OCORA

Open CCS On-board Reference Architecture

Localisation On-Board (LOC-OB)

High-level Requirements

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Revision History

Version	Change Description	Initials	Date of change
1.0	Official version for OCORA Release R1	SM	26.11.2021
2.0	Functional and Non-Functional requirements added	SeF	09.06.2022
3.0	Consistency updates and improvements as part of OCORA Release R3	SeF	08.12.2022
3.1	OCORA-904 improved definition of the requirement	SeF	05.05.2023

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References

Reader's note: please be aware that the document ids in square brackets, e.g. [OCORA-BWS01-010], as per the list of referenced documents below, are used throughout this document to indicate the references to external documents. Wherever a reference to a TSI-CCS SUBSET is used, the SUBSET is referenced directly (e.g. SUBSET-026). OCORA always reference to the latest available official version of the SUBSET, unless indicated differently.

[EEIG 92S126 Ref 02S1266] ERTMS/ETCS RAMS Requirements Specification Chapter 2 - RAM version 6

[EEIG 97s066] ERTMS/ETCS Environmental Requirements version 5

[EN 45545-2] Railway applications - Fire protection on railway vehicles - Part 2: Requirements for fire behavior of materials and components

[EN 50121-3-2] Railway applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus

[EN 50125-1] Railway applications - Environmental conditions for equipment - Part 1: Rolling stock and on-board equipment

[EN 50125-3] Railway applications - Environmental conditions for equipment Part 3: Equipment for signalling and telecommunications

[EN 50155] Railway applications - Rolling stock - Electronic equipment

[EUG 21E109] - Vehicle Locator Concept Architecture, LWG

[EUG 22E126] - LOC-OB System Definition & Operational Context, LWG

[IEC 60721] Classification of environmental conditions

[IEC 60721-3-5] Classification of Environmental Conditions Part 3: Classification of Groups of Environmental Parameters and Their Severities - Section 5: Ground Vehicle Installations

[IEC 61373] Railway applications – Rolling stock equipment – Shock and vibration tests

[OCORA-BWS01-010] – Release Notes

[OCORA-BWS01-020] – Glossary

[OCORA-BWS01-030] – Question and Answers

[OCORA-BWS01-040] – Feedback Form

[OCORA-BWS03-010] - Introduction to OCORA

[OCORA-BWS04-010] - Problem Statements

[OCORA-TWS01-100] – Localisation On-Board (LOC-OB) – Introduction

[OCORA-TWS01-030] – System Architecture

[OCORA-TWS01-035] – CCS-On-Board Architecture

[OCORA-TWS05-010] – Requirements – Management Guideline

[RCA.Doc.18, BL0 R2] - RCA Domain Knowledge

[RCA.Doc.46, BL0 R2] - Concept : Digital Map

1 Introduction

1.1 Purpose of the document

The purpose of this document is to provide the collection of all Localisation On-Board (LOC-OB) requirements in a structured manner. However, the current release focuses on the exported requirements of LOC-OB (see chapter 2 - Prerequisites), i.e. the requirements/needs LOC-OB has towards other components to fulfil its mission.
It is recommended to get familiar with the general Localisation On-Board principles [OCORA-TWS01-100], the Localisation On-Board Concept Architecture [EUG 21E109] and the Localisation On-Board system definition [EUG 22E126] prior to reading this document.

The current release shall be seen as a complementary document of the Localisation On-Board system definition [EUG 22E126]. Figures provided are preliminaries and may change in future release.

This document is addressed to experts in the CCS domain and to any other person, interested in the OCORA concepts for on-board CCS which architecture is described in [OCORA-TWS01-030] and [OCORA-TWS01-035]. The reader is invited to provide feedback to the OCORA collaboration and can, therefore, engage in shaping OCORA. Feedback to this document and to any other OCORA documentation can be given by using the feedback form [OCORA-BWS01-040].

1.2 Applicability of the document

The document is currently considered informative but may become mandatory at a later stage for OCORA compliant on-board CCS solutions. Subsequent releases of this document will be developed based on a modular and iterative approach, evolving within the progress of the OCORA collaboration.

1.3 Context of the document

This document is published as part of an OCORA Release, together with the documents listed in the release notes [OCORA-BWS01-010] . Before reading this document, it is recommended to read the Release Notes [OCORA-BWS01-010]. If you are interested in the context and the motivation that drives OCORA we recommend to read the Introduction to OCORA [OCORA-BWS03-010], and the Problem Statements [OCORA-BWS04-010]. The reader should also be aware of the Glossary [OCORA-BWS01-020] and the Question and Answers [OCORA-BWS01-030].

1.4 Requirements Engineering Process

This OCORA requirement document is developed, using the Requirements Management Guideline [OCORA-TWS05-010]. The requirements are engineered in a top-down manner:

- As a starting point all **"Stakeholder Requirements"** towards the OCORA initiative **(A-Level requirements)** are captured and formalised.

- In a second step, the **"Program- and Design Requirements" (B-Level requirements)** are developed. These requirements define tools, processes, methodologies and design rules to be

used within the program and to be considered during the system analysis and the system design/architecture work.

- As a next step, the A- and B-Level requirements are further developed in the MBSE analysis to become **"System Requirements" (C-Level requirements).**

- As part of the MBSE architecture work, building blocks are identified taking into account the MBSE analysis (C-Level requirements). All applicable requirements (A-Level, B-Level, and C-Level) are apportioned to the identified building blocks, resulting in **"Building Block Requirements" (D-Level requirements)**, forming the OCORA tender templates, together with the applicable program & design requirements.

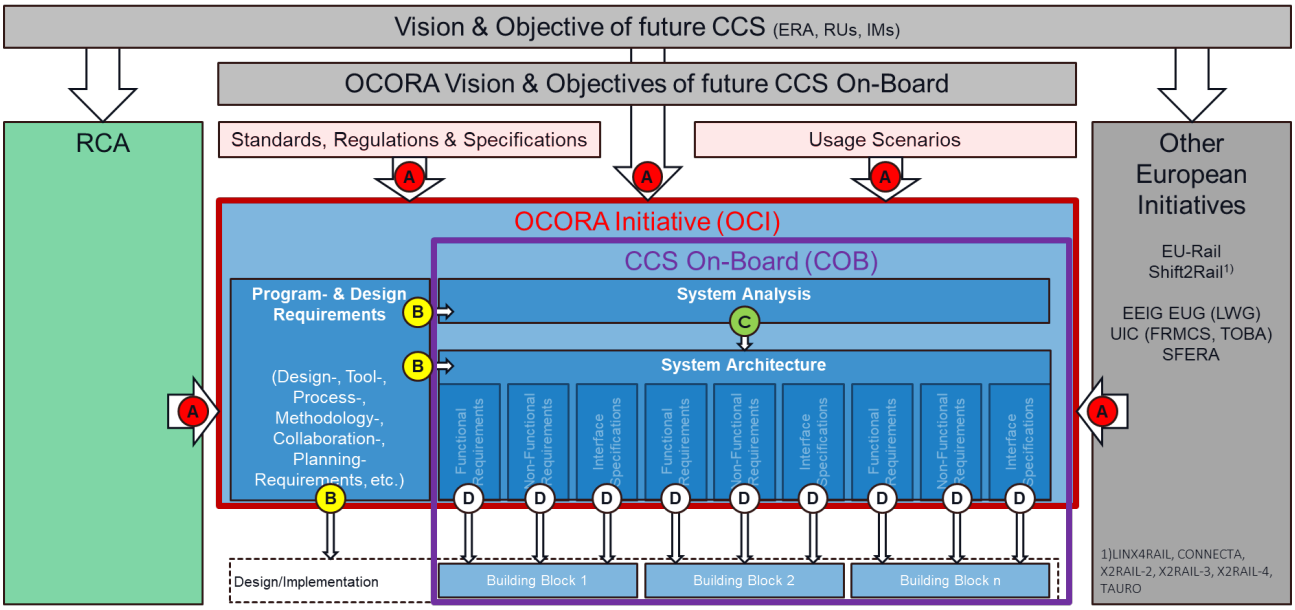

Figure 1 OCORA Requirements Engineering Process

Please note, that the A-Level requirements are applicable to the OCORA Initiative (OCI) while the B- and C-Level requirements are targeted towards the CCS On-Board System (COB) and its architecture. D-Level requirements are applicable to the respective building blocks.

