Consultation comments and responses

Document Title: Guidance on the Use of On-Train Satellite Positioning Technology Based Locator for Railway Applications.

Document number: GEGN8578

Issue number: 3

Consultation closing date: 16 August 2022

1. Responders to consultation

No	Name	Company
1	Cristina Galvan	Network Rail
2	Darren Upfield	Hull Trains
3	Andrew Hunter	Thales Group
4		
5		

2. Summary of comments

Code	Description	Total
-	Consulted	248
CE	Critical errors	
ED	Editorial errors	
TY	Typographical errors	
OB	Observations	
-	Total comments returned	

Classification codes for a way forward:

- DC – Document change
- NC – No change

3. Collated consultation comments and responses

No	Page	Clause	Comment	Suggestion	By	Way forward	Page	Clause	Response
1	S2RaGeneral		The context of this guidance has changed, and scope should be expanded, as a minimum, to reflect the advances in Localisation listed in PP262_F1 4.1	Note X2RAIL5 WP5, WP6 and WP07 X2RAIL-5 (shift2rail.org) OCORA Publication/06_OCORA R2 at master · OCORA-Public/Publication · GitHub ERTMS Users Group – Localisation Working Group Localisation Working Group | Drupal (ertms.be)	1	DC			Agreed, the updated guidance will reflect the developments in the area.
2	6	G 1.1.1	"This document gives guidance on the use of satellite positioning technology for location dependent railway applications" This does not reflect current developments (OCORA/RCA/EUG/NR T190plus) that favour a multi-sensory approach to localisation, also including GNSS.	The title/content should include multi-sensory approach, not only satellite positioning. Revise guidance to include developments since Issue 3 was published and align to other parts of the document that do mention sensors other than GNSS (i.e.section 3, fig 4)	1	DC			The purpose of the document is to give guidance on the use of on-train satellite positioning technology-based locator for railway applications. The document introduces the concept of a 'locator'. Three classes of locator (A, B and C) are defined for general use within the railway. A Class C locator will generally consist only of a GNSS receiver, while as Class B and Class A locators are hybridised locators (integrating GNSS with one or more other sensors and systems). Figure 4 shows a generic locator architecture indicating other potential hybridisation and augmentation sources that could be considered. G 1.1 (purpose of the document) will be updated to align with the purpose of the next version the document. The impact of the current developments will be reviewed, and the updated guidance will reflect the outcomes.
3	6	G 1.1.3	The current guidance does not include IM Trackside as an interested party, which would be relevant in ETCS Level 3 scenarios.	Update content	1	NC			Clause G.1.1.3(a) stated that it includes Infrastructure Managers, implying that it includes Infrastructure Manager Trackside.
4	7	G 2.1	Scope must be updated to reflect the latest OCORA development in train architecture, for which localisation is not only based on satellite positioning, particularly relevant for safety-critical applications (i.e. ERTMS L3).	Perhaps scope can be expanded to distinguish between safety-critical and non-safety critical use cases. OCORA has published R2 of their set of documents: Publication/06_OCORA R2 at master · OCORA-Public/Publication · GitHub Ideally, a naming should also follow the same convention. Currently OCORA refers to the vehicle locator as LOC-OB, with a number of interfaces to other on-board elements.	1	DC			The guidance is applicable to Global Navigation Satellite Systems (GNSS) based positioning technology and the scope is the on-train arrangements that include the locator and its external interfaces. There are diverse range of location dependent applications as introduced in G 2.5 of GEGN8578, these include safety related applications. The applications have been classified into five groups, one of which is relating to signalling and control. The document introduces the concept of a 'locator'. Three classes of locator (A, B and C) are defined for general use within the railway. A Class A locator is distinguished by its ability to provide a definable level of integrity (up to SIL2). A Class A+ is defined to support applications with an integrity performance up to SIL4. The latest development of Open CCS On-board Reference Architecture (OCORA) initiative will be reviewed and reflected in the updated GEGN8578.

