the interface between PSL and the MOT has to be standardised to guarantee interoperability.

8.1.1.5 PeLS shall be sustainable that is a positive business case shall be demonstrated along the life cycle in a global perspective with comparison with existing provisions in use.

Rationale:

it has to be demonstrated that PeLS will bring benefit in global term along its life cycle considering CAPEX, OPEX, reliability/availability/maintainability, calibration, capacity improvement compared with existing solutions in operation performing the same functionalities; the positive business case estimation should be determined starting from the current driving costs railways need to reduce.

8.1.1.6 PeLS security shall be ensured.

Rationale:

robust security process for PeLS shall be considered in relation to the overall RCA architecture.

8.1.1.7 Upon start-up, PeLS shall reach full operational capability in minimal time with minimal human supervision.

Rationale:

automation is a key factor to increase safety and performance.

8.2 Safety targets

8.2.1.1 PeLS safety integrity shall be determined according to the use of the information provided and the possible additional provisions envisaged.

Rationale:

safety integrity of PeLS depends on the consequences a wrong object position information would have and on the presence of possible additional provisions to be considered.

8.3 RAM targets

8.3.1.1 PeLS reliability/availability/maintainability shall be determined considering the possible additional provisions envisaged.

Rationale:

to be considered the impact of reliability/availability of PeLS on the overall architecture.

8.3.1.2 When compared to the current person locator, the PeLS shall bring improvements in availability (or at least the same level of availability).

Rationale:

compared to possible device currently in use, improvements are expected without compromising safety requirements;

this includes reduction of physical kits/device trackside.

8.3.1.3 PeLS shall be able to self-diagnose when accuracy targets are not fulfilled and the relevant mitigation/measure shall be identified in a way that safety is not affected.

Rationale:

self-diagnostic capability is necessary to minimise maintenance activities and consequences of PeLS failures.

8.3.1.4 PeLS capability to predict situation where PeLS is failing to fulfil accuracy targets and the relevant mitigation/measure shall be described.

Rationale:

predictability capability is necessary to minimise the consequences of PeLS failures.

8.4 Accuracy targets

8.4.1.1 When compared to the current person locators on the surroundings of the track, the PeLS shall bring significant improvements in accuracy/resolution.

Rationale:

8.4.1.2 *compared to device currently in use, improvements are expected without compromising safety requirements.*

8.4.1.3 PeLS shall provide efficient mechanism to calibrate/periodically correct data to keep person position information within accuracy targets.

Rationale:

maintenance activity for calibrate *is costly and is sensitive action regarding introduction of errors, manual calibration should be avoided; calibrate/periodically correct data mechanism have to be defined to fulfil accuracy targets.*