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Functional Requirement Specification - ASTP



Requirements Specification - ASTP

Author(s)	Gabriele Ridolfi
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1 Introduction

1.1 Scope of the document


This document provides the Requirement Specification of the Advanced Safe Train Positioning (ASTP). This document represents the first level of iteration of the requirements collected from previous or ongoing projects. When necessary, these requirements will be further detailed in the following stage of the system analysis.







With reference to STIP  SPPMO-50 - Standardization and TSI Input Plan - Template, this document only refers to the so called "full" ASTP step due to Train CS domain decision that "basic" ASTP will not imply the segregation of the odometry function into an independent Interoperability Constituent and it will only focus on the enhancement of the performance and robustness of the odometry function and on the standardisation of the EVC output interface of an odometry data set for testing purposes.

Requirements valid for the enhanced odometry (former "basic" ASTP) are anyway inherited by the "full" ASTP for backward compatibility reasons.

Therefore, in this document the term ASTP has to be read with the meaning of "full" ASTP of the STIP.

1.2 Methodological approach

According to the ASTP baseline exercise  SPT2ARC-1794 - Absolute Train Positioning including usage of EGNOS, this document represents the moment of convergence between the top-down process (following SEMP) and the bottom-up one (taking inputs from existing projects and initiatives). Therefore the following documents/activities have been considered as input:

- CBOs applicable to ASTP  CBO for enhanced train positioning
- operational analysis  SPT2ARC-704 - Absolute Train Positioning OA (and first level of SA), system capabilities and Functional chains and sequences from modelling *SPT0Test240118/Export of capabilities/Export of _Localise rolling stock on railway infrastructure_ : 246539*
- requirements collected by projects (S2R stream 1 and IP R2DATO WP21)
- 8 technical notes and open points from IP R2DATO WP21
- TrainCS open points on ASTP  ASTP Open Points
- TrainCS architecture and specifications  202 Train CS Architecture & Specifications
- ASTP working hypothesis document  10 Working Hypothesis for ASTP
- ASTP Architecture variants, including Technical (based on granularity principle) and Economic evaluation  System architecture description - Basic ASTP

The label [UN] is added to identify a requirement which is not consolidated yet (unstable) and therefore linked with a decision still to be made. The list of all open topics is reported in the last chapter of this document.

Requirements will also be classified by using Polarion attributes to work items in order to have the possibility to produce different view of the FRS according to the classification.




























1.3 Glossary

ASTP	Advanced Safe Train Positioning
ATO	Automatic Train Operation

BTM	Balise Transmission Module
CCN	CCS Consist Network
CCS	Control Command and Signalling
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
EU	European Union
EUG	ERTMS Users Group
GNSS	Global Navigation Satellite System
IP	Innovation Pillar
IC	Interoperability Constituent
LRBG	Last relevant Balise Group
MAACI	Max Accepted Acceleration Confidence Interval. See D21.1 6.2.3.
MAAU	Max Accepted Acceleration Underestimation. See D21.1 6.2.3.
MAAO	Max Accepted Acceleration Overestimation. See D21.1 6.2.3.
MAPCI	Max Accepted Position Confidence Interval. See D21.1 6.2.1.
MAPU	Max Accepted Position Underestimation. See D21.1 6.2.1.
MAPO	Max Accepted Position Overestimation. See D21.1 6.2.1.
MASCI	Max Accepted Speed Confidence Interval. See D21.1 6.2.2.
MASU	Max Accepted Speed Underestimation. See D21.1 6.2.2.
MASO	Max Accepted Speed Overestimation. See D21.1 6.2.2.
OB	Onboard
RU	Railway Undertaking
R2DATO	Rail to Digital Automated Train Operation (Name of Focus Project Nr. 2 of Innovation Pillar)
SP	System Pillar
STIP	Standardisation and TSI Input Plan
TRDP	Train Real-Time Protocol
TSI	Technical Specification for Interoperability
WP	Work Package


1.4 Definitions

The following definitions apply:

- Basic ASTP  SPT2ARC-2659 - basic Advanced Safe Train Positioning (basic ASTP)
- Full ASTP  SPT2ARC-1828 - Advanced Safe Train Positioning (ASTP)
- Odometry  SPT2ARC-1829 - Odometry
- **Train Position ?**
- 1D reference frame  SPT2TRAIN-2537 - 1D reference frame
- 3D reference frame  SPT2TRAIN-2541 - 3D reference frame
- Absolute position reference frame  SPT2TRAIN-2542 - Absolute position reference frame
- Accuracy  SPT2TRAIN-2543 - Accuracy
- Angular rate  SPT2TRAIN-2544 - Angular rate
- attitude reference frame  SPT2TRAIN-2545 - Attitude reference frame
- carriage front end  SPT2TRAIN-2547 - Carriage front end
- confidence interval  SPT2TRAIN-2548 - Confidence Interval
- estimated distance  SPT2TRAIN-2549 - Estimated Distance
- estimated speed  SPLI-825 - ESTIMATED SPEED
- estimated train front end position  SPT2TRAIN-2550 - Estimated Train Front End Position
- kinematic data  SPT2TRAIN-2551 - Kinematic data
- localisation information  SPT2TRAIN-2552 - Localisation Information
- reference location  SPT2ARC-2228 - Reference Location
- relative position  SPT2TRAIN-2553 - Relative position
- supporting information  SPT2TRAIN-2554 - Supporting Information
- train front end  SPT2TRAIN-2546 - Train front end
- train true position  SPT2TRAIN-2555 - Train true position
- train true speed  SPT2TRAIN-2556 - Train true speed
- train true acceleration  SPT2TRAIN-2557 - Train true acceleration
- valid localisation information  SPT2TRAIN-2558 - Valid localisation information
- vehicle  SPLI-287 - vehicle  SPLI-254 - vehicle
- velocity  SPT2TRAIN-2559 - Velocity

1.5 CBO

Summary of ASTP related SP CBO and Railway Requirements from the SP operational vision.

These paragraphs are references to SP CBO items or Railway Requirements from the SP operational vision document (see  Operational Vision CCS Part). Not all CBO items or Requirements related to ASTP are mentioned here but the main ones needed for the following discussion are highlighted.

CBO for enhanced train positioning

vehicle design/performance

Optimize the vehicle design and performance parameters. (eg braking curves optimization and braking performance, Localisation accuracy, Movement Authority automated extensions). {vehicle design/performance}

less trackside assets

The system design shall support the removal of trackside asset and promote effective solutions. {less trackside assets}

Improved ETCS performance

This includes for example precise braking and speed regime, complete supervision in all normal

situations (like for shunting), fast and simple border transitions, fast change of direction, all types of movements (like propelling of yellow fleet trains) or fast start of mission.