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5	7	Figure 1	This proposed architecture only takes into consideration satellite signals.	Modular architecture is favoured in European research projects, including augmentation, IMUs, radar, and other sensors on the train. Guidance must include other interfaces. Publication/OCORA-TWS01-030-System-Architecture.pdf at master · OCORA-Public/Publication · GitHub LocalisationConceptArchitecture_1.pdf (ertms.be)	1	DC			Figure 1 is intended to illustrate locator interfaces to applications both on board and at trackside, and to clarify the boundary between the guidance note and other documents. The generic architecture of the locator is provided in Figure 4. Figure 1 will be updated to be clearer.
6	8	G 2.2 (general)	Whilst G 2.2.2 acknowledge the safety related applications, the rest of the section does not describe any. There has been extensive work done in this area that should be reflected in the guidance.	Bring guidance up to date with localisation research projects and separate use cases.	1	DC			The document introduces the concept of a 'locator'. Three classes of locator (A, B and C) are defined for general use within the railway. A Class A locator is distinguished by its ability to provide a definable level of integrity (up to SIL2). A Class A+ is defined to support applications with an integrity performance up to SIL4. It is acknowledged that extensive work has been carried out regarding safety related applications since the publication of GEGN8578 issue three in 2015. The updated guidance will reflect these developments.
7	8	G 2.2.5	"An alternative single locator approach is promoted by this document, especially to support applications requiring high quality GNSS positioning information that is not achievable by low cost equipment." This statement is misleading and only looks at the GNSS solution. European work promotes a single locator based on a modular multi-sensory system, which GNSS seen as a game changer.	Guidance document should be expanded to add other sensor that can aid GNSS solutions. This would help with the statement in G 2.2.2. that states "what works for one operator may not work for another operator due to the topography of the route and the layout of stations and surroundings."	1	NC			The single locator approach promoted by GEGN8578 includes all class of locators, which apart from Class C locator, look at hybridised solutions with multiple sources of sensor inputs.
8	8	G 2.2.6	I agree with b) but with the perspective of a multi-sensory approach (not only GNSS).	Clarify as above.	1	NC			Mult-sensory approach is included for Class B and Class A locators in the existing guidance.
9	9	G 2.3.1 Part 3	Part 3 should include use cases, to derive performance requirements	Different use cases have different performance / functional requirements.	1	NC			Part 3 introduces the concept of a locator and sets out three classes of locators each defined by a level of performance (service coverage, accuracy and integrity). The definition of the locator classes is to encourage users to identify locator requirements according to the class appropriate for their applications. Appendix A provides selected applications to illustrate the use of a GNSS based locator to achieve a given performance. Part 5 of GEGN8578 gives guidance on defining requirement for applications. Use cases and related requirements are included in the deliverables of RSSB research T892. Further research is being planned to improve the understanding of current implementations.