2 Prerequisites

The prerequisites in this chapter represent a register of requirements towards other components of the CCS On-Board system. It is expected that the necessary functionalities and/or interfaces are realised as part of the linked component(s).

OCORA-986, D-Level - Augmentation Data improves localisation accuracy (SCI-AUG)

Augmentation Data shall lead to more accurate localisation information and faster estimation of accurate localisation after startup of the LOC-OB in operation.

Status	✓ Approved
Classification	Requirement
Rationale	Augmentation data has to enhance GNSS localisation information to support functionalities such as track selectivity. Furthermore, involving augmentation has to result in faster accurate localisation estimation after the startup of the LOC-OB. Augmentation data is not limited to GNSS and could be supporting information such as temporary slippery conditions (rail friction coefficient) that can be regarded by the sensors and/or fusion logic to improve the overall performance.
Remark	In the Netherlands drivers are warned about slippery conditions.
Acceptance Method	Test

OCORA-904, D-Level - Guaranteed availability of GNSS Augmentation Data wherever GPS and Galileo are available/usable (SCI-AUG)

GNSS augmentation data shall be available for areas where increased GPS and Galileo accuracy is required.

Status	✓ Approved
Classification	Requirement
Rationale	If the system is using augmentation data to improve the perfomance, augmentation data has to be completely available to fulfil interoperability in application areas of ERTMS. It has to improve the navigation system's attributes, such as accuracy, reliability, integrity and availability, through the integration of external information into the calculation process. Augmentation data has to provide safe barriers against external feared events (fault and failures) of GPS and Galileo.
Remark	
Acceptance Method	Test

OCORA-1005, D-Level - Augmentation provides safe corrections (SCI-AUG)

Augmentation data shall be provided through a safe process and shall have an integrity we rely on.

Status	✔ Approved
Classification	Requirement
Rationale	Since augmentation data is used to provide safe train localisation with better accuracy, augmentation data is safety relevant.
Remark	
Acceptance Method	Certification

OCORA-992, D-Level - Provide Cold Movement Detection Availability (SCI-CMD)

If the train is fitted with a Cold Movement Detection function, it shall be available when exiting the ETCS No Power-mode (NP) with the subsequent exception. Information memorised by the Cold Movement Detection function shall be considered as not available if the Cold Movement Detection function has encountered a condition, during the ETCS No Power period, which shall prevent the use of the Cold Movement information (e.g. the battery, ensuring the Cold Movement Detection function, ran down during the No Power period).

Status	✔ Approved
Classification	Requirement
Rationale	If the train is fitted with a cold movement detection function, it has to be always available to support the LOC-OB at startup. Technical solutions as GNSS/INS systems require a movement to align and calibrate their position after startup. Having the information if the train has been moved or not enables the option to determine a safe accurate position after startup already during standstill.
Remark	Subset-026-3.15.8.3, by also considering EUG CR1378
Acceptance Method	Test

OCORA-987, D-Level - Provide Cold Movement Detection Power Off Durability (SCI-CMD)

Cold Movement Detection and recording shall be available at least for 72 hours after train power off.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB (train position) and other ETCS functions (EOLM information, ERTMS/ETCS level, table of trackside supported levels, RBC ID/Phone Number) use the ouput of the same CMD function. Therefore, the availability of 72 hours is in alignment with the ETCS requirements from Subset-026. If the technical solution involves batteries, whose lifespan normally decreases, 72 hours mark a sufficient threshold for a maintenance reaction.
Remark	Subset-026-3.15.8.1
Acceptance Method	Test

OCORA-915, D-Level - Cold Movement Detection Information (SCI-CMD)

CMD information shall provide movement flag.

Status	✔ Approved
Classification	Requirement
Rationale	The LOC-OB needs cold movement detection from the On-Board (CMD-OB), in order to validate if the position at power on is correct (see OCORA-7231 and OCORA-7230). The movement flag indicates, if a movement took place.
Remark	UNIFE CR1345 Missing requirement for CMD function
Acceptance Method	Test

OCORA-7378, D-Level - Record cold movements (SCI-CMD)

CMD information shall record and provide an array of cold movements during power off with travelled distances along with the indication of direction.

Status	✓ Approved
Classification	Optional Requirement
Rationale	The LOC-OB needs travelled distances during power off from the On-Board (CMD-OB), in order to validate if the position at power on is correct (see OCORA-7231 and OCORA-7230). The movement flag indicates, if a movement took place in general (see OCORA-915). Sometimes, slight movements can occur, for example during coupling. Therefore, information about the travelled distance is needed, to evaluate if the travelled distance is neglectable or can be even used for localisation correction. Since many moves may occur during power off, the provided array records all movements and their direction.
Remark	UNIFE CR1345 Missing requirement for CMD function
Acceptance Method	Test

OCORA-912, D-Level - Provide Cold Movement Detection at Power On (SCI-CMD)

CMD information shall be available at power on of LOC-OB.

Status	✓ Approved
Classification	Requirement
Rationale	The LOC-OB needs cold movement detection from the On-Board (CMD-OB) during the initialisation phase (see OCORA-7231 and OCORA-7230), in order to validate if the position at power on is correct.
Remark	
Acceptance Method	Test

OCORA-913, D-Level - Provide Cold Movement Detection According to Safety Requirements (SCI-CMD)

CMD information shall be determined and provided with the respective safety integrity requirements, e.g., is consistent with the Preliminary Hazard Analysis (PHA) result.

Status	✔ Approved
Classification	Requirement
Rationale	As stated in the CR1378, not having CMD information can lead to safety critical issues. Therefore, the provision of CMD information has to match safety integrity requirements accordingly.
Remark	Available products on the market provide for example SIL4.
Acceptance Method	Certification

OCORA-985, D-Level - Provide Train Integrity Status (SCI-TCMS)

The train integrity information shall consist of the following train integrity status:

- No train integrity information
- Train integrity information confirmed by integrity monitoring device
- Train integrity information confirmed (entered) by driver
- Train integrity lost

Status	✔ Approved
Classification	Requirement
Rationale	The Train Integrity Information is needed, because the requirements of the LOC-OB permit a physical installation not only on the first coach (cab anywhere). Considering ETCS L3 without trackside integrity detection systems, the on-board train integrity information is crucial to report the train front position as "safe". In case the LOC-OB is installed in the first coach, train integrity information is not required.
Remark	Subset-026-3.6.5.2.3 LOC-OB concept architecture (ERTMS Users Group - LWG) [EUG 21E109] TCMS is providing the interface between the train integrity function and the LOC-OB.
Acceptance Method	Test

OCORA-953, D-Level - Provide non-safe Time Information (SCI-TS-OB)

The Vehicle Locator (LOC-OB) shall need accurate time information from the Time Service On-Board (TS-OB) to determine the current localisation information (e.g., position, speed) at a common time.

Status	✓ Approved
Classification	Requirement
Rationale	Accurate time information is used to timestamp localisation information (position, speed, etc.) to know exactly where a train/vehicle has been at a certain point in time or in other words it's the time when the localisation information was valid. Localisation information with accurate time information • is beneficial in dense-traffic areas to optimise train scheduling (TMS plan optimisations/extrapolation) in near real-time. • simplifies error and event analysis as events are logged with accurate time information
Remark	A GNSS-based LOC-OB may collect time information directly through its GNSS sensor; however, to keep time consistency, the same time information needs to be provided to the Time Service On-Board (TS-OB) component as a time input signal. See also CR EUG514 and UNIFE action 5.08 for further details on time-related requirements and use cases.
Acceptance Method	Test

OCORA-1004, D-Level - Allowed inaccuracy of non safe Time information (SCI-TS-OB)

A non safe time inaccuracy of max. +/- 10 ms to a given UTC reference clock shall be acceptable.