Optimizing track capacity

The relevance of track occupancy information including safety margins shall be taken into account for optimizing track capacity. Traffic CS of today on mainline does not make the full use of the physical track capacity in this way. Diffuse operational states (e.g., track position of a starting train) are reported and control optimisations do not take train capabilities into account.

Optimizing track capacity

The train protection processes onboard are tuned in a way that allows the optimal use of the physical capacity without blocking capacity too early or too much.

Reduction of trackside CCS assets

The amount of trackside CCS assets is reduced by more than 50% (in the long-term just radio antenna, a strongly reduced number of balises and train detection sensors, and controller for points and crossings). Trackside control and safety systems are centralized to reduce maintenance, cost, and to simplify upgrades/updates.

Optimizing track capacity

The ability to combine, mix and use all modern sensor technologies (scalability) even on the same line delivers a precise perception of the operational state and exact traffic flow. Combined with precise and dynamic control algorithms the traffic flow is tuned to the physical capacity limit.

Train stopping nearer to their optimal stop position

Train stopping nearer to their optimal stop position (reduction of train travelling time for the next train movement, accumulated on many stops and avoidance of stopping point corrections). Other relevant factors affecting the train stop position, which are not related to ASTP, are the braking model and its configuration, actual braking characteristic of the train and engineering of the MA itself (distance between stop location to end of authority (EoA) and supervised location (SvL).

Trains driving faster in stopping areas

Trains driving faster on average into stations, due to a more precise location of the train safe front end with respect to EoA and to a more precise target speed. Other relevant factors affecting the train speed when approaching an EoA, which are not related to ASTP, are the braking model and its configuration, actual braking characteristic of the train and engineering of the MA itself (distance between stop location to end of authority (EoA) and supervised location (SvL).

Optimised placement of balise groups and TTD

A more precise train location allows a relaxation of the engineering rules for placing balise groups and TTD related to maintaining a sufficiently good train location. This could overall allow for a more optimal number and less complex placement of balise groups and TTD.

Reduce track occupation of trains

Enable longer trains to fit into shorter tracks and with ETCS L2 installations remove the need to build a physical track extensions or shorten trains. Even though ASTP might not be enough to fully avoid the need for track extensions, overlaps and release speed due to other factors also impacting these points, improving localisation could decrease the length of the track extensions, overlap length and reduce the need for release speeds.

Improve moving block operation

Improving moving block operation with onboard train localisation. Even though other factors such as safe train length and train integrity are needed to make moving block possible, a more precise and available train localisation will make the operation of moving block more efficient and increase its capacity and availability.

Safer train operation

Safer train operation due to strict compliance to the distance tolerances (CR1389) defined in the TSI 2023 under all weather conditions.

Improve introduction of virtual sections

The introduction of virtual sections for train detection and especially their certification and risk analysis benefits from a more predictable odometry behaviour due to a clearer definition of the availability.

Improve shunting manoeuvres

Improve performance of shunting manoeuvres, also in view of full supervision of shunting manoeuvres.

Single localisation service

Single localisation service onboard for multiple consumers (safe and non-safe) besides Automatic Train Protection (ATP).

Reduce certification effort when replacing odometry in isolation

Reduced certification effort as a change in odometry does not require a complete recertification of the whole ETCS onboard.

Support of ASTP product development

The development of the ASTP upgrades is also supported as the economical viability of solutions is easier to achieve with lower upgrade costs.

1.6 Operational needs

This chapter summarises more detailed operational needs which are linked to CBO. ASTP requirements included in chapter 2 are derived from these operational needs.

Trains headways need to be improved. This is mainly valid for applications where train distancing is based on the train position report (on-board centric track vacancy proving) however, a better accuracy can anyway improve traffic management in station minimising the need for overlaps which makes a piece of track unavailable for possible contemporary movements.

Traffic optimisation in station minimising the need for overlaps which makes a piece of track unavailable for possible contemporary movements, needs to be improved.

The approach to a stop location needs to be more efficient (quicker and allow the train to stop closer to the EoA) even without release speed.

Train stop at accurate locations needs to be possible to support ATO.

The approach to a point of a line where track conditions apply needs to be more efficient (shorten the distance between the point the vehicle/driver shall apply the track condition and the physical location of the track condition).

The approach to a point of a line where the permitted speed decreases/increases needs to be more efficient (shorten the distance between the point the train shall respect the new permitted speed and the physical point the speed reduction/increase applies).

The time to release movable devices (switches, LXs) needs to be reduced. This is mainly valid for applications where moveable devices command/release is based on the train position report (on-board centric track vacancy proving) however, a better accuracy can anyway improve traffic management in station minimising the need for overlaps which makes movable devices unavailable for possible contemporary movements.

The time the LX barriers are down needs to be reduced. This is mainly valid for applications where moveable devices command/release is based on the train position report (on-board centric track vacancy proving) however, a better accuracy can anyway improve traffic management in station minimising the need for overlaps which makes movable devices unavailable for possible contemporary movements.

The fulfilment of the operational needs, needs to be achieved by reducing the deployment of physical relocation points, compared to current ETCS specifications (LRBG) and removing any constraint related to a maximum distance between BGs.


The distance run in a ETCS mode with restricted supervision of train movements, without the need for ETCS physical balises, in case valid and un-ambiguous train position cannot be guaranteed after SoM or after recovery from a failure, needs to be reduced.

2 Requirements specification

2.1 Functional requirement


2.1.1 ASTP general data provision


SPT2ARC-2623 - ASTP shall be an independent on-board IC providing its output to multiple users over standardised interfaces.

 **SPT2ARC-3029** - ASTP modularisation

Note: This requirement shall be justified by a technical and an economic analysis. Anyway, this does not impede to group ASTP IC together with other IC according to the IC grouping principle defined in the TSI CCS. ASTP IC will replace the current odometry equipment IC.

SPT2ARC-2622 - ASTP shall provide position, speed, and acceleration with the relevant confidence interval.

SPT2ARC-4950 - [UN] In addition to  **SPT2ARC-2622**, ASTP shall provide other data such as heading, attitude (pitch, roll, yaw) with the relative confidence interval to multiple users simultaneously.


 **SPT2ARC-4951** - TBD-To be added to ASTP Open Points Definition and scope of "additional" positio...

Note: the need to make available other data will be duly demonstrated through a survey aiming to identify all ASTP consumers and their requirements.

