Version: 2
Date: 8 April 2025

EUROPEAN COMMISSION
Directorate-General for Communications Networks, Content and Technology
Digital Decade and Connectivity

Directorate-General for Mobility and Transport
Single European Sky

EU Roadmap

For Ensuring Safe Coexistence Between Mobile Networks and Aircraft Radio Altimeters Within the Frequency Range 3.4-4.4 GHz in the Union

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EU Roadmap

for ensuring safe coexistence
between mobile networks and aircraft radio altimeters
within the frequency range 3.4-4.4 GHz in the Union

1. Objective and scope

The main objective of this 'EU roadmap' is to define key activities and milestones towards ensuring the safe coexistence between mobile networks (notably 5G and 6G in the future), and aircraft radio altimeters (RA), setting out a coordinated approach within the frequency range 3.4-4.4 GHz in the Union for both systems. The use of this frequency range by terrestrial wireless broadband (mobile) electronic communications networks is distinguished between universal (including high-power) networks operating within 3.4-3.8 GHz (hereafter 'WBB') and low/medium power networks operating within 3.8-4.2 GHz (hereafter 'LMP WBB').

This 'EU roadmap' indicates the major technical, standardisation, regulatory, and deployment activities in the aviation and telecom/spectrum domains, their timelines, milestones and the key dependencies between them.

This 'EU roadmap' has been developed considering only civil aircraft in the environment of airports operating in the Union. It could be extended to address also State[1] aircraft if the relevant information becomes available (e.g. input from EDA).

The acronyms used across this document are explained in section 9.

2. Preparation and further development

The engagement from Member States, EEA countries, organisations and other stakeholders, and a reinforced cooperation between entities in aviation and telecom/spectrum domains are key elements for the fulfilment of the objectives of the 'EU roadmap'. Consequently, this 'EU roadmap' has been prepared by the services of the European Commission (DG MOVE and DG CNECT) considering technical inputs from