Status	✓ Approved
Classification	Requirement
Rationale	Non safe Time information is required to timestamp the output of LOC-OB with the validity of the localisation information (see OCORA-953 - Provide non-safe Time Information (SCI-TS-OB)).
Remark	Considering a train at speed 140 km/h, a time inaccuracy of +/- 10 ms leads to a position inaccuracy of +/- 40 cm.
Acceptance Method	Test

OCORA-982, D-Level - Provide safe Time Information (SCI-TS-OB)

Same requirement as stated in OCORA-953 but with the additional condition that the time information provided shall be safety-certified (SIL x) and shall be used for safety-relevant use cases.

Status	✓ Approved
Classification	Optional Requirement
Rationale	LOC-OB consumers use safe localisation information in combination with safe time information for safety-related use cases such as • level crossing time optimisation • timely warning of track workers (in parallel operation) • train length calculations and train integrity monitoring based on train front end and train rear end positions/speeds More generally speaking, LOC-OB needs safe time information to timestamp LOC-OB data (localisation information) for safety-related/-critical consumers.
Remark	It is assumed that the safe time provided by the Time Service On-Board (TS-OB) component originates from the safe computing platform. See also CR EUG514 for further details on time-related use cases.
Acceptance Method	Test

OCORA-8188, D-Level - Guaranteed inaccuracy of safe time information (SCI-TS-OB)

A safe time inaccuracy of max. +/- 50 ms to a given safe reference clock shall be guaranteed. The maximum inaccuracy shall be safety-certified SIL 4 depending on the safety relevant use cases.

Status	✓ Approved
Classification	Optional Requirement
Rationale	Safe time information is required to timestamp the output of LOC-OB with the validity of the localisation information and to accept safe messages in the safe validity time range by or from other applications. On-board safety application usually run with a cycle time of 200ms. The time inaccuracy is the half of this cycle time.
Remark	This requirement is mandatory in the case requirement OCORA-982 - Provide safe Time Information (SCI-TS-OB) is selected.
Acceptance Method	Certification

OCORA-1001, D-Level - IP-based distribution of time information (SCI-TS-OB)

The time information shall be distributed by the Time Service On-Board (TS-OB) through an IP-based protocol.

Status	Approved
Classification	Requirement
Rationale	The IP-based protocol is defined by OCORA specification.
Remark	Time jumps during system initialisation or due to time synchronisation are allowed and must be handled by the LOC-OB. The influence of load on the network has to be regarded.
Acceptance Method	Test

OCORA-1003, D-Level - First valid time signal (SCI-TS-OB)

A valid and stable time signal (within the specified inaccuracy band defined in OCORA-1004) shall be provided within xx seconds (also during system initialisation).

Status	In Review
Classification	Requirement
Rationale	It is essential to guarantee a max duration until a valid/stable time signal is available, for example, not to delay the start of mission (SoM) process.
Remark	The actual value (xx seconds) has to be aligned at system level (part of SoM)
Acceptance Method	Test

OCORA-983, D-Level - Provide Train Routing Information (SCI-RC)

An interlocked (safe) train path shall be uniquely assigned to a train/vehicle if the LOC-OB is not able to provide by itself track selectivity everywhere on the network.

Status	✔ Approved
Classification	Requirement
Rationale	This information is seen useful to fetch the required map data for the train path ahead and to validate the determined position by the LOC-OB against track selectivity, e.g., at startup after vehicle has moved during power-off mode (degraded mode). It might also be used to determine track selectivity, e.g., if the vehicle position is known prior to passing a switch point and to decide whether it turned left or right.
Remark	Today's ETCS Movement Authority (MA) specifies a distance (in meters) from a fixed, unique reference location(= balise group ID) up to which distance can be driven from this reference location. However, it does not specify a track-selective, unique route, for example, providing relevant track edge sections (see RCA domain knowledge [RCA.Doc.18, BL0 R2]) describing the interlocked train path. An ETCS MA (message 3) along with linking information (packet 5) provides the list of balise groups that the train is expected to pass on its route. Since the positions of all physical and virtual balise groups (each identified by a unique balise group id) are known by the digital map, the LOC-OB can use this information to determine the tracks that will be occupied by the train. Though, this is only a valid scenario as long as balise groups are defined consequently at the leg parts of each switch point to identify whether the left or right leg will be used and the selected mode of ETCS requires a MA. Another solution is to receive the position of each point (switch stand) as part of the interlocked train path (not covered yet by ETCS) that indicates a safe direction of travel (e.g., straight track, diverging track). Whether routing information can be used to actually determine track selectivity (not only for validation purposes) needs to be further analysed with respect to safety. In either case, the LOC-OB logic needs to avoid position jumps to other tracks if train routing information is suddenly interrupted.
Acceptance Method	Test

OCORA-984, D-Level - Provide Physical ETCS Transponder Information (SCI-PETS)

Eurobalise Data Telegrams as specified in ERTMS/ETCS [SubSet-026, chapter 8] shall be provided every time the train passes or stands over a balise. At least the following fields shall be relevant for the LOC-OB:

- NID_C: Identity number of the country or region
- NID_BG: Identity number of the balise group
- N_PIG: Relative Position of the balise in the balise group
- time of balise passage (based on central Time Service On-Board (TS-OB) information: OCORA-953 / OCORA-982)

Hence, PETS shall provide information that enables the LOC-OB to evaluate the direction of the train on the basis of the reported sequence of passed balises.

Status	✓ Approved
Classification	Requirement
Rationale	Depending on the algorithms used, balise information can be used as an absolute reference location (e.g., also in combination with digital map information) and reduce/reset the confidence interval (Subset-026-3.6.4.2.2). This information is also useful to validate the determined position by the LOC-OB against the matching physical reference position.
Remark	Only telegrams matching the following criteria are of relevance: • Q_UPDOWN = 1 (track to train) • Q_MEDIA = 0 (Balise) Subset-036-4.2.4
Acceptance Method	Test

OCORA-993, D-Level - Provide Digital Map Data (SCI-DREP-OB)

Digital Map Repository On-Board (DREP-OB) shall provide Digital Map Data according to the LOC-OB request.

Status	✓ Approved
Classification	Requirement
Rationale	Digital map data provides track description and the network topology. These information are useful for sensor fusion algorithms based on absolute positioning determination. While the train is travelling, if required, LOC-OB needs to extend the Digital Map Data according to the train path.
Remark	The Map Data includes a build-up set of edges along with associated nodes (e.g. points, buffer stops), the relevant infrastructure characteristics (e.g. curve radius and gradients), and location information (e.g. specific reference locations, balises) [RCA.Doc.46, BL0 R2].
Acceptance Method	Test

OCORA-994, D-Level - Integrity of Digital Map Data in compliance with LOC-OB safety goals (SCI-DREP-OB)

The integrity, the accuracy and the currentness of Digital Map Data shall be compliant with LOC-OB safety goals.

Status	✓ Approved
Classification	Requirement
Rationale	Map data is used by LOC-OB functions in safety critical context. Map data shall not induce feared events in LOC-OB functions leading to hazards that can't be mitigated.
Remark	
Acceptance Method	Certification

OCORA-995, D-Level - Provide identification of active cab (SCI-TCMS)

Train Control & Management System shall provide to LOC-OB the identification of the active cab.

Status	✔ Approved
Classification	Requirement
Rationale	The status of the driver's cabs are required by the LOC-OB to determine the train front end and the train orientation. The status of a cab could be active, open or closed following an action by the driver. Only one cab is active on the train.
Remark	
Acceptance Method	Test

OCORA-996, D-Level - Provide installation location of LOC-OB sensors with regard to the centre of the coach (SCI-CDS)

Configuration Data Storage (CDS) component of the EREP-OB shall provide on request the configuration for LOC-OB sensors on the train with regard to the centre of the coach (coach where sensors are installed).

Status	✔ Approved
Classification	Optional Requirement
Rationale	Positioning and orientation (if needed) of the different sensors is required by LOC-OB to compute accurate localisation information (position, speed...). E.g., correction between GNSS antenna and INS installation location.
Remark	
Acceptance Method	Test

OCORA-1070, D-Level - Allowed inaccuracy of the installation location of LOC-OB sensors with regard to the centre of the coach (SCI-CDS)

The installation location inaccuracy of LOC-OB sensors with regard to the centre of the coach shall be less or equal to 1 cm.