2.1.2 1D localisation, speed and acceleration


SPT2ARC-2621 - ASTP shall provide train 1D position relative to a physical balise reference location and the travelled distance from the last power on, according to 1D reference frame.


Note: The allocation to ASTP of the function of detecting physical balise, currently in charge of BTM, needs to be evaluated in the context of the ASTP on-board architecture.

SPT2ARC-2956 - [UN] ASTP shall provide train 1D position of the ASTP reference point, relative to a virtual reference location unambiguously identified into the digital map, according to 1D reference frame.  **SPT2ARC-3018** - WP21 TN4 Need for digital map

Note: This requirement implies that the detection of a virtual reference location over the digital map is allocated to the ASTP.

Note: ETCS position report principles are not changed.

SPT2ARC-2958 - [D21.2 TN1] [UN] 1D position shall refer to the ASTP reference point in the carriage where ASTP is installed in the absolute position reference frame.  **SPT2ARC-3020** - WP21 TN1 Bogie pin vs train front end reference frame


SPT2ARC-2962 - [D21.2 TN8] [UN] When the CCS-OB is equipped with a CMD and if no cold movement was detected, the CMD threshold shall be taken into account into the stored confidence interval after a new start-up.  **SPT2ARC-3016** - WP21 TN8 Use of small distance to detect cold movement (2m)


SPT2ARC-2836 - [D21.1 7.1.3.1.1] ASTP shall provide safe ASTP 1D speed according to the ASTP 1D reference frame. This includes: Movement direction, estimated ASTP speed, underestimation ASTP speed, overestimation ASTP speed, validity timestamp, and function status.

SPT2ARC-2835 - [D21.1 7.1.4.1.1] ASTP shall provide safe ASTP 1D acceleration according to the ASTP 1D reference frame. This includes: Estimated ASTP acceleration, underestimation ASTP acceleration, overestimation ASTP acceleration, validity timestamp, and function status.

2.1.3 3D position, velocity and acceleration

SPT2ARC-2803 - [D21.2 005] ASTP shall provide absolute, non-safe, estimated 3D position and the corresponding uncertainty in the absolute position reference frame. This includes: 3D position, 3D position uncertainty, coordinate system, track edge ID, validity timestamp, and function status

SPT2ARC-2837 - [D21.2 006] [UN] 3D train position shall define which reference coordinate system uses. At least ETRS89 and WGS84 shall be supported.  [SPT2ARC-3018 - WP21 TN4 Need for digital map](#)


SPT2ARC-2838 - [D21.2 TN1] [UN] 3D train position shall refer to the ASTP reference point of the carriage where ASTP is installed in the absolute position reference frame.  [SPT2ARC-3020 - WP21 TN1 Bogie pin vs train front end reference frame](#)

SPT2ARC-2804 - [D21.2 007] ASTP shall provide non-safe train 3D estimated velocity together with the corresponding uncertainty, according to 3D ASTP reference frame. This includes: 3D velocity, 3D velocity uncertainty, validity timestamp, and function status.

SPT2ARC-2805 - [D21.2 008] ASTP shall provide non-safe train 3D estimated acceleration together with the corresponding uncertainty, according to 3D ASTP reference frame. This includes: 3D acceleration, 3D acceleration uncertainty, validity timestamp, and function status.

2.1.4 Attitude (rotational angles)

SPT2ARC-2806 - [D21.2 009] [UN] ASTP shall provide non-safe train 3D estimated attitude (rotational angles) and attitude rates together with the corresponding uncertainty, according to the attitude ASTP reference frame. This includes: Attitude, attitude uncertainty, angular rate, angular rate uncertainty, validity timestamp, and function status.

 [SPT2ARC-4951 - TBD-To be added to ASTP Open Points Definition and scope of "additional" positio...](#)

Note: the need to make available attitude will be duly demonstrated through a survey aiming to identify all ASTP consumers and their requirements.

2.1.5 Other


SPT2ARC-2649 - [D21.2 017] ASTP, from the train power on, shall initialise itself and provide the outputs with no human supervision.

Note: Manual procedures are only admitted at the first power-on or during maintenance activities.

SPT2ARC-2604 - ASTP shall always provide train speed and travelled distance after an ASTP initialisation independently if the position is valid or not for ETCS.

SPT2ARC-2839 - [D21.2 011] ASTP shall use a common time synchronisation technique compatible with the safety requirements in accordance with the EN50159 standard.


SPT2ARC-2877 - [D21.1 5.2.1.1.8] ASTP shall be able to operate in LNTC, ETCS Level 1, ETCS Level 2.

SPT2ARC-2794 - [D21.1 4.3] [UN] ASTP shall determine train travelling direction.  [SPT2ARC-3017 - WP21 TN5 Definition of area with and without constraints](#)

SPT2ARC-2632 - ASTP shall ensure the fulfilment of functional and non-functional requirements without the need for human intervention (unless for maintenance or first configuration purposes).

SPT2ARC-2842 - [D21.2 014] ASTP shall manage a time stamped event memory to log all events related to ASTP behaviour (no achievement of the requirements) or environmental event detected by the ASTP sensors (for example: uncommon vibration, spoofing event).

Note: The event memory will ease the ASTP own maintenance and the onboard or trackside maintenance. The memory needs to manage the data for a minimum time of on month.

SPT2ARC-4939 - [UN] ASTP shall make available the possible telegram associated to a virtual reference location, acting as a virtual balise, identified into the digital map.  [SPT2ARC-5137 - WP21 TN2 Detection and transmission of of Eurobalise Telegram for the virtual ba...](#)


Note: This requirement implies that the detection of a virtual balise over the digital map and its telegram determination is allocated to the ASTP.

2.2 Environmental requirements

SPT2ARC-2645 - [UN] ASTP shall ensure the fulfilment of functional and non-functional requirements in an onboard vehicle, fitted for a SERA area, whose characteristics (traction system, temperature, pressure, EMC, pollutions, pressure, water proofing, vibration and shock, chemical, fire prevention, etc.) shall be defined.

Note: vehicle characteristics affecting odometry behaviour are depending on the considered set of sensors technologies.


Note: The traction system has an impact on the adhesion factor between wheel and rail; exceptions can be accepted for vehicle not in commercial operation.

 [SPT2ARC-3030 - ASTP Reliability requirements definition](#)

SPT2ARC-2647 - ASTP shall ensure the fulfilment of functional and non-functional requirements in severe weather condition (temperature, altitude, rain, snow, fog, wind, etc.) which allow train operations in Europe (SERA) and which shall be defined.

