MEETING: Control Command and Signalling

DATE: 17 November 2022

SUBJECT: Ten-year review of GKGN0602 Issue 1 - Guidance on Train Rooftop Antenna Positioning

SPONSOR: Ged Neacy

AUTHOR: Jianhong Jin

---

1. Purpose of the paper

1.1 This paper sets out the assessment of the 10-year review of GKGN0602 Issue 1 - Guidance on Train Rooftop Antenna Positioning. It seeks Standards Committee approval/support on the recommendation and way forward.

2. Background

2.1 The purpose of this guidance note on train rooftop antenna positioning is intended to assist infrastructure managers, railway undertakings and other organisations required to fit antennas on train rooftops in relation to good practice for train rooftop antenna positioning.

2.2 The scope of the guidance note is the onboard arrangements for implementation and installation of rooftop radio antennas that support legacy, emerging digital radio communication systems and Global Navigation Satellite Systems (GNSS) on the GB railway.

2.3 It includes guidance on the selection of antennas, their mounting locations and arrangements, as well as information concerning the associated radio frequency components. It sets out good practice on the specification, implementation and installation of radio antennas on top of the roofs of trains.

2.4 The good practice guidance applies to passenger trains, locomotives and on-track machines.

2.5 GKGN0602 issue one is largely based on the output of RSSB research report T739 (2009) 'Train Rooftop Antenna Positioning – Issues Study'.

2.6 Initial feedback has been sought from and discussed with both Future Communication & Positioning System Advisory Group (FC&PS AG) and FRMCS & GSM-R Guidance Sub-Group (FGG). The feedback was that the document was useful and should be retained. The following are the key comments:

i) The guidance needs to be updated to algin with current technologies and implementations. For example, Cab Secure Radio (CSR) and National Radio Network (NRN) are no longer in use. The references to these complicating the document unnecessarily. The guidance (in 2.4.3) needs updating to include 4G and 5G.

ii) It is proposed to replace CSR and NRN terms with 'obsolete heritage communication systems' and provide guidance that if the aerials are still present these could be removed, and the space reused.

iii) Include details on Future Railway Mobile Communication Systems (FRMCS) and its implication for antenna system architecture.

iv) The physical separation of 0.5 m between Global System for Mobile communications – Railways (GSM-R) voice and Global Positioning System (GPS)

antennas, as given in Table 2 (2.4.1 of GKGN0602), is not necessary, because of the improved internal filtering of GPS technology.

v) It is proposed to include additional guidance on the limit of antenna separations in 2.6 of GKGN0602 to reflect the improved performance against interference since the publication of GKGN0602 issue one in 2010. The existing guidance is for use when siting systems from different vendors where dedicated interference testing between those systems has not been performed. It is proposed to clarify that reduced antenna separation is acceptable where interference testing between two individual antennas has been carried out and it has been shown that reduced separation can be tolerated.

vi) It is proposed to include additional guidance in 2.4.3.3 on using interference testing to demonstrate that the interferences from Group C antenna systems can be tolerated rather than specifying the use of frequency multiplexer for multi-band antenna systems. GEGN0602 issue one pre-dates the latest GSM-R transceivers which meet ETSI TS 102 933-1 and these versions of transceivers are more resilient to interference from group C devices.

vii) It is proposed to clarify that the separations between antennas can be less than 1 m as set out in Table 4 (2.4.4), where interference tests show that reduced separation can be tolerated. This will allow the use of multiband antennas which reduce the number of antennas needed on rooftop of the train.

viii) There are other techniques which can be used to address the issue of contact line strike and the guidance should not preclude these. It is proposed to revise the second paragraph of 4.7.2 to address other design protection that could be used.

ix) It is proposed to add guidance on avoiding using antennas which are shaped like a "shark's fin" which have a concave rear edge because when they are travelling in the reverse direction they can act as hooks and snag branches and other debris.

x) It is proposed to add a note to Table B.1 to reflect that poor Voltage Standing Wave Ratio (VSWR) of an antenna will need to be tolerated, to accommodate the use of antennas that have the capability of operating over many wide bandwidths.

xi) The term GPS is outdated and will be replaced by Global Navigation Satellite System (GNSS).