Status	✔ Approved
Classification	Requirement
Rationale	The accuracy is required by LOC-OB to compute accurate localisation information (position, speed...). E.g., correction between GNSS antenna and INS installation location.
Remark	The coordinate system (longitudinal axis and transversal axis) with an origin on the centre of the coach is used to define the location and orientation (if needed) of sensors.
Acceptance Method	Inspection

OCORA-997, D-Level - Provide safe length between the train front end and the front of the coach (SCI-ODS or TCMS)

Operational Data Storage (ODS) component of the EREP-OB or TCMS shall provide on request the distance between the train front end and the front of the coach where LOC-OB sensors are installed.

Status	✔ Approved
Classification	Requirement
Rationale	The safe length is required to determine the most extreme position of the train front end.
Remark	Assumption: all sensors are installed in the same coach The use of ODS or TCMS interface is not yet defined.
Acceptance Method	Test

OCORA-1071, D-Level - Allowed inaccuracy of the safe length between the train front end and the front of the coach (SCI-ODS or TCMS)

The reported safe length by ODS or TCMS along the longitudinal axis, between the train front end and the front of the coach shall be always equal or greater than the real distance (incl. coupling devices) and shall be max. 30 cm longer than its real distance.

Status	✓ Approved
Classification	Requirement
Rationale	The safe length is required to determine the most extreme position of the train front end.
Remark	The use of ODS or TCMS interface is not yet defined.
Acceptance Method	Inspection

OCORA-8189, D-Level - Provide safe length between the center and the front of the coach (SCI-CDS)

Configuration Data Storage (CDS) component of the EREP-OB shall provide on request the safe length between the center and the front of the coach where LOC-OB sensors are installed.

Status	✓ Approved
Classification	Requirement
Rationale	The safe length between the center and the front of the coach is required to determine the most extreme position of the train front end.
Remark	Assumption: all sensors are installed in the same coach.
Acceptance Method	Test

OCORA-8190, D-Level - Allowed inaccuracy of the safe length between the center and the front of the coach (SCI-CDS)

The inaccuracy of the reported safe length by CDS along the longitudinal axis, between the center and the front of the coach shall be less than 1 cm.

Status	✓ Approved
Classification	Requirement
Rationale	The safe length between the center and the front of the coach is required to determine the most extreme position of the train front end.
Remark	
Acceptance Method	Test

OCORA-998, D-Level - Provide distance between two bogies of the coach (SCI-CDS)

Configuration Data Storage (CDS) component of the EREP-OB shall provide on request the distance between the pivot of the two bogies of the coach where LOC-OB sensors are installed.

Status	✓ Approved
Classification	Requirement
Rationale	The distance between the pivot of the two bogies of the coach is needed to make the correction of localisation information (e.g., speed, acceleration...) in curves between coach longitudinal axis and track centreline axis.
Remark	
Acceptance Method	Test

OCORA-1072, D-Level - Allowed inaccuracy of the distance between two bogies of the coach (SCI-CDS)

The distance inaccuracy between the pivot of the two bogies of the coach where LOC-OB sensors are installed shall be less or equal to 1 cm.

Status	✓ Approved
Classification	Requirement
Rationale	The distance between the two pivots is required to compute the localisation information in curves between coach longitudinal axis and track centreline axis.
Remark	
Acceptance Method	Inspection

OCORA-1000, D-Level - Provide distance between the train front end and the balise reader antenna (SCI-CDS)

Configuration Data Storage component of the EREP-OB shall provide on request the distance between the train front end and the balise reader.

Status	✓ Approved
Classification	Requirement
Rationale	This parameter is required to process correctly physical balise detection and locate the balise in the digital map.
Remark	See Subset-040 Dimensioning and Engineering rules for balise reader requirements and chapter 4.1.2.2 for minimum/maximum distance between the train front end and the Eurobalise antenna. Following this requirement, the assumption is made that the balise antenna is always installed in the first coach of the train. Alternatively, a balise reader antenna could be seen as a LOC-OB sensor whose requirement is covered by OCORA-996 and OCORA-997. However, a change in the existing Subset-040 would be required which is currently not anticipated.
Acceptance Method	Test

OCORA-7379, D-Level - Provide Cold Movement Detection function configuration (SCI-CDS)

The Configuration Data Storage shall provide the Cold Movement function configuration parameters:

- Cold Movement function activated on the train
- Distance threshold of detection movement
- Array of travelled distances activated

Status	✓ Approved
Classification	Requirement
Rationale	These parameters are required to configure the LOC-OB: - Cold Movement Detection function activated see OCORA-992, OCORA-7231, OCORA-7230 - Distance threshold of detection movement; due to the sensitivity of the Cold Movement Detection function, the train might move slightly without ,triggering any detection. This distance is required to correct the confidence interval after the system is powered on see OCORA-7231 - Array of travelled distances activated in order to improve the correction of the localisation after power on see OCORA-7378
Remark	
Acceptance Method	Test

OCORA-999, D-Level - Integrity of ETP Repository On-Board (EREP-OB) data in compliance with LOC-OB safety goals (SCI-ODS/SCI-CDS)

The integrity of EREP-OB data (CDS, ODS) shall be compliant with LOC-OB safety goals.

Status	✓ Approved
Classification	Requirement
Rationale	LOC-OB is providing safe localisation information to safety relevant consumers. Thus, train configuration and operational data has to comply with the safety goals of LOC-OB.
Remark	
Acceptance Method	Certification

OCORA-7180, D-Level - Provide LRBG information (SCI-VS)

Vehicle supervisor (VS) shall provide the actual LRBG when VS is determining a new LRBG.

Status	✓ Approved
Classification	Requirement
Rationale	This interface is required only if the LOC-OB is using LRBG as a reference location. LRBG is required to process the train front end location. see subset 026.
Remark	This interface is required in the case balise is used as a reference location.
Acceptance Method	Test

OCORA-7181, D-Level - Provide software updates (SCI-MDCM-OB)

The onboard monitoring, diagnostic, configuration and maintenance system (MDCM-OB) shall provide software updates (incl. security patches)

Status	✓ Approved
Classification	Requirement
Rationale	The ability of updating the LOC-OB software is essential. To minimize maintenance cost, the default update deployment mechanism shall be remotely (e.g., over-the-air) with no physical presence of any maintenance personnel on site (e.g., on the train). MDCM-OB is the OCORA component in charge to manage the software update remotely.
Remark	
Acceptance Method	Test

OCORA-7182, D-Level - LOC-OB authorisation and authentication (SCI-IAM-OB)

LOC-OB shall receive authorisation and authentication data from Identity and Access Management On-Board (IAM-OB)

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is handling and processing sensitive and safety-relevant data. Authorisation and Authentication are part of mitigation measures to prevent cybersecurity issues.
Remark	
Acceptance Method	Test

3 System interfaces

The interfaces of LOC-OB are identified and described in the document [EUG 22E126].

OCORA-7184, D-Level - LOC-OB interface to consumers (SCI-VL)

LOC-OB shall provide localisation information to consumers through the SCI-VL interface.

Status	✔ Approved
Classification	Requirement
Rationale	The LOC-OB is a CCS on-board OCORA component with a standardised interface.
Remark	For data exchanged through the interface see document [EUG 22E126] chapter 6.2
Acceptance Method	Test

OCORA-7188, D-Level - LOC-OB standardised interface (SCI-VL)

LOC-OB shall provide a standardised interface to all applications. This interface shall be able to handle safety and non-safety protocols. The interface shall comply with performance, technical interface conformity and allocated tolerable hazard rate requirements.