Note: weather conditions affecting odometry behaviour are depending on the considered set of sensors technologies.

SPT2ARC-2873 - [D21.1 8.5.1.1.1] [UN] The ASTP shall function in compliance with the environmental conditions specified in the norms EN 50155 and EN 50125

 [SPT2ARC-3030 - ASTP Reliability requirements definition](#)

SPT2ARC-2646 - ASTP shall ensure the fulfilment of functional and non-functional requirements in all physical SERA rail environments and type of infrastructure such as station areas, urban areas surrounded with high buildings, forests, deep valley, tunnel bridges, with or without catenary, concrete track, ballast, etc.. Those other external conditions affecting odometry shall be defined.



Note: other external conditions than vehicle or weather affecting odometry behaviour are depending on the considered set of sensors technologies.

SPT2ARC-2878 - [D21.1 4.1.2.4.7.3] ASTP shall ensure the fulfilment of functional and non-functional requirement when performing under all light environmental conditions (e.g., night, darkness, sunlight...).


2.3 Performance requirements


Requirements in this chapter shall be considered in addition to the relevant requirement valid for the enhanced odometry (former "basic" ASTP) which are inherited by ASTP as well and applicable when ASTP can not work according to its full capabilities (e.g. trackside does not provide the necessary ASTP



features/interfaces) - see also Migration requirements. The performance requirements for enhanced odometry are in the scope of CR 07695.



SPT2ARC-2876 - [D21.2 060] [UN] Main operational conditions/constraints where the ASTP shall fulfil performance requirements shall be defined.  [SPT2ARC-3017 - WP21 TN5 Definition of area with and without constraints](#) [ Open]



Note: it is under investigation, whether performance requirements will be defined according to the operational conditions distinguishing for instance the acceleration/deceleration phases (e.g. during to joining operations, heavy acceleration/braking, emergency braking) from running at line speed.



SPT2ARC-2789 - [D21.1 5.2.5.2.6] [UN] For every measured distance, ASTP accuracy shall be better or equal to $\pm (5\text{m} + 2\% \text{ s})$, i.e. the over reading amount and the under reading amount shall be equal to or lower than $(5\text{m} + 2\% \text{ s})$.  [SPT2ARC-3010 - WP21 TN6 Accuracy positioning target](#)


SPT2ARC-2643 - [UN] ASTP shall improve the positioning/speed accuracy model (error profile and over/under reading amount) compared to the existing on-board odometry solutions used in the ETCS domain (see Subset 041).  [SPT2ARC-3010 - WP21 TN6 Accuracy positioning target](#)



SPT2ARC-2848 - [D21.2 080] [UN] The computed safe confidence interval toward estimated speed shall not exceed 2 km/h, for speeds lower than 30 km/h, and increasing linearly up to 12 km/h for speeds between 30 km/h and 500 km/h.  [SPT2ARC-3012 - WP21 TN6 Accuracy speed target](#) [ Open]



SPT2ARC-2849 - [D21.2 013] [UN] If the computed confidence interval (Underestimation of the estimated speed - Overestimation of the estimated speed) exceeds 2 km/h, for speeds lower than 30 km/h, and increasing linearly up to 12 km/h for speeds between 30 km/h and 500 km/h, the dataset shall be considered unavailable.  [SPT2ARC-3011 - WP21 TN5 Availability at fulfilling the accuracy target](#) [ Open]

SPT2ARC-2850 - [D21.2 040] [UN] For at least 95% of the cases, the absolute error of the estimated train speed provided by ASTP shall not exceed $\pm 1 \text{ km/h}$ for speeds from 0 km/h to 100 km/h and $\pm 1\% \cdot v$ for speeds from 100 km/h to 500 km/h.  [SPT2ARC-3012 - WP21 TN6 Accuracy speed target](#) [ Open]

SPT2ARC-2851 - [D21.2 041] [UN] ASTP shall provide the train estimated acceleration with a computed $\frac{1}{2}$ confidence interval better than $0,2 \text{ m/s}^2$.  [SPT2ARC-3011 - WP21 TN5 Availability at fulfilling the accuracy target](#) [ Open]


SPT2ARC-2852 - [D21.2 013] [UN] If the computed confidence interval (Underestimation of the estimated acceleration - Overestimation of the estimated acceleration) exceeds $0,2 \text{ m/s}^2$, the dataset shall be considered unavailable.  [SPT2ARC-3011 - WP21 TN5 Availability at fulfilling the accuracy target](#)

 [SPT2ARC-4624 - TBD-To be added to ASTP Open Points How to handle justifications of requirements...](#) [ Open]

SPT2ARC-2853 - [D21.2 043] [UN] For at least 95% of the cases, the absolute error of the estimated train acceleration provided by ASTP shall not exceed 0.05 m/s^2 .  [SPT2ARC-3011 - WP21 TN5 Availability at fulfilling the accuracy target](#)  Open]

SPT2ARC-2845 - [D21.2 036 & 037] [UN] The computed 1/2 confidence interval (Underestimation of the estimated distance - Overestimation of the estimated distance) toward the ASTP reference position provided by ASTP shall not exceed (absolute value)::

- 60 m in areas with negligible constraints.
- 60 m in areas with constraints, only if the train is not stopping in this area.
- 10 m in areas with constraints if the train is stopping in this area

 [SPT2ARC-3010 - WP21 TN6 Accuracy positioning target](#)

 Open]

Note: the following definitions apply

Area with negligible constraint: Mainline, Dense traffic line, track section between two areas with constraints.

Area with constraints: Station area, traffic node (specific point), stopping point (EoA), limit of authority (LoA).



SPT2ARC-2846 - [D21.2 013] [UN] If the computed 1/2 confidence interval (Underestimation of the estimated distance - Overestimation of the estimated distance) toward the ASTP reference position provided by ASTP exceeds the following absolute values:

- 60 m in areas with negligible constraints.
- 60 m in areas with constraints, only if the train is not stopping in this area.
- 10 m in areas with constraints if the train is stopping in this area

The dataset shall be considered unavailable.

All other items concerning the 1D location dataset shall not be impacted.

All other datasets shall not be impacted.

 [SPT2ARC-3010 - WP21 TN6 Accuracy positioning target](#)  Open]

Note: the following definitions apply

Area with negligible constraint: Mainline, Dense traffic line, track section between two areas with constraints.


Area with constraints: Station area, traffic node (specific point), stopping point (EoA), limit of authority (LoA).

Note: Given the same number of physical relocation points and the same distance run, the average size of the confidence interval determined by the ASTP shall be smaller compared to the size of the confident interval detected by the existing on-board odometry solutions used in the ETCS domain.

Note: this requirement covers both the cases of (virtual/physical) fixed blocks, where accuracy matters when approaching a singular point (signal, LX, switch, speed variation ...) and of moving block applications where accuracy also matters along the entire run.



SPT2ARC-2641 - ASTP shall allow to determine a trusted position in a short time and minimising the distance to be run in a non-supervised mode.  Open]

Note: This will make safer and more efficient the operation at Start of Mission, when other subsystems cannot ensure an un-ambiguous train position and after passing a switch point.

SPT2ARC-2602 - ASTP shall ensure a start-up time compatible with common rail starting up operational procedures (order of 60 seconds). [ Open]

SPT2ARC-2847 - [D21.2 038] [UN] For at least 95% of the cases, the absolute error of the ASTP reference estimated position provided by ASTP shall not exceed:

- +/- 5.0 m in areas with negligible constraints.
- +/- 5.0 m in areas with constraints.



 **SPT2ARC-3011** - WP21 TN5 Availability at fulfilling the accuracy target [ Open]



Note: the following definitions apply

Area with negligible constraint: Mainline, Dense traffic line, track section between two areas with constraints.

Area with constraints: Station area, traffic node (specific point), stopping point (EoA), limit of authority (LoA).

SPT2ARC-2844 - [D21.2 034] [UN] ASTP dataset time validity shall not exceed 200 ms when transferred to users.



 **SPT2ARC-4624** - TBD-To be added to ASTP Open Points How to handle justifications of requirements... [ Open]

SPT2ARC-2854 - [D21.2 044] [UN] For at least 95% of the cases, the absolute error of the estimated 3D ASTP reference position shall not exceed 2.5m on the x y and z axis of the carriage reference frame..  **SPT2ARC-3010** - WP21 TN6 Accuracy positioning target [ Open]



SPT2ARC-2855 - [D21.2 045] [UN] For at least 95% of the cases, the absolute error of the estimated 3D train velocity shall not exceed 2 km/h on each axis of the carriage reference frame.



 **SPT2ARC-3012** - WP21 TN6 Accuracy speed target [ Open]

SPT2ARC-2856 - [D21.2 046] [UN] For at least 95% of the cases, the absolute error of the estimated 3D train acceleration shall not exceed 0.05 m/s² on each axis of the carriage reference frame.

 **SPT2ARC-3032** - Accuracy acceleration target [ Open]

SPT2ARC-2857 - [D21.2 048] [UN] For at least 95% of the cases, the absolute error of the estimated 3D attitude (rotational angles) shall not exceed 0.1° for yaw, and 0.5° for pitch and roll angles.

 **SPT2ARC-3031** - Accuracy attitude target [ Open]

SPT2ARC-2858 - [D21.2 049] [UN] The safe maximum distance (Estimated distance max) and the safe minimum distance (Estimated distance min) under and over estimation compared to the estimated distance travelled (Estimated distance travelled) shall be lower than 2% of the travelled distance.  **SPT2ARC-3010** - WP21 TN6 Accuracy positioning target [ Open]

SPT2ARC-2635 - ASTP shall ensure the fulfilment of functional and non-functional requirements from standstill to the maximum speed allowed by ETCS (500 km/h).

2.4 Reliability requirements


SPT2ARC-2601 - [D21.1 5.2.2.1.1] ASTP shall allow an improvement in terms of RAM and LCC compared to the legacy on board odometry solutions used in the ETCS domain and considering the possible differences in terms of life duration.


SPT2ARC-2600 - [UN] ASTP reliability target (MTBF) shall be defined according to the impact on operation of the failure: minor (no impact), reduced service, immobility. [D21.2 069] The ASTP hardware

shall comply with the overall CCS on-board reliability as defined in [EEIG 92S126 [25] chapter 2]:

- Minor failure: $\lambda < 1.25 * 10^{-4}/h$.
- Reduced service failure: $\lambda < 3.3 * 10^{-6}/h$.
- Immobility failure: $\lambda < 3.7 * 10^{-7}/h$.

 SPT2ARC-3030 - ASTP Reliability requirements definition

SPT2ARC-2817 - [D21.2 001] [UN] Only if safety is granted (fulfilment to the safety requirements), the occurrence of sudden variation (e.g., sudden increase of the confidence interval while the train is following a braking curve) or loss of ASTP localisation information by a safety relevant consumer due to the lack of valid data (e.g., lack of message, data is too old, etc.) leading to a brake intervention (service brake or emergency brake) shall be less than $2 * 10^{-6}/h$ (one brake intervention per year for a fleet of 10 trains operated during 14 hours per day).  SPT2ARC-3030 - ASTP Reliability requirements definition

SPT2ARC-2815 - [D21.1 8.2.1.1.4] [UN] The occurrence of ASTP not operational (major failure, ASTP is not providing any output) shall be less than 1 event every 10 years.  SPT2ARC-3030 - ASTP Reliability requirements definition

SPT2ARC-2834 - [D21.2 075] ASTP life cycle shall be at least 30 years.


2.5 Availability and Robustness requirements

Requirements in this chapter shall be considered in addition to the relevant requirement valid for the enhanced odometry (former "basic" ASTP) which are inherited by ASTP as well and applicable when ASTP can not work according to its full capabilities (e.g. trackside does not provide the necessary ASTP features/interfaces) - see also Migration requirements. The robustness requirements for enhanced odometry are in the scope of CR 07692.

SPT2ARC-4980 - [D21.1 8.2.1.1.2] [UN] The ASTP is considered as available if it provides localisation information to users and if the confidence intervals are within the MAPCI (position), MASCI (speed) and MAACI (acceleration).

 SPT2ARC-3011 - WP21 TN5 Availability at fulfilling the accuracy target

SPT2ARC-2599 - [D21.2 051] [UN] The ASTP shall have an overall availability of 99,998% per month.

 SPT2ARC-3011 - WP21 TN5 Availability at fulfilling the accuracy target



Note: it is under investigation, whether availability requirements will be defined according to the operational conditions distinguishing for instance the acceleration/deceleration phases (e.g. during to joining operations, heavy acceleration/braking, emergency braking) from running at line speed.


SPT2ARC-2790 - [D21.1 9.3.2.1.5] [UN] ASTP shall improve the availability of the odometry function, meaning its capability to fulfil the accuracy target along the mission. The following list is identifying some events under which a function can be in degraded mode. These are examples, the list is not exhaustive.

- Some sensors are not performing as expected (e.g., calibration of a sensor is not done), the function cannot provide some output data or data are not within the expected accuracy.
- Some supporting information is not available (e.g., augmentation data, routing information...)
- One sensor is in failure, the function cannot provide some output data or data are not within the expected accuracy.
- Sensor device based on radio signal is facing spoofing, interferences, jamming during a time or a distance. These parameters are not specified in this release, more investigations are required to determine the values.

Note: capability of ASTP to detect/react against possible configuration, maintenance or calibration error is to be analysed.


Note: this requirements aims to avoid misinterpretation of the term "malfunction" used by Subset 41.

 SPT2ARC-3011 - WP21 TN5 Availability at fulfilling the accuracy target [ Open]


SPT2ARC-2814 - [UN] [D21.1 8.2.1.1.4] If the ASTP is not providing data at the defined frequency, the ASTP is considered as unavailable during this time.  SPT2ARC-3011 - WP21 TN5 Availability at fulfilling the accuracy target

Note: The ASTP being considered as "unavailable" does not prevent the ASTP from providing data to consumers. The data will simply not achieve the performance target.


2.6 Maintainability requirements

SPT2ARC-2597 - [UN] ASTP shall be able to self-diagnose hardware temporary and permanent failures and systematic errors from individual sensors, allowing a possible degraded working mode before considering the entire ASTP out of order.  SPT2ARC-4623 - TBD-To be added to ASTP Open Points Maintenance requirements and maintainability

SPT2ARC-5116 - [D21.1 8.3.1.1.1] Maintenance costs negatively affect life cycle costs. For this reason, the system must be designed in such a way that maintenance work is minimal.

SPT2ARC-2808 - [D21.1 8.3.1.1.7] [UN] The results of the self-diagnose shall be able to determine the replaceable unit to be replaced.  SPT2ARC-4623 - TBD-To be added to ASTP Open Points Maintenance requirements and maintainability


SPT2ARC-2596 - ASTP shall make available maintenance-relevant information for recording to determine possible predictive and corrective maintenance interventions.

 SPT2ARC-4623 - TBD-To be added to ASTP Open Points Maintenance requirements and maintainability

Note: Predictive and corrective maintenance analysis can be performed offline and outside ASTP.


SPT2ARC-2595 - [D21.2 070] [UN] Preventive maintenance and periodic workshop sensor calibration period of the overall ASTP shall exceed 2 years.


 SPT2ARC-4623 - TBD-To be added to ASTP Open Points Maintenance requirements and maintainability

SPT2ARC-2859 - [D21.2 071] [UN] If a periodic workshop sensor calibration is needed, the procedure shall not exceed 2hours for the whole ASTP sensors and shall be done without the use of complex calibration benches.  SPT2ARC-4623 - TBD-To be added to ASTP Open Points Maintenance requirements and maintainability

SPT2ARC-2860 - [D21.2 015] Calibration procedure(s) operated during the train operation shall avoid the use of specific trackside equipment.

SPT2ARC-2861 - [D21.2 016] [UN] Following the installation of a new set of on-board equipment (line replaceable unit of the ASTP), ASTP shall reach full operational capability at switch-on in less than 20 minutes with no human intervention.

 SPT2ARC-4623 - TBD-To be added to ASTP Open Points Maintenance requirements and maintainability

SPT2ARC-2810 - [D21.1 8.3.1.1.8] [UN] The Mean Repair Time (MRT) shall be less than 15 minutes as per EN50126.  SPT2ARC-4623 - TBD-To be added to ASTP Open Points Maintenance requirements and maintainability

SPT2ARC-2809 - [D21.1 8.3.1.1.9] The ASTP's design and maintenance concept shall meet a Mean Time To Restore (MTTR) $\leq 1h$. The Mean Time to Restore (MTTR) is defined in EN50126. The time elapsed to restore starts when the failure occurs and ends when the ASTP is ready for service. The administrative delay (MAD), Logistic Delay (MLD) shall not be counted into the MTTR.

SPT2ARC-2593 - ASTP shall include monitoring and diagnosis interface locally.

SPT2ARC-2811 - [D21.1 5.2.3.1.7] Maintenance optimization shall also be considered minimizing calibration operations in case of a component replacement.

SPT2ARC-2812 - [D21.1 8.3.1.1.3] The long-term maintenance strategy shall include damage-dependent (past) and preventive (forward-looking) measures.


SPT2ARC-2880 - It shall be ensure that spare parts are available for the entire ASTP life cycle.

SPT2ARC-2881 - [D21.1 8.3.1.1.5] Maintenance measures shall be carried out in such a way that the system can be operated within the defined RAMS requirements for the entire system life cycle.

2.7 Safety requirements


SPT2ARC-2625 - ASTP shall serve users with different safety integrity requirements (e.g. ETCS, ATO, traffic management, maintenance and diagnostic, asset management, passenger info, etc.).

SPT2ARC-2807 - [D21.2 073] [UN] If ASTP is unable to produce a data respecting the safety requirements (THR) because ASTP cannot guarantee safe operation due to internal safety process faults (for ex: safe computer failure, self-testing KO etc): ASTP shall not provide any information to the users.

 **SPT2ARC-4622** - TBD-To be added to ASTP Open Points Management of Data output in degraded modes

Note: To be investigated if it could be more efficient to use a safety qualifier indicating that there is a safety issue. This allows users who don't use the data, including diagnostics, to continue operating.

SPT2ARC-2862 - [D21.2 054] The safety of the ASTP shall be ensured and demonstrated according to the applicable law.


SPT2ARC-2863 - [D21.2 056] [UN] The ASTP reference point true position shall be included in ASTP computed confidence interval within the most constraining THR.  **SPT2ARC-3020** - WP21 TN1 Bogie pin vs train front end reference frame

SPT2ARC-2864 - [D21.2 067] The ASTP true speed shall be included in ASTP computed confidence interval within the most constraining THR.

SPT2ARC-2865 - [D21.2 068] The ASTP true acceleration shall be included in ASTP computed confidence interval within the most constraining THR.


SPT2ARC-2866 - [D21.2 058] If needed, calibration procedure(s) shall comply with the safety requirements.

SPT2ARC-2620 - [UN] ASTP shall provide position, speed information with the relevant confidence interval, with SIL4 and the relevant THR.

 **SPT2ARC-3028** - ASTP safety requirements definition

Note: the highest safety integrity level according to CENELEC standards is justified by having the ASTP output used to protect the run of the train by the ATP.