3. Impacts of the document(s) following publication/entering into force

3.1 Consideration has been given to the following during the assessment:

a Business case for change – The document was developed before the RSSB business case for change process was established however the main objective of helping the industry to apply good practice on the rooftop antenna positioning has been achieved.

b Deviations - Not applicable.

c Current projects or proposals being processed – There are currently no projects or proposals that impact on GEGN0602.

d Limited change release – There have been no limited change releases.

e Amendments and clarifications – There have been no amendments and clarifications.

f Enquiries – There have been no enquires since the last review.

g Research projects – The following sets out current research being undertaken. The findings from these will be assessed in the next review because the impact on the antennas is dependent on the consensus on the design and implementation of the future railway communication systems.

i) A Shift2Rail project X2Rail-3 entitled 'Advanced Signalling, Automation and Communication System (IP2 and IP5) – Prototyping the future by means of capacity increase, autonomy and flexible communication', aims to 'continue the research and development of key technologies to foster innovations in the field of railway signalling, telecommunication, testing methodologies and Cyber Security, as part of a longer term Shift2Rail IP2 strategy towards a flexible, real-time, intelligent traffic control management and decision support system.' X2Rail-3 D3.4 (2020) provides specifications for both onboard and ground-based antenna systems for supporting adaptable communication and to provide guidelines for the choice of antenna technologies for platform integration. The specifications also include considerations for Future Railway Mobile Communication Systems (FRMCS). The adaptable communication system (ACS) architecture requires bearer (radio access technology) independence and parallel use of bearers. The selection of the bearers depends on the railway scenario such as mainline/high-speed, urban/metro or regional/freight. Antenna specifications for both onboard and trackside antennas are presented for each of the railway scenarios. Innovative methodology for finding good antenna position onboard the train in a tunnel environment is discussed. The impact of ACS to GEGN0602 is limited at this stage and will be re-assessed in future.

ii) The International Union of Railways (UIC) led the first FRMCS trial project '5Grail', to validate the first set of FRMCS specification (FRMCS V1.0). The project is expected to be completed next year, to enable the planned time to market for FRMCS product in 2025. A parallel operation of GSM-R and FRMCS is planned until 2035. The FRMCS onboard system architecture migration scenarios are described in TOBA-7540 (2020) published by UIC Telecom Onboard Architecture (TOBA) workgroup. The report indicated that further study on solution(s) for antenna sub-system that supports FRMCS Onboard System is to be carried out by TOBA workgroup. ETSI TR 103 459 (2020) provides a high-level description of the FRMCS architecture, as agreed among UIC and ETSI. The document identifies the dependency of the FRMCS system on progress in 3rd generation partnership project (3GPP) and other bodies, and that further study such as the interworking between GSM-R and FRMCS, and cyber security principles that go beyond the scope of 3GPP. The developments in FRMCS will be monitored and impact to GKGN0602 will be assessed with possible phased updates.

iii) The European Conference of Postal and Telecommunications Administrations (CEPT) has mandated two frequencies (900 MHz and 1900 MHz) for critical communications requiring interoperability. In the UK the 900MHz spectrum has been secured but 1900 MHz remains an issue. The impact on antennas would be dependent on future use cases and spectrum availability in GB that are yet to be agreed. This will lead to different spectrum requirements which have impact on the amount of frequency bands to be supported.

iv) ERA 2017 31 OP (2018) is a report on the study of the evolution of onboard communication system conducted by SYSTRA on behalf of European Union Agency for Railways (ERA). The study intended to provide inputs to ERA on options of future onboard communication system architecture concepts that provide sufficient flexibility to support current and future user needs. The study addresses both system architecture and hardware architecture, with a focus on the applications included in CCS TSI. The report recognizes the special challenges posed

upon onboard antenna systems in terms of space on the roof of the train is limited, making it challenging to simultaneously satisfy all requirements. During the migration period, the onboard equipment would need to support both FRMCS bands and the GSM-R band, which makes it even more challenging especially when it comes to the retrofitting of existing trains with limited space.

v) UNIFE position paper (2021) identify the need to understand the constraints and implications on the onboard system and rooftop antenna will be key to properly addressing the strategic planning of the migration to FRMCS. It is anticipated that the FRMCS system will enable the support of a hybrid model making use of Public MNO resources for non-critical and non-interoperable services as a complementary solution.

h Changes in regulations – There are no changes in regulations that have direct impact to this document.

i Changes in technology - The guidance needs to be updated to algin with current technologies and implementations (see 2.6 above).

j National Technical Specification Notices (NTSNs) and European standards – Future updates to CCS NTSN will need to be assessed for this document, as it is expected that FRMCS version 1.0 is to be included in the next version of CCS TSI.

k Published list of NTRs – There is no impact on current published NTRs.

l Any other observations –

i) RIS-0700-CCS is a standard on internet access on trains for customer and operational railway purpose. Data connection on and off train is delivered through a Mobile Communications Gateway (MCG) connecting to the internet via wideband external mounted on-train antennas. For longer trains two or more MCGs may be considered to improve availability and support load balancing. The rooftop antennas for the MCG are classed as Group C antennas in GKGN0602. Location and spacing of rooftop antennas for Groups C is required by 2.72 of RIS-0700-CCS to be determined so that they do not interfere with Group A and Group B antennas. The guidance on Group C antennae given in GKGN0602 need to be aligned with sections 2.7.1 and 2.7.2 of RIS-0700-CCS.