Status	✓ Approved
Classification	Requirement
Rationale	The LOC-OB is part of the CCS on-board OCORA architecture. It is easier and cost effective to provide the same interface to all applications in order to: • simplify integration of different suppliers and products • leverage new localisation technologies in the future without the need to modify the remaining part of the CCS On-Board functionality • update the internal LOC-OB logic without triggering a re-certification (homologation) of the entire CCS On-Board Unit if the standardised interfaces are not impacted by the change
Remark	
Acceptance Method	Test

OCORA-7185, D-Level - LOC-OB input interfaces

LOC-OB shall receive data from other onboard components through the following interfaces: SCI-DREP (optional), SCI-RC (optional), SCI-AUG (optional), SCI-CDS (mandatory), SCI-ODS (mandatory), SCI-TCMS (mandatory), SCI-PETS (optional), SCI-VS (optional), SCI-CMD (optional), PI-VLS (optional).

Status	✔ Approved
Classification	Requirement
Rationale	The LOC-OB is a component of the CCS on-board OCORA architecture. With these standardised input interfaces it is envisaged that safe and accurate on-board localisation systems can be built based on today's and future localisation technologies that meet the requirements of the consumers of LOC-OB. By providing additional information, the following optional interfaces are used if necessary to improve the localisation performance of the LOC-OB: • SCI-DREP (Digital Map) • SCI-RC (Train routing information) • SCI-AUG (Augmentation data) • SCI-PETS (Physical balise data) • SCI-VS is used if LOC-OB is using LRBG as a reference location. • SCI-CMD is used to detect cold movement when the train is powered off. • PI-VLS (perception data).
Remark	For data exchanged through the input interfaces see document [EUG 22E126] chapter 6.3 SCI: Standard Communication Interface PI: Perception Interface
Acceptance Method	Test

OCORA-7186, D-Level - LOC-OB input/output interfaces

LOC-OB shall provide or receive data from On-Board Security Services components through the following interfaces SCI-TS-OB, SCI-IAM-OB, and from the CCS-On-Board components through SCI-MDCM-OB.

Status	✓ Approved
Classification	Requirement
Rationale	The LOC-OB is a component of the CCS on-board OCORA architecture. Common service applications offered by the OCORA architecture such as time service, security controls, and central diagnosis / maintenance has to be used.
Remark	For data exchanged through the interface see document [EUG 22E126] chapter 6.4
Acceptance Method	Test

OCORA-7187, D-Level - Standardised interfaces from CCS on-board applications

The LOC-OB shall implement all interfaces required to get input information from the relevant CCS on-board applications (see OCORA-7185 and OCORA-7186).

Status	✓ Approved
Classification	
Rationale	The LOC-OB is part of the CCS on-board OCORA architecture. It is easier and cost effective to integrate LOC-OB using the standardized interface.
Remark	
Acceptance Method	Test

OCORA-7189, D-Level - LOC-OB interface messages

The LOC-OB shall handle safety relevant and non-safety relevant messages.

Status	✓ Approved
Classification	Requirement
Rationale	The LOC-OB is processing safe and non-safe data
Remark	see document [EUG 22E126] chapters 6.2, 6.3 and 6.4
Acceptance Method	Test

OCORA-7190, D-Level - LOC-OB interface safety protocol

The LOC-OB shall implement the safety protocol defined for the CCS on-board OCORA architecture.

Status	✔ Approved
Classification	Requirement
Rationale	To ensure the required message integrity level, a safety protocol is required. It is easier and cost effective to use the same safety protocol between CCS on-board OCORA applications.
Remark	
Acceptance Method	Design Review

OCORA-7200, D-Level - CCN interface

In case the LOC-OB is running on its own computing platform, it shall be connected to the OCORA CCS Communication Network (CCN). In that case, the interface shall comply with the specifications of the OCORA CCS Communication Network.

Status	✔ Approved
Classification	Optional Requirement
Rationale	The LOC-OB is part of the CCS on-board OCORA architecture. Compliance to the CCS on-board OCORA architecture is required.
Remark	
Acceptance Method	Test

OCORA-7225, D-Level - API interface

In case the LOC-OB is running on the OCORA safe computing platform, LOC-OB shall comply with the API interface specifications.

Status	✔ Approved
Classification	Requirement
Rationale	The LOC-OB is part of the CCS on-board OCORA architecture. Compliance with the CCS on-board safety platform is required.
Remark	
Acceptance Method	Design Review

4 Functional Requirements

The system definition of LOC-OB is following the black box approach. Only the inputs and outputs functions of LOC-OB have been identified and described. They are listed and described in the document [EUG 22E126] chapter 5.2.

5 Non-Functional Requirements

The system definition of LOC-OB is defining non-functional requirements (as part of the Operational Context) see [EUG 22E126] chapter 7. In this chapter additional requirements are mentioned only.

5.1 Performances

The different terms and acronyms used to define the function performance are defined in the document [EUG 22E126] chapters 1, 7.3.1,7.3.2, 7.3.3, 7.3.4 and 7.3.5.

5.1.1 Function Performance

5.1.1.1 LOC-OB_SF-001: Provide safe Train Front End 1D Position

OCORA-7239, D-Level - Safe train front end position

The LOC-OB_SF-001 shall provide safe train front end position with reference to the reference location with a maximum confidence interval depending on the capacity constraints (for capacity constrains definition see [EUG 22E126]) defined in the following table:

Type of Area	MAPO, MAPU	Safety relevant
Mainline / Dense traffic line	Max(30m, Distance run in 1s at the track speed)	Yes
Train traffic node	10m	
Precise positioning area	10m	

Status	✓ Approved
Classification	Requirement
Rationale	The capacity of the line depends on critical points. Figures are results from capacity studies
Remark	See document [EUG 22E126] chapter 5.2.2 for LOC-OB_SF-001 definition.
Acceptance Method	Test

OCORA-7240, D-Level - Train front end estimated position

The LOC-OB_SF-001 shall provide train front end estimated position with reference to the reference location with an accuracy depending on the operational constraints. The probability of 95.4% shall be achieved at least.

Type of Area	Estimated position accuracy (p=95.4%)
Mainline / Dense traffic line	+/- 5 m
Train traffic node	+/- 1 m
Precise positioning area	+/- 1 m

Status	✓ Approved
Classification	Requirement
Rationale	The accuracy of the estimated position is required to reach a stopping point accurately. Under ATO driving mode the accuracy of the estimated train front end is important to drive the train as close to the EBI curve and to stop the train precisely at the stopping point if required.
Remark	See document [EUG 22E126] chapter 5.2.2 for LOC-OB_SF-001 definition.
Acceptance Method	Design Review

OCORA-7241, D-Level - Safe and precise operation

In safe and precise operation, the LOC-OB_SF-001 shall provide safe train front end position with confidence interval less than 1 m and an estimated position with an accuracy of +/-0.50m with at least a probability of 99.98%, for train moving at speed lower than 30 km/h.

This performance is required for train control in parking areas, stopping, coupling and shunting operations.

Status	✓ Approved
Classification	Requirement
Rationale	In parking area, it is required to park trains close to each other. During automatic coupling operation, the distance between the two trains needs safe position accuracy. For stopping operation it is required if the difference in length between the train and the platform is marginally small. It is required for stopping trains accurately on platforms equipped with platform screen doors.
Remark	See document [EUG 22E126] chapter 5.2.2 for LOC-OB_SF-001 definition.
Acceptance Method	Test

OCORA-7242, D-Level - Estimated train front end position after reading a balise

After a balise passage, the estimated train front end position shall be determined at an accuracy of 0.20 m for speeds below 40 km/h, then (0.15 m + 0.0011*v) for speeds from 40 km/h until 500 km/h with at least a probability of 99.8% [SS036, chapter 4.2.10.3].

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture, it complies with ETCS specification SS036 chapter 4.2.10.3
Remark	See document [EUG 22E126] chapter 5.2.2 for LOC-OB_SF-001 definition.
Acceptance Method	Test

OCORA-7244, D-Level - Variation of the min safe train front end position

The increase of the min safe train front end position shall be equal or less than the estimated travelled distance of the train.

Status	✔ Approved
Classification	Requirement
Rationale	Overpassing this condition might lead to safety issue (e.g., in the case the condition is not enforced, the following train might have a reduced braking distance leading to an emergency braking, a collision…).
Remark	See document [EUG 22E126] chapter 5.2.2 for LOC-OB_SF-001 definition.
Acceptance Method	Test

5.1.1.2 LOC-OB_SF-002: Provide safe Train Speed

OCORA-7246, D-Level - Speed reference frame

The safe train speed or the train estimated speed refer to the X axis of the bogie reference frame.

Status	✓ Approved
Classification	Requirement
Rationale	Speed along the track is relevant to determine the train protection and to drive the train under ATO. The bogie reference frame provides the speed along the track.
Remark	See document [EUG 22E126] chapter 5.2.3 for LOC-OB_SF-002 definition.
Acceptance Method	Design Review

OCORA-7247, D-Level - Safe train speed

The LOC-OB_SF-002 shall provide safe train speed with confidence interval better than 2 km/h (MASO/MASU), for speeds lower than 30 km/h, and maximum confidence interval value (MASO/MASU) increasing linearly up to 12 km/h for speeds between 30 km/h and 500 km/h.

Status	✓ Approved
Classification	Requirement
Rationale	Speed performance is required for train protection and has an impact on the capacity of the line and the duration of the train journey.
Remark	See document [EUG 22E126] chapter 5.2.3 for LOC-OB_SF-002 definition.
Acceptance Method	Test

OCORA-7248, D-Level - Train estimated speed

The LOC-OB_SF-002 shall provide train estimated speed with an accuracy of ± 1 km/h for speeds from 0 km/h to 100 km/h and ± 1% * v for speeds from 100 km/h to 500 km/h. The probability of 95.4% shall be achieved at least.

Status	✔ Approved
Classification	Requirement
Rationale	Estimated speed is used to indicate to the driver the train speed. Estimated speed is used by the ATO to drive the train. The accuracy is required to drive the train close to the EBI curve.
Remark	See document [EUG 22E126] chapter 5.2.3 for LOC-OB_SF-002 definition.
Acceptance Method	Test

5.1.1.3 LOC-OB_SF-003: Provide safe Train Acceleration

OCORA-7250, D-Level - Acceleration reference frame

The safe train acceleration refers to the X axis of the bogie reference frame.

Status	✔ Approved
Classification	
Rationale	Acceleration along the track is relevant to determine the train protection and to drive the train under ATO. The bogie reference frame provides the acceleration along the track.
Remark	See document [EUG 22E126] chapter 5.2.4 for LOC-OB_SF-003 definition.
Acceptance Method	Design Review

OCORA-7251, D-Level - Safe train acceleration

The LOC-OB_SF-003 shall provide safe train acceleration with confidence interval better than 0.2 m/s2 (MAAO/MAAU).

Status	✔ Approved
Classification	Requirement
Rationale	Acceleration performance is required for train protection (computation of the safe braking curve).
Remark	See document [EUG 22E126] chapter 5.2.4 for LOC-OB_SF-003 definition.
Acceptance Method	Test

OCORA-7252, D-Level - Train estimated acceleration

The LOC-OB_SF-003 shall provide train estimated acceleration with an accuracy of 0.05 m/s2. The probability of 95.4% shall be achieved at least.

Status	✔ Approved
Classification	Requirement
Rationale	The train estimated acceleration performance is required to drive the train under ATO.
Remark	See document [EUG 22E126] chapter 5.2.4 for LOC-OB_SF-003 definition.
Acceptance Method	Test

5.1.1.4 LOC-OB_SF-004: Provide 3D Position and Uncertainty

OCORA-7254, D-Level - 3D train position performance

The LOC-OB_SF-004 shall provide 3D train front end position with an uncertainty of 1m on the x axis and 0.5 m on the y and z axis of the carriage reference frame with at least a probability of 95.4%.

Status	✓ Approved
Classification	Requirement
Rationale	The 3D train front end position is used by the Incident & Prevention Management on-board (IPM-OB) e.g., for detecting an obstacle on the track. The 3D train front end position is used by the Perception On-board (PER-OB) and the Signal Converter (SCV) for e.g., detecting relevant signal.
Remark	See document [EUG 22E126] chapter 5.2.5 for LOC-OB_SF-004 definition. The requirement is the result of perception prototyping feature. It is a first approach to be consolidated.
Acceptance Method	Design Review

5.1.1.5 LOC-OB_SF-005: Provide 3D Velocity and Uncertainty

OCORA-7256, D-Level - 3D train velocity performance

The LOC-OB_SF-005 shall provide 3D train velocity with an uncertainty of 2 km/h on each axis of the carriage reference frame with at least a probability of 95.4%.

Status	✓ Approved
Classification	Requirement
Rationale	The 3D train velocity might be used by the Incident & Prevention Management on-board (IPM-OB) e.g., for detecting a track issue.
Remark	See document [EUG 22E126] chapter 5.2.6 for LOC-OB_SF-005 definition. The requirement is the result of perception prototyping feature. It is a first approach to be consolidated.
Acceptance Method	Test

5.1.1.6 LOC-OB_SF-006: Provide 3D Acceleration and Uncertainty

OCORA-7258, D-Level - 3D train acceleration performance

The LOC-OB_SF-006 shall provide 3D train acceleration with an uncertainty of 0.05 m/s2 on each axis of the carriage reference frame with at least a probability of 95.4%.

Status	✓ Approved
Classification	Requirement
Rationale	The 3D train acceleration might be used by the Incident & Prevention Management on-board (IPM-OB) e.g., for detecting a track issue or a shock.
Remark	See document [EUG 22E126] chapter 5.2.7 for LOC-OB_SF-006 definition.
Acceptance Method	Test

5.1.1.7 LOC-OB_SF-007: Provide 3D Attitude (rotational angles) and Uncertainty

OCORA-7260, D-Level - 3D carriage attitude performance

The LOC-OB_SF-007 shall provide 3D attitude (rotational angles) with an uncertainty of 0.1° for pitch and yaw angle and 1° for roll angle of the carriage reference frame with at least a probability of 95.4%.

Status	✓ Approved
Classification	
Rationale	The 3D train front end position is used by the Incident & Prevention Management on-board (IPM-OB) for e.g., detecting an obstacle on the track. The 3D carriage attitude is used by the Perception On-board (IPM-OB) and the Signal converter (SCV) to detect signal.
Remark	See document [EUG 22E126] chapter 5.2.8 for LOC-OB_SF-007 definition The requirement is the result of perception prototyping feature. It is a first approach to be consolidated.
Acceptance Method	Test

5.1.1.8 LOC-OB_SF-008: Provide Estimated Distance Travelled (since power-on)

OCORA-7262, D-Level - Estimated distance travelled

LOC-OB_SF-008 shall provide the estimated distance travelled since power-on. According to subset 035 D_Est is the train front end estimated position, D_Min and D_Max are the bounds of the confidence interval. The three values shall comply with requirements OCORA-7239 - Safe train front end position and OCORA-7240 - Train front end estimated position.

Status	✓ Approved
Classification	Requirement
Rationale	This requirement is derived from SS035.
Remark	See document [EUG 22E126] chapter 5.2.9 for LOC-OB_SF-008 definition.
Acceptance Method	Test

5.1.2 Initialisation requirements

OCORA-7237, D-Level - Initialisation without human supervision

The LOC-OB at standstill shall initialise itself and provide the outputs with no human supervision.

Status	✓ Approved
Classification	Requirement
Rationale	The LOC-OB is part of the CCS on-board architecture. The application of the CCS-on-board shall be initialised by itself
Remark	
Acceptance Method	Test

OCORA-7231, D-Level - Time to reach entire operational capability with last known position

After the LOC-OB is switched-on, it shall fulfil entire operational capability in less than 1 minute when initial position is valid under the following conditions:

- initial position is known (e.g., last known position is saved before LOC-OB is switched-off)
- track edge id is known (e.g., last track edge id is saved before LOC-OB is switched-off)
- CMD doesn't indicate a train movement while the train is powered off.

Status	✔ Approved
Classification	Requirement
Rationale	This time avoids waiting too long before the train may move following the train power on.
Remark	
Acceptance Method	Test

OCORA-7230, D-Level - Time to reach entire operational capability without any localisation information

After the LOC-OB is switched-on, it shall fulfil entire operational capability in less than 5 minutes when initial position is not valid under any of the following conditions:

- initial position is unknown (e.g., last known position is not saved before LOC-OB is switched-off)
- track edge id is unknown (e.g., last track edge id is not saved before LOC-OB is switched-off)
- CMD indicates a train movement during the train is powered off.

Status	✔ Approved
Classification	Requirement
Rationale	It is not the nominal case, extended time to initialise LOC-OB is allowed.
Remark	This is not the nominal case
Acceptance Method	Test

OCORA-7232, D-Level - Initialisation under degraded mode

In case the LOC-OB cannot reach full operational capability after the system is powered on (e.g., weak GNSS signal), estimated speed and travelled distance since the LOC-OB is powered on (this is not the distance to the reference location) shall always be available.

Status	✔ Approved
Classification	Requirement
Rationale	Estimated speed is displayed to the driver. The driver must know the speed of the train while the train is moving. It is allowed to move the train without localisation information from a reference location under some mode of operation (e.g., Staff responsible) or under NTC operation. In these cases, the distance run since the train is powered on is required (see document [EUG 22E126] chapter 5.2.9 for LOC-OB_SF-008 definition).
Remark	
Acceptance Method	Test

OCORA-7233, D-Level - Initialisation of LOC-OB after replacement of equipment

Following the installation of a new set of on-board equipment (line replaceable unit of the LOC-OB), after the LOC-OB is switched-on, it shall reach full operational capability in less than 20 minutes with minimal human supervision (nominal condition: no human supervision, degraded situation: simple check of the maintenance engineer).

Status	✔ Approved
Classification	Requirement
Rationale	Replacement of equipment is done under the supervision of qualified maintenance personnel. After the replacement of equipment, the LOC-OB needs to set-up all sensors configuration data and internal data. maintenance engineer supervision may be used to acknowledge the position.
Remark	
Acceptance Method	Test

OCORA-7234, D-Level - Initialisation with Digital Map support

When onboard Digital Map is available, the initialisation localisation procedure shall be supported and accelerated.

Status	✔ Approved
Classification	Requirement
Rationale	Digital Map provides valuable data to initialise the position when the train is at standstill.
Remark	
Acceptance Method	Test

5.2 RAMSS Requirements

5.2.1 Reliability

OCORA-7197, D-Level - Lack of valid output data

The LOC-OB hardware shall comply with the overall CCS on-board reliability:

- Minor failure: λ <1,25 10-4/h.
- Reduced service failure: λ < 3,3 10-6/h.
- Immobility failure: λ < 3,7 10-7/h.

The mission profile for these values is defined in document [EEIG 92S126 Ref 02S1266]
These values are defined at the overall CCS on-board system level and should be derived in a later release.

Status	✓ Approved
Classification	Requirement
Rationale	• A minor failure of the LOC-OB hardware could lead to a warning information requiring service intervention within a failure specific period to prevent reduced performance. • A failure of the LOC-OB hardware could lead to a reduced service with the consequence of a reduced performance. • A failure of the LOC-OB hardware could lead to immobility, for instance in case of a transition of the VS on-board into the system failure (SF) mode.
Remark	See document [EUG 22E126] chapter 7.4.2 for definitions and high level reliability requirements.
Acceptance Method	Demonstration

5.2.2 Availability

For this release availability from LOC-OB system definition document [EUG 22E126] were not derived.

5.2.3 Maintainability

OCORA-7198, D-Level - Expandability

The design of the LOC-OB shall allow implementing modifications or further functions with reasonable effort (impact on costs) without any impact on the other CCS on-board OCORA components.
Costs for the extension shall be in about the same proportion to the original overall costs as the number of modified or added functions relative to the total number of implemented functions.

Status	✔ Approved
Classification	Requirement
Rationale	To handle the lifecycle of a whole train it is essential that extensions / modifications can be introduced with reasonable effort impact. To deploy innovation, it is essential that extension / modifications can be introduced with reasonable effort impact.
Remark	See document [EUG 22E126] chapters 7.4.4 and 7.5.4 for definitions and high level maintainability requirements.
Acceptance Method	Demonstration

OCORA-7205, D-Level - Hardware resources

The design of LOC-OB shall have available hardware resources (e.g. wired inputs/outputs, memory, cpu load...) for future updates and additional features.

Status	✔ Approved
Classification	Requirement
Rationale	To handle the lifecycle of the LOC-OB, it is essential that enough hardware resources are available for future updates.
Remark	See document [EUG 22E126] chapters 7.4.4 and 7.5.4 for definitions and high level maintainability requirements.
Acceptance Method	Design Review

OCORA-7202, D-Level - Local software update

The LOC-OB shall provide mechanisms to locally update the software (e.g., when the system is installed in the train).

Status	✓ Approved
Classification	Requirement
Rationale	The ability of updating the LOC-OB software is essential. In case remote (e.g., over the air) updates fail for any reason, it must be possible to perform local updates with physical access to the LOC-OB. Updates shall be uploaded via industry standard interfaces. In case of limited bandwidth and depending on the size of the file to be downloaded, software updates may have to be deployed locally.
Remark	See document [EUG 22E126] chapters 7.4.4 and 7.5.4 for definitions and high level maintainability requirements.
Acceptance Method	Test

OCORA-7201, D-Level - Remote (over the air) software update

The LOC-OB shall provide safe and secure mechanisms to remotely update the software through the MDCM-OB component. The software update shall be done while the train is not in operation.

Status	✓ Approved
Classification	Requirement
Rationale	The ability of updating the LOC-OB software is essential. To minimize maintenance cost, the normal update deployment mechanism shall be remotely (e.g., over-the-air) with no physical presence of any maintenance personnel on site (e.g., on the train). The update could be done when the train is parked or in a maintenance area.
Remark	See document [EUG 22E126] chapters 7.4.4 and 7.5.4 for definitions and high level maintainability requirements.
Acceptance Method	Test

OCORA-7203, D-Level - Logging and tracing

The LOC-OB shall provide logging and tracing support

Status	✔ Approved
Classification	Requirement
Rationale	Logging and tracing are critical when analysing the LOC-OB behaviour and faults.
Remark	See document [EUG 22E126] chapters 7.4.4 and 7.5.4 for definitions and high level maintainability requirements.
Acceptance Method	Test

OCORA-7204, D-Level - Monitoring and diagnostics

The LOC-OB shall include monitoring and diagnostics interface accessible locally or by a remote connection through the MC-OB.

Status	✔ Approved
Classification	Requirement
Rationale	Monitoring and diagnostics are essential to analyse the LOC-OB behaviour and performance during test and operation.
Remark	See document [EUG 22E126] chapters 7.4.4 and 7.5.4 for definitions and high level maintainability requirements.
Acceptance Method	Test

5.2.4 Safety

OCORA-7206, D-Level - LOC-OB certification

The LOC-OB as a component of the CCS on-board architecture shall be certified according to CENELEC safety standards.

Status	✓ Approved
Classification	Requirement
Rationale	To handle the life-cycle of the LOC-OB it is essential that the LOC-OB is certified at the level of the component. To allow introducing innovative solution during the life-cycle of the LOC-OB, certification at the level of LOC-OB is cost effective.
Remark	See document [EUG 22E126] chapter 7.4.5 for definitions and high level safety requirements.
Acceptance Method	Certification

5.2.5 Security

OCORA-7199, D-Level - Security

The LOC-OB shall be included in the cyber security considerations made at CCS on-board and / or vehicle level.

Status	✓ Approved
Classification	Requirement
Rationale	The LOC-OB component is sensitive regarding the CCS onboard behaviour. It has therefore to be prevented that it can be deliberately manipulated by not appropriate people.
Remark	See document [EUG 22E126] chapter 7.4.6 for definitions and high level security requirements.
Acceptance Method	Test

OCORA-7422, D-Level - Spoofing and jamming

The LOC-OB shall be able to detect spoofing or jamming signals and to react accordingly. The LOC-OB shall be robust to such attacks.

Status	✓ Approved
Classification	Requirement
Rationale	Spoofing and jamming may happen. They are safety critical events, therefore detection is necessary to react and to minimise the consequences.
Remark	This requirement is relevant to all types of devices that are using radio signals (.e.g., GNSS, Radar...)
Acceptance Method	Test

5.3 Environmental Requirements

Refer to document [EUG 22E126] chapter 7.5.3 for high level requirements.

5.3.1 General

OCORA-7263, D-Level - Reusing an existing certification

To reuse an existing certification based on a standard which is not prescribed in this chapter, it shall be demonstrated that the alternative standard provides results that are equivalent to or better than those obtained by using the standards stated in this chapter.

Status	✓ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards. To reduce cost and reusing existing products which are not certified on applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7264, D-Level - Environmental

The LOC-OB shall be qualified to the environmental requirements stated in chapter 5.3 - Environmental Requirements in conjunction with the guidelines and test requirements defined in the document [EEIG 97s066].

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7309, D-Level - Surrounding environment

The LOC-OB shall not be disturbed by the surrounding environment or surrounding systems

Status	✔ Approved
Classification	Requirement
Rationale	The LOC-OB is part of the CCS on-board OCORA architecture. On-board, other systems are already installed,and under operation. LOC-OB shall not be sensitive to these surrounding systems.
Remark	
Acceptance Method	Test

OCORA-7380, D-Level - Surrounding systems

The LOC-OB shall not disturb surrounding systems

Status	✔ Approved
Classification	Requirement
Rationale	The LOC-OB is part of the CCS on-board OCORA architecture. On-board, other systems are already installed,and under operation. LOC-OB shall not disturb these surrounding systems.
Remark	
Acceptance Method	Test

OCORA-7306, D-Level - Test

The LOC-OB shall be tested to the test requirements defined in [EEIG 97s066] to the classes and categories defined in the environmental requirements.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7295, D-Level - Acceptance of deviations

The acceptance of deviations to the specified requirements shall be RU’s responsibility and risk mitigations supplier's responsibility.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.2 Temperature

OCORA-7265, D-Level - Class of equipment

The LOC-OB shall operate as specified to meet the temperature conditions given for class TX equipment in [EN 50125-1] and in [EN 50155] class OT2 for equipment inside the vehicle and class OT4 for outside the vehicle.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7267, D-Level - Transient temperature

The LOC-OB shall operate as specified to meet the short-term transient temperature conditions given for classes ST1, ST2 and H2 in [EN 50155].

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7268, D-Level - Transient temperature change

The frequency and the duration of the short-term transient temperature change shall be specified.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.3 Altitude

OCORA-7270, D-Level - Altitude

The LOC-OB shall operate as specified at altitudes of up to 2300 m above sea level for class AX equipment in [EN 50125-1] .

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.4 Humidity

OCORA-7272, D-Level - Humidity conditions

The LOC-OB shall operate as specified in humidity conditions (internal and external) for train borne equipment described in [EN 50125-1], [EN 50125-3] and [EN 50125-1].

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.5 Air movements

OCORA-7277, D-Level - Cross winds

The LOC-OB shall operate as specified in permanent cross winds of 35 m/s according to [EN 50125-1].

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7273, D-Level - Transient wind gusts

The LOC-OB shall operate as specified in transient wind gusts of 50 m/s for a duration of 1 s per gust.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7274, D-Level - Withstand wind gusts

The LOC-OB shall withstand wind gusts of 50 m/s for a duration of more than 1 s per gust without permanent damage and impact to structural integrity and installation.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7275, D-Level - Pressure pulses

The LOC-OB shall operate as specified when subjected to pressure pulses caused by trains passing in tunnels.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.6 Rain, snow, hail, ice and water[MS(-E2] [AG3]

OCORA-7297, D-Level - Operation in rain, snow and hail

The LOC-OB shall operate as specified in rain, snow, and hail according to the requirements defined in [IEC 60721] for external train equipment.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7298, D-Level - Ice and water condition

The LOC-OB shall withstand ice and water condition defined in [IEC 60721] without permanent damage and impact to structural integrity and installation.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.7 Solar radiation

OCORA-7279, D-Level - Exposure to solar radiation

The LOC-OB shall remain unaffected when exposed to the effect of solar radiation of class 5K3, prescribed in [IEC 60721-3-5] for 8 h.

Status	✔ Approved
Classification	Optional Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.8 Pollutants and contaminants

OCORA-7282, D-Level - Operation in pollutants and contaminants

The LOC-OB shall be capable of operating in (or be protected from) pollutants and contaminants as defined in [EEIG 97s066] for external and internal train equipment.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.9 Fire

OCORA-7285, D-Level - Fire protection

The LOC-OB shall comply with the fire protection requirements and measures defined in [EN 45545-2] .

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.10 Electromagnetic compatibility and power supplies

OCORA-7291, D-Level - Susceptibility

The LOC-OB shall function as specified in the presence of electromagnetic phenomena defined in [EN 50121-3-2] and [EN 50155].

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7292, D-Level - Electromagnetic energy emission

The electromagnetic energy emission of the LOC-OB shall comply to the requirements specified in [EN 50121-3-2] and [EN 50155].

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

OCORA-7289, D-Level - Electrical service conditions

The LOC-OB shall comply with the electrical service conditions specified in [EN 50155].

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.11 Vibration and Shock

OCORA-7287, D-Level - Shock and vibration conditions

The LOC-OB shall function as specified under shock and vibration conditions defined in [IEC 61373] for train borne equipment.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.12 Chemicals

OCORA-7284, D-Level - REACH conformity

The LOC-OB shall be REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) compliant.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.13 Ergonomics

OCORA-7281, D-Level - Installation in the driver's cab

The LOC-OB shall comply with the ergonomic requirements stated in [EEIG 97s066] in case of installation in the driver’s cab of the train.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

5.3.14 Track

OCORA-7293, D-Level - Rail environment

The LOC-OB performance requirements shall be met on every European rail physical environment including (the list does not have to be considered exhaustive) tunnels, forests, mountains, underground stations, presence of metal masses around rail.

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB can be installed on any train running in Europe.
Remark	
Acceptance Method	Certification

OCORA-7305, D-Level - Slip, slide and torsional vibrations

LOC-OB shall meet performance requirements also during slip and slide events and torsional vibrations on vehicles.

Status	✔ Approved
Classification	Requirement
Rationale	Under degraded adherence or specific conditions, the train wheel may slip and slide.
Remark	
Acceptance Method	Certification

OCORA-7303, D-Level - Track environment

LOC-OB shall meet performance requirements regardless of the track environment (e.g. type of superstructure such as ballast, slab track, level crossings, iron bridges, etc.).

Status	✔ Approved
Classification	Requirement
Rationale	LOC-OB can be installed on any train running on any track environment.
Remark	
Acceptance Method	Certification

5.3.15 Degraded visual environments

OCORA-7301, D-Level - Visual environments with no degraded performance

The LOC-OB shall operate as specified for system functions LOC-OB_SF-001, LOC-OB_SF-002 and LOC-OB_SF-003 in degraded visual environments.

Status	✔ Approved
Classification	Requirement
Rationale	Under weather conditions the visibility is degraded (heavy rain, fog, etc.)
Remark	
Acceptance Method	Certification

OCORA-7302, D-Level - Visual environments with possible degraded performance

The LOC-OB's other system functions shall be operational in degraded visual environments.

Status	✔ Approved
Classification	Requirement
Rationale	Under weather conditions the visibility is degraded (heavy rain fog...)
Remark	
Acceptance Method	Certification

OCORA-7300, D-Level - Degraded conditions scenes

Note: The International Visibility Code (IVC) may be used to specify the degraded condition scenes.

Status	✔ Approved
Classification	Information
Rationale	LOC-OB is part of the CCS on-board OCORA architecture. LOC-OB shall be compliant with all applicable standards.
Remark	
Acceptance Method	Certification

6 Appendix A Open issues

6.1 Open issue 1:

Under some environmental conditions the LOC-OB is operational but it can't achieve the full performance as specified. The degraded performances have to be specified.