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10	9	G 2.4.5	“Infrastructure managers can use Part 3 of this document, to assist their assessment on how an on-train locator contributes to the overall solution, and G 4.3 on what data could be made available from the locator.”	For CCS, RCA architecture describes the interaction between train and track RCA_Baseline_set 0 Release 4.zip (basecamp.com)	1	NC			Noted. The existing scope of the GEGN8578 is on-board locator and interfaces only.
11	10	G 2.5.2	T892 was published in 2011. Technology has evolved rapidly in this area, in particular IMUs.	T892 study needs updating. Since this guidance is largely based on this study, GEGN8578 will also need updating.	1	DC			Yes, agreed. A new research project is being proposed to inform the update of GEGN8578.
12	10	2.5.3	“An on-train locator can be used as the sole train position solution for multiple on-train applications”	Agreed, but only on a multi-sensory approach (not just GNSS)	1	NC			The document introduces the concept of a ‘locator’. Three classes of locator (A, B and C) are defined for general use within the railway. A Class C locator will generally consist only of a GNSS receiver, while as Class B and Class A locators are hybridised locators (integrating GNSS with one or more other sensors and systems). Figure 4 shows a generic locator architecture indicating other potential hybridisation and augmentation sources that could be considered.
13	13	G 2.6.1	“RSSB research report T671. Communication and positioning system in the GB rail industry.”	Unable to find RSSB research report T671 in SPARKS.	1	NC			Noted. T671 is available in SPARKS after reported to SPARK admin an error to the link for T671.
14	14	G 3.2.2	This clause indicates the need to improve the GNSS signal. Augmentation is one way, but there are others available that should not be dismissed.	Developments in the latest OCORA and EUG LWG should be used to update this guidance (see links above).	1	DC			This paragraph describes a basic Locator, which is a Class C locator that could be supported by augmentation. G 3.2.4 provides guidance on the limitation of the augmentation technique. G 3.2.5 refers to the generic locator architecture with hybridisation and augmentation sources that could be considered. Latest development will be reviewed and considered when updating the guidance.
15	15	Figure 3	Figure should be updated to reflect a multi-sensor modular approach.	Figure should be updated to reflect a multi-sensor modular approach.	1	NC			Figure 3 is for the basic Class C Locator. Mult-sensor approach is depictured in Figure 4.
16	16	G 3.3,	This section is confusing as it implies the locator is only formed by the GNSS. All the elements of the locator, including other location sources (Fig 4) have an impact on the overall QoS offered by the locator.	Revise content	1	DC			G 3.3 gives the general quality of service of a locator in terms of service coverage, accuracy, and integrity. This applies to any classes of locator that is used. This will be made clearer in the updated version.
17	16	G 3.3.3	“The parameters are interrelated (for example, specifying a high accuracy has a negative impact on integrity, and a low accuracy can make integrity more readily achievable)”	Partly agree. The real impact is on cost. Indeed, some applications (use cases) will require a high degree of all three elements (accuracy, integrity and coverage) that will need to be met in order to support such application. These are derived from the requirements (functional and non-functional) for a particular use case.	1	NC			Agreed that cost is a factor and that some applications will require all three.

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18	17	G 3.4.1	General	The approach is GNSS centric. I think the locator approach should be more generic; identify the requirements first and then see how they can be met, not just assessing the GNSS coverage in an area. For example, there will always be tunnels, cuttings and busy urban environments with very limited or no coverage. However, the locator should still be able to provide the desired accuracy	1	DC			The scope of the GEGN8578 is on-board GNSS based locator and its interfaces. This section is about defining the quality of service parameters. Agreed the need to identify the requirements first. The existing scope of GEGN8578 is about on-train GNSS based Locator and interfaces. Part 5 has provided guidance in 5.1 on defining requirement prior to 5.2 which is about choice of locator. The updated version will make this clearer. G 3.4.1.1 explains that lack of coverage is the main factor in determining whether hybridization is required.
19	18	G 3.4.3	General	There must be a wholistic approach to the integrity requirements. EGNOS have evolved since this document was published and ESA are actively interacting with railways to provide safe localisation services to railways. Space4Rail | Space4Rail (esa.int)	1	DC			Guidance in this section will be updated to reflect with current development in EGNOS and other works.
20	18	G 3.4.4	OCORA has published a list of high-level requirements for Localisation On-Board (LOC-OB) that would be useful for a future update of the document.	Publication/OCORA-TWS01-101_Localisation-On-Board-(LOC-OB)-Requirements.pdf at master · OCORA-Public/Publication · GitHub	1	DC			Agreed. OCORA publications will be reviewed in more detail when updating GENG8578.
21	19	G 3.4.5.1	A lack of service coverage has an immediate effect upon accuracy and integrity, so it may be necessary for the locator to estimate when the accuracy has fallen below a specified threshold	In some cases, the suspension of the application and function concerned is not possible due to the operational impact. Whilst the suspension of 'nice to have' functions would cope with no service this may not be acceptable for safety-critical applications. To avoid this, it is desirable to design a Locator that can cope with the requirements established for the required service.	1	DC			Noted. Part 3 introduce the concept of a locator and sets out three classes of locators each defined by a level of performance (service coverage, accuracy and integrity). The definition of the locator classes is to encourage users to identify locator requirements according to the class appropriate for their applications. More guidance will be provided for class A/A+ Locators considering the developments in this area.
22	20	G 3.5.2	Table 6	It would be interesting to see what use cases are satisfied by these service class definitions. My view is that the different use cases would define what level of GNSS service is needed. For safety critical application, track discrimination is key, hence accuracy must be defined in both longitudinal and lateral against tracks. LOC-OB System Definition & Operational Context (ertms.be) provides the proposed system functions for ETCS Localisation	1	DC			Agreed that the different use cases would define what level of GNSS service is needed. The rationale for defining a small number of classes is to encourage both the users to identify locator requirements according to the applications and to the supply market to focus on providing locator products appropriate for the railway environment that align with these classes. Class A+ is defined to support applications with an integrity performance up to SIL4. The update guidance will consider the recent developments for safety critical application.
23	20	G 3.6	General	The design options are based around what is offered by the GNSS (with or without hybridisation). Developments have taken place in this area (and tested i.e. virtual balise concept in X2R2 T2.4) that would need to be considered in future updates of this guidance note.	1	DC			Section 3.6 of GEGN8578 provides guidance on design options for each class of locator. A Class C locator will generally consist only of a GNSS receiver which may be designed to take advantage of augmentation data. The improved level of performance (service coverage, accuracy and integrity) for Class B, Class A and Class A+ locators are typically achieved achieved by hybridisation – integrating GNSS with one or more other complementary sensors and systems. Agreed that related developments would be considered in future updates.

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24	22	G 3.6.2.2	Digital map	Note that a digital map is seen as a must for accurate localisation (in safety critical applications). There is an RCA Cluster working on the requirements for a Digital Map (DM). T190plus includes DM as a dependency, to allow the localisation against an absolute reference. CLUG requires a map to provide the information for their localisation algorithm CLUG Projects: Required Digital Map for Localisation | The Clug Project	1	DC			Agreed. Outcomes of Target 190plus and other developments in this area will be reviewed and relevant guidance updated. The research being proposed will consider the current and potential implementations of GNSS based on-train locator that support related industry strategies including Target 190plus localisation work stream.
25	24	G 3.6.3.7	"Class A+ is defined to support applications with an integrity performance up to SIL4…The viability of these techniques as yet remains unproven"	As above, there have been many developments since this GN was published, and they have proved the viability of techniques to support safety critical applications and are in the process of being certified. This statement is no longer applicable.	1	DC			The research being proposed will consider the current and potential implementations of GNSS based on-train locator that supports related industry strategies including Target 190plus localisation work stream. This will include the recent developments, noting the techniques to support safety critical applications are in the process of being certified.
26	24	G 3.6.3.8	"It is expected that GALILEO, the European GNSS, when fully operational, may be able to influence the practical implementation of safety-related railway applications"	Yes. However, as per the note, the UK is no longer allowed to utilise GALILEO for critical infrastructure.	1	DC			Agreed The research being proposed will consider the impact of the development of Galileo and other constellations and that the UK is no longer participate in Galileo and EGNOS. The related guidance will be informed by the outcome of the research.
27	25	PART 4	Locator external interfaces	OCORA and EUG LWG have produced a set of system functions and interfaces for the Onboard Localisation unit within the CCS architecture. Publication/EUG-22E126_LOC-OB-System Definition-and-Operational-Context_v1.0.pdf at master · OCORA-Public/Publication · GitHub Wouldn't physical architecture be vendor specific? Section would need to be aligned to current developments.	1	DC			The purpose of this part is to provide guidance on interfaces for the on-train locator. It aims to be as generic as possible to allow a multitude of applications to be supported and a variety of locator units to be used within a common framework. The update guidance will consider the recent developments for safety critical applications.
28	26	G 4.3	Locator position data output	Message formatting proposal will need updating to align to latest developments/proposals, and to avoid any bespoke solutions that would make the locator not interoperable. ESA are actively working with railways to integrate satellite navigation into future railway signalling systems.	1	DC			This section recommended the adoption of the National Marine Electronics Association (NMEA) standard. NMEA is a widely used standard for reporting outputs from GNSS receivers and other navigation equipment and is supported by all major manufacturers. The update guidance will consider the recent developments for safety critical applications.
29	29	G 4.4	Antennas	This section would also need aligning to latest developments (prob following FRMCS available documentation and latest GNSS requirements) Note that the Locator equipment may or may not be physically located in the cab. This would have an impact on the physical connection to the antenna/s.	1	DC			This section provides guidance on antenna(s) interface, including antenna configuration and selection. It also provides a summary of message types for augmentation and hybridisation data that may need to be supported by the antenna interface. The updated guidance in this section will consider and align with latest developments.

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30	33	G 4.6.5	Location database update	One of the interfaces in OCORA is with the Digital Map repository. Whilst full requirements are not defined yet for DM, FRMCS would be able to provide the comms for the DM sections needed as the train moved. Current expectation (requirements yet to be formally published) is that sections of the path that the train follow will be required, and the train would request the next sections as it travels on the given pathway.	1	DC			This section is about the updates of the location database over external interfaces to the Locator. There was no consistently used standard protocol and format for transferring location data update at the date of publication of GEGN8578 issue three. The requirements for OCORA will be reviewed and guidance relating to the capability of FRMCS to be provided.
31	36	G 5.1	Defining requirements	This should be done per use case. Work has been done by the EUG LWG to address needs of the railway https://ertms.be/sites/default/files/2021-07/LocalisationConceptArchitecture_1.pdf To be looked at in conjunction with LOC-OB System Definition & Operational Context (ertms.be)	1	DC			This section provides guidance on attributes to be considered for applications that require locator technology. The work carried out by ERMTS User Group (EUG) Localisation Working Group (LWG) and OCOCA will be reviewed.
32	38	G 5.2	Choice of locator	I think the choice of locator should be based on the needs of the application, and not be limited to GNSS. This section implies that the locater to choose from is only based on the QoS parameters in G 3.4, but a more wholistic approach should be taken (aligned with the developments in this area).	1	DC			Part 3 of GEGN8578 introduces the concept of a locator and sets out three classes of locators each defined by a level of performance (service coverage, accuracy and integrity). The definition of the locator classes is to encourage users to identify locator requirements according to the class appropriate for their applications. Three classes of locator (A, B and C) are defined for general use within the railway. A Class C locator will generally consist only of a GNSS receiver, while as Class B and Class A locators are hybridised locators (integrating GNSS with one or more other sensors and systems). The existing guidance in this section states that the choice of the locator (for a specific application) depends on its ability to satisfy the requirements of the intended applications in terms of the quality-of-service parameters set out in G 3.4, namely, service coverage, accuracy and integrity. This does not preclude the use of sources other than GNSS.
33	39	G 5.3	Procurement of GNSS equipment	This section would need to be updated to reflect the evolution in GNSS technology/services as well as GSM-R/FRMCS, IMUs, etc developments since this GN was produced.	1	DC			Agreed. The existing guidance will be updated so that it reflects the technology development since the publication of the Guidance.
34	General		The document does not seem to reflect the current RCA and OCORA developments for train localisation for Safety-critical applications. The On-board or Vehicle Locator is proposed to have several components/sensors. Satellite positioning is only one of them that will be combined with others (i.e. IMUs, radar, etc.)	The document should make clear that the locator is only the satellite part and should refer to both OCORA and RCA architectures (both under development but architecture releases in the public domain). The document should also emphasize the need of a multi-sensory approach to the localisation solution.	1	DC			Section 3.2 g of the review paper referenced research projects in the area of safety critical applications. Section 3.3 I referred to OCORA developments and the concept of “vehicle locator” from EUG. The paper had made clear that the main difference is the specific emphasis on the GNSS based locator solutions in GEGN8578 however Class B and Class A Locators supports and promotes hybridised solutions. The update of GEGN8578 will include reviewing the outcome of the RCA and OCORA development and include further guidance on Class A/A+ Locators.

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35	General		CLUG project has now been completed and documentation is publicly available.	Update guidance with findings in CLUG Résultats et Livrables | The Clug Project	1	DC			Agreed and noted. The impact of the findings will be reviewed when updating the guidance.
36	General		Target 190plus Localisation Strategy has been approved internally. Copies can be requested from the project.	A copy of the GB Localisation Strategy can be requested from NR.	1	DC			A copy of the strategy has been obtained. The five-year review paper reference has been updated to the later version.
37	General		OCORA	OCORA has published R2 of their set of documents: Publication/06_OCORA R2 at master · OCORA-Public/Publication · GitHub	1	DC			Noted. The impact of the findings will be reviewed when updating the guidance.
38	4 5	Iv 4.1.8	I disagree that the concept of the locator in this document reflects the OCORA/EUG LWG view. OCORA/EUG both agree on a modular multisensory approach, whilst this document only includes satellite, implying that solution is sufficient.	Use readily available OCORA / EUG LWG documentation to update the document. Note that use cases will define the requirements for each localisation application.	1	DC			Part 3 of GEGN8578 introduces the concept of a locator and sets out three classes of locators each defined by a level of performance (service coverage, accuracy and integrity). Three classes of locator (A, B and C) are defined for general use within the railway. A Class C locator will generally consist only of a GNSS receiver, while as Class B and Class A locators are hybridised locators (integrating GNSS with one or more other sensors and systems). This aligns with the modular multi-sensory approach by OCORA and EUG LWG. The existing and future documentation of OCORA and EUG LWG will be reviewed and impact assessed when conducting the proposed research and updating GEGN8578.
39	General		Augmentation CR1368 document was updated May 2022	This document needs to be taken into considerations for the update of the guidance note.	1	DC			Noted It has been assumed that the document referenced in the comment is entitled “GNSS Augmentation for ERTMS/ETCS , Interface Control Document for GA-OB / GA-TS (Airgap), EUG Solution for Enhanced Onboard Localisation Change Request (CR1368) – GNSS Augmentation for ERTMS/ETCS”. The scope of the document is ‘to define interoperability-relevant messages, packets and variables exchanged over the airgap for GNSS augmentation, enabling the use of GNSS within enhanced onboard localisation equipment in ETCS/ERTMS.’ This document will be referenced when updating GEGN8578 as part of the guidance for Class A/A+ locator. However, it should be noted that the existing scope of the GEGN8578 is the locator and interfaces on-board train.
40	5	5.1	Recommendations Section	We agree that the update of GEGN8578 should be deferred pending a research project to inform its update. This is because there have been developments in this area since the last review, as detailed below.	2	NC			Noted.
41	NA	NA	Current use of locator technology	There are examples of modern rolling stock using centralised locators and then disseminating this information to other systems via on train data buses. However the interface to subsystems is often richer than simple GPS co-ordinates. For example a passenger counting system may need access to location data as well as door release data.	2	NC			Noted. It is encouraging to know there are examples of using centralised locator. Agree that specific subsystems will need access to data other than position data.

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42	10	G 2.5.5	The function table is missing some items.	Add the following functions: ASDO Passenger counting TCMS log environment data.	2	DC			Table 1 to Table 5 in section G 2.5 of GEGN8578 set out the location dependent applications identified by RSSB research T892. These applications are at various stages of development, ranging between those fully operational and those which are not yet in any formal plans. A list of signalling and control applications is set out in Table 1 in G 2.5.5. Table 2 in G 2.5.6 lists operation related applications, which includes Door Operations and Passenger Count. The proposed research project will refresh the catalogue of applications to inform the update of GEGN8578. The suggested items will be considered.
43			Research proposal brief: GPS enhancements	During 2023 GPS is due to be enhanced with 2 frequencies transmitted from each satellite. This will provide enhancements, however it is not known which existing receivers can use the improved functionality, and if there would be a benefit in upgrading these. The research proposal should consider this.	2				Guidance on procurement of GNSS equipment are set out in G5.3 of GEGN8578. The research proposal will include impact of recent technology advances to inform the update of the relevant guidance.
44			Research proposal brief : eLORAN	A commercial organisation is about to start implementing an eLORAN solution which would give many advantages for rail operation including being able to work undercover, and possibly underground. Such a system would provide resilience against possible future issues with satellite communications systems. Should this be considered as a robust addition to provide resilience in the event of GPS disruption?	2	DC			eLORAN was identified as being a potential interest for rail applications in the existing GEGN8578, as a typical hybridisation source for Class B Locator. The relevant guidance will be reviewed and updated with current implementations in the UK.
45			Research proposal brief: RBLS/OTTO	Network Rails development of RBLS / OTTO should be considered as a potential centralised locator. This system will also be able to define which running line the train is on. Can a data standard be formulated to allow export of location data from the system to allow multiple on and off train systems to benefit.	2	DC			The proposed research and future updates of the guidance will seek inputs from industry work streams including OTTO. The five-year review paper has been updated to include reference to OTTO. The scope of GEGN8578 is on-train GNSS based Locator and interfaces. A request for help could be submitted for a new data standard that allows exporting of location data from the system to benefit multiple on and off train systems.
46			Research project brief: Impact on operations of loss or degradation of satellite positioning	Resilience and redundancy in the event of the loss or downgrading of GPS should be considered. This may result in unacceptable loss of some functions.	2	DC			Agreed, the impact of vulnerability is the one of the areas to look at for the proposed research. The outcome will inform the updating of the guidance in this area.
47			Research project brief: Receiver position on the train	The location of the GPS receiver on the train is an important point, especially if multiple (redundant) receivers are used. The separation of the receivers could be ~240m apart. The guidance should state this needs to be considered in the design, especially if regular switching occurs between receivers (e.g. front of train receiver blocked by over bridge, rear receiver clear).	2	DC			GEG8578 promotes the idea of one locator accommodating the requirements for as many applications as it is reasonably possible. The existing guidance includes guidance on the position of the locator. The proposed used of multiple receivers is interesting and will be proposed to be reviewed as part of the research.

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48			Research Brief: GPS engine options	GPS receiver engines often contain options. Each of these options needs to be assessed for application in the rail environment and set appropriately. One example of an option seen previously is where upon loss of signal, the receiver assumes movement will continue along the same trajectory for a set time period or until a new fix is obtained. This can lead to incorrect location information being shared (eg. train thinks it is at sea). Future standard update should contain guidance on reviewing options.	2	DC			Assume 'GPS engine options' mentioned relates to the options for configuring the receiver. Section G 5.3.2 of GEGN8578 issue three provides some guidance regarding two broad categories of professional and consumer grade receiver and that professional grade receiver is considerably less suited to railway application. The proposed research will assess the current configuration options and provide further guidance.
49			Research Brief: Language for defining position on the railway.	Work is ongoing within Network Rail is the digital mapping space. The research brief should consider what the standard language should be in defining a position on the railway, especially if the locator is able to define the running line.	2	DC			Agreed. Having standardised language in defining a position on the railway is vital for operational performance as well as well aid security. Part 4 of GEGN8578 provides guidance on interfaces for the on-train locator. It aims to allow a multitude of applications to be supported within a common framework. It is recognized (RSSB Research T1253) that there is a wide range of disparate data across the rail sector. The ongoing Network Rail digital mapping work has the potential to be used by all. T1253 also recommend the implementation of data standards so that future location data is recorded correctly. A separate research idea could be needed to support this as the current scope of GEGN8578 is for GNSS based locator only.
50			With reference to the 5-year review of GEGN8578 Issue 3 / 3.2 g (Research projects) – in addition to the NR Target 190+ programme and related localisation workstream it may be useful to consider any impact or specific guidance coming from the NR Optimised Train Track Operation (OTTO) programme as entailing an on-board unit making use of satellite positioning (together with other technologies) for supervisory functions.		3	DC			The proposed research and future updates of the guidance will seek inputs from industry work streams including OTTO. The five-year review paper has been updated to include reference to OTTO.