Note: Still to be investigated and justified which are the possible other data to be provided with SIL4.

SPT2ARC-2619 - [D21.1 5.2.2.1.2] [UN] ASTP shall provide position, speed information with the relevant confidence interval, with SIL lower than 4. I.e. ASTP shall serve the safety integrity needs of the ETCS users (e.g. ETCS-OB, ATO-OB, TMS, maintenance and diagnostic, asset management, passenger info, etc.).  **SPT2ARC-3028** - ASTP safety requirements definition

Note: The lower safety integrity level according to CENELEC standards is sufficient for many auxiliary functions, which will benefit from the higher accuracy and lower confidence intervals.

Note: Still to be investigated and justified which are the other possible data to be provided with SIL lower than 4.


2.8 Intentionally deleted

2.9 Security requirements


SPT2ARC-2618 - ASTP and its interfaces shall be designed considering the security detections and mitigation measures identified adopting a systematic procedure performed according to recognised standards, aiming to identify all the possible security threats and risks.

SPT2ARC-2867 - [D21.1 8.4.1.1.2] ASTP shall fulfil requirements and recommendations for cybersecurity as specified in CLC/TS 50701 with the purpose to demonstrate that the system is up to date from a cybersecurity perspective and that it meets and maintains the target level of security for the entire system life cycle.


SPT2ARC-2868 - [D21.1 8.4.1.1.3] [UN] ASTP security shall be ensured by using means and technologies in accordance with project security plan.

 **SPT2ARC-4620** - TBD-To be added to ASTP Open Points SP Shared Security Services impact on ASTP

SPT2ARC-2869 - [D21.1 8.4.1.1.4] [UN] Whether GNSS technology is used, the ASTP shall be resilient to signal spoofing, jamming (e.g. GNSS, Balise signals...) attacks. Appropriate detection measures of such conditions and mitigation measure to counter such attacks shall be addressed to keep the integrity of the ASTP.

 **SPT2ARC-3014** - WP21 D21.1 and D21.2 Need for GNSS augmentation

2.10 Installation requirements


SPT2ARC-2870 - [D21.1 5.2.3.1.2] ASTP can be installed on any wagon/carriage of the train.
[ Open]

Note: ASTP may not be a monolithic module, embedding several types of sensors in different locations in the train.

SPT2ARC-2644 - ASTP technology and installation choices shall not interfere with the correct working of all other subsystems present into the vehicle environment.



SPT2ARC-5122 - ASTP manufacturer shall provide the installation requirements valid for the sensors used by the ASTP.

Note: ASTP installation will consider the specific weak points of each sensor to avoid loss of performance under conditions considered probable.

SPT2ARC-2872 - [D21.1 5.2.3.1.4] ASTP design shall be easy to install on new trains and in refurbished trains. [ Open]

SPT2ARC-2874 - [UN] [D21.2 061] ASTP components shall comply with the EN 45545 [16] standard: Railway applications - Fire protection on railway vehicles. The latest edition shall apply.

Note: To be decided if EN 50155 shall be referenced instead of EN 45545.

 **SPT2ARC-3030** - ASTP Reliability requirements definition [ Open]

SPT2ARC-2875 - [D21.2 062] ASTP components shall comply with the REACH and RoHS2. The latest edition shall apply.

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006R1907>

<https://eur-lex.europa.eu/eli/dir/2011/65/oj/eng>


[🔗 Open]

2.11 Interface requirements

At the stage of this document, the functional and physical architecture of ASTP is not defined yet therefore it is not possible to provide precise interface requirements. In the stage of "Basic" ASTP, odometry dataset is foreseen to be provided by the EVC (embedding the odometry function) through a standard output interface which is intended to be re-use as part of the output interface of the ASTP.

SPT2ARC-2616 - The functions, performance figures, interfaces, testing and certification of the ASTP having an impact on interoperability shall be standardised (this also implies modification to possible already existing interfaces). [🔗 Open]

SPT2ARC-4619 - The functions, performance figures, interfaces, testing and certification of the ASTP having an impact on modularity shall be standardised (this also implies modification to possible already existing interfaces).


 **SPT2ARC-3029** - ASTP modularisation


Note: functions allocation (e.g. the inclusion of BTM functions into ASTP), architecture and interface definition are in the scope of next steps of the process. [🔗 Open]


SPT2ARC-5003 - [UN] The following datasets to be provided by the ASTP shall be standardised:

- 1D localisation (D21.2 002)
- 1D speed (D21.2 003)
- 1D acceleration (D21.20 004)
- 3D position (D21.2 005)
- 3D velocity (D21.2 007)
- 3D acceleration (D21.2 008)
- 3D Attitude (D21.2 009)
- Odometer information (D21.2 010)
- Virtual reference location (D21.2 086)


Note: These datasets have to be considered as an output of the EVC only for testing/monitoring purposes.


 **SPT2ARC-4951** - TBD-To be added to ASTP Open Points Definition and scope of "additional" positio... [🔗 Open]

SPT2ARC-5108 - [UN] The datasets defined according to  **SPT2ARC-5003** shall be standardised based on the CCS consist network principles (Subset 147). See [UN]-link for the related requirement. [🔗 Open]


SPT2ARC-5004 - [UN] The datasets defined according to  **SPT2ARC-5003** shall be standardised in term of interfaces (inputs and outputs of the ASTP). See [UN]-link for the related requirement. [🔗 Open]

Note: functions allocation, architecture and interface definition are in the scope of next steps of the process.


SPT2ARC-2795 - [UN] If the ASTP uses GNSS sensors and needs GNSS augmentation information for integrity and recalibration purposes, it shall use standardised GNSS augmentation data provided through radio from trackside.  **SPT2ARC-3014** - WP21 D21.1 and D21.2 Need for GNSS augmentation

SPT2ARC-5109 - [UN] ASTP shall use standardised track digital map provided through radio from trackside.  **SPT2ARC-5137** - WP21 TN2 Detection and transmission of of Eurobalise Telegram for the virtual ba...

SPT2ARC-2796 - [D21.2 FP2-ASTP-SRS-027] [UN] If routing information is needed by ASTP to fulfil requirements, ASTP shall use standardised routing information provided through radio from trackside.


 [SPT2ARC-3013 - WP21 TN4 Need for routing information](#)

SPT2ARC-2799 - [UN] ASTP shall use train integrity information when ASTP is not installed into the first vehicle of the train and the train is separable.


 [SPT2ARC-3019 - WP21 TN2 Train integrity status](#)

Note: If trains equipped with ASTP are not equipped with Train Integrity, the ASTP shall be installed in the very first (leading) vehicle.

SPT2ARC-2797 - [D21.2 033] [UN] ASTP shall use the Last Relevant Reference Location provided by ETCS (BTM).

 [SPT2ARC-3029 - ASTP modularisation](#)


SPT2ARC-2802 - [D21.1 7.1.20] [UN] ASTP shall exchange data with Time control unit, Control cybersecurity access, and Maintenance and diagnostic monitoring unit.

 [SPT2ARC-3029 - ASTP modularisation](#)

SPT2ARC-2798 - [D21.2 032] [UN] If centralised at the train level, ASTP shall acquire its static configuration from the common onboard configuration data storage component. Otherwise, specific static configuration information shall be managed as an internal component of ASTP.

 [SPT2ARC-3020 - WP21 TN1 Bogie pin vs train front end reference frame](#)

SPT2ARC-2801 - [UN] ASTP shall use cold movement information from the cold movement detector.

 [SPT2ARC-3015 - WP21 TN2 Detection of cold movement](#)


2.12 Upgradability requirements

SPT2ARC-2614 - [UN] The ASTP shall be an upgradeable constituent allowing the introduction of future technological solutions (sensors, algorithms, computing platforms), meaning that any upgrade will not necessarily imply a substantial impact on the safety case of any vital ASTP consumers unless the relevant interfaces are modified as well.

 [SPT2ARC-3029 - ASTP modularisation](#)  Open]

SPT2ARC-2612 - [UN] ASTP software upgrade shall be possible remotely.


 [SPT2ARC-4623 - TBD-To be added to ASTP Open Points Maintenance requirements and maintainability](#)  Open]

SPT2ARC-2610 - ASTP hardware shall be resilient to minor future upgrades in terms of spare resources (e.g. wired inputs/outputs, memory, cpu load...)  Open]

2.13 Migration requirements

This chapter has been written according to the following principle: ASTP will be introduced in TSI CCS in a compatible way. If necessary to limit operations to trains only equipped with ASTP, IMs and RUs need to agree upon access conditions through means different from the TSI specifications (an approach like ATO could be adopted).


SPT2ARC-2628 - ASTP shall ensure on-board and trackside backward compatibility to facilitate migration strategies.

 Open]

SPT2ARC-2608 - In case ASTP information from trackside is not available (e.g. trains equipped with the ASTP running on a trackside without ASTP interfaces), ASTP shall ensure the fulfilment of the performance requirements valid for enhanced odometry (former "basic" ASTP) without exporting condition to the trackside subsystem.

 Open]

Note: This also includes the scenario of a non-radio-based signalling system.

SPT2ARC-2634 - Trackside backward compatibility (i.e. making possible the train operation without ASTP over a trackside equipped with ASTP interfaces) should be technically possible in order to facilitate migration strategy. [ Open]








Note: an impact analysis (including possible safety aspect) against a train without ASTP will be necessary anyway due to the reduction of the physical relocation balises.













































2.14 Process requirements



















(all activities needed to make a solution for ASTP mature, sustainable, certifiable)

3 List of open points

Note: List to be updated

Source	Topic	Relevant requirement
WP21 TN1	Bogie pin vs train front end reference frame	 SPT2ARC-2798  SPT2ARC-2838  SPT2ARC-2958  SPT2ARC-2863
WP21 TN2	Train integrity status	 SPT2ARC-2799
WP21 TN2	Detection and transmission of of Eurobalise Telegram for the virtual balises	 SPT2ARC-4939  SPT2ARC-5109

WP21 TN2	Detection of cold movement	 SPT2ARC-2801
WP21 TN4	Need for routing information	 SPT2ARC-2796
WP21 TN4	Need for digital map	 SPT2ARC-2837  SPT2ARC-2956
WP21 TN5	Definition of area with and without constraints	 SPT2ARC-2794  SPT2ARC-2876
WP21 TN5	Availability at fulfilling the accuracy target	 SPT2ARC-2790  SPT2ARC-2847  SPT2ARC-2849  SPT2ARC-2852  SPT2ARC-2853  SPT2ARC-2851  SPT2ARC-4980  SPT2ARC-2599  SPT2ARC-2814
WP21 TN6	Accuracy positioning target (including that ETCS must be able to handle a shrinking confidence interval).	 SPT2ARC-2789  SPT2ARC-2845  SPT2ARC-2846  SPT2ARC-2854  SPT2ARC-2643  SPT2ARC-2858
WP21 TN6	Accuracy speed target	 SPT2ARC-2848  SPT2ARC-2850  SPT2ARC-2855
WP21 TN8	Use of small distance to detect cold movement (2m)	 SPT2ARC-2962
WP21 D21.1 and D21.2	Need for GNSS augmentation	 SPT2ARC-2795  SPT2ARC-2869
 ASTP Open Points	ASTP safety requirements definition	 SPT2ARC-2619  SPT2ARC-2620
 ASTP Open Points	ASTP modularisation (including pending SP decision on the architecture of ASTP)	 SPT2ARC-2603 - Missing cross-reference  SPT2ARC-2614  SPT2ARC-2623  SPT2ARC-2797  SPT2ARC-4619  SPT2ARC-2802
 ASTP Open Points	ASTP Reliability requirements definition	 SPT2ARC-2815  SPT2ARC-2817  SPT2ARC-2600  SPT2ARC-2645  SPT2ARC-2873  SPT2ARC-2874

 ASTP Open Points	Accuracy acceleration target	 SPT2ARC-2856
 ASTP Open Points	Accuracy attitude target	 SPT2ARC-2857
TBD-To be added to ASTP Open Points	SP Shared Security Services impact on ASTP	 SPT2ARC-2868
TBD-To be added to ASTP Open Points	Management of Data output in degraded modes	 SPT2ARC-2807
TBD-To be added to ASTP Open Points	Maintenance requirements and maintainability	 SPT2ARC-2595  SPT2ARC-2596  SPT2ARC-2597  SPT2ARC-2808  SPT2ARC-2859  SPT2ARC-2861  SPT2ARC-2810  SPT2ARC-2612
TBD-To be added to ASTP Open Points	How to handle justifications of requirements- to be included in the FRS or in a separate document?	 SPT2ARC-2844
TBD-To be added to ASTP Open Points	Definition and scope of "additional" positioning data, such as heading and attitude.	 SPT2ARC-4950  SPT2ARC-2806  SPT2ARC-5003