ii) Key Train Requirements (KTR (2022)) describes good practice for organisations to consider when specifying, contracting, procuring, design reviewing, testing, commissioning and introducing new trains. Clause 5.15 of KTR (2022) identifies the need for the provision of specific space to fit an FRMCS antenna to each driver's cab along with associated cable route space and equipment to reduce the risk of more expensive retrofitting activities. The updates to GKGN0602 will consider this relating to guidance on the introduction of FRMCS. Clause 5.13.4 of KTR (2022) refers to a dual GSM-R/GNSS antenna being the preferred standard.

4. Discussion

4.1 Review assessment

4.1.1 The initial feedback suggested that GKGN0602 is useful and should be updated as proposed in 2.6 of this paper.

4.1.2 The updated GKGN0602 needs to align with guidance on Group C in RIS-0700-CCS. Future updates to CCS NTSN need to be assessed for any impact on GKGN0602.

4.1.3 A parallel operation of GSM-R and FRMCS is planned until 2035. It will be challenging to support both FRMCS and GSM-R, especially when retrofitting existing trains with limited

spaces. There are dependencies of the FRMCS on progress in 3GPP, and further studies such as interworking between GSM-R and FRMCS. Solutions(s) for antenna sub-system that supports FRMCS are yet to be defined.

4.1.4 In the UK the 900 MHz spectrum has been secured but 1900 MHz remains an issue. The impact on antennas would be dependent on future use cases and spectrum availability in GB.

4.1.5 It is proposed to carry out an industry consultation to obtain further feedback on the use of the GKGN0602 and any updates.

4.1.6 It is proposed to initiate a change project to update the document. The updates relating to FRMCS are to be phased - pending on the strategic planning of the migration to FRMCS in GB, and any development of solutions for antenna sub-system to support FRMCS.

5. Recommendations

5.1 The CCS SC Standard Committee is asked to:

a DISCUSS the assessment and the following proposed recommendation:

i Action required:

Initiate a change project.

Carry out consultation with industry – identify additional stakeholders to consult

b APPROVE:

The recommendation including consultation with industry.

5.2 The ENE, PLT, RST and TOM Standard Committees are asked to:

a DISCUSS the assessment and the following proposed recommendation:

i Action required:

Initiate a change project.

Carry out consultation with industry – identify additional stakeholders to consult

b SUPPORT:

The recommendation including consultation with industry.

References

ERA 2017 31 OP (2018)	Study on the architecture of onboard radio communication equipment, SYSTRA
ETSI TR 103 459 (2020)	Rail Telecommunications (RT); Future Rail Mobile Communication System (FRMCS); Study on system architecture
ETSI TS 102 933-1	Railway Telecommunications (RT); GSM-R improved receiver parameters; Part 1: Requirements for radio reception
KTR (2022)	Key Train Requirements, v7 draft
X2Rail-3 D3.4 (2020)	Antenna system specifications for adaptable communications in railway environment.
T739 (2009)	'Train Rooftop Antenna Positioning – Issues Study'.
5Grail, 2020	5Grail, available from [online] Available from: https://5grail.eu/ [accessed 22 July 2022]
TOBA-7540 (2020)	Telecom Onboard System – Architecture Migration Scenarios
UNIFE position paper (2021)	Successful Transition to FRMCS

RSSB completion: [do not delete]

Lead Standards Committee	*Meeting date*	*Recommendation approved*	*Minute numbers*		*Next review date*
			Pre-consultation review	*Post-consultation review*	
Control Command and Signalling					

Appendix A Associated information to support the review

The information in this appendix is provided by the industry groups information manager to assist with the review. This appendix should be deleted prior to submitting the review form to the SCs.

Deviations	List current deviations: Nil	List deviations in progress: Nil
Request for Help	Nil.	
Proposals	List approved proposals: Nil	List proposals not yet approved by the standards committee: Nil
7. RSSB Standards Programme	This document is currently not on the RSP	
Amendments or clarifications	Nil	
Limited change releases	5-year review - Proposal for follow-on project approved.	
Enquiries	There are currently no enquiries recorded against this document in the CRM. Please confirm with all Technical Specialists.	
Business case for change	Nil	
Information from RMDB Note: update RMDB to reflect action/decision	This document is not listed in the RMDB CCS sub-system, therefore there is no file 'Considerations for revisions' relating to this guidance note. Please confirm with the TS/PM if there is anything to record. If not, this can be marked Nil.	

Related documents:
Process procedure for the 12 month and five-year review of Railway Group Standards and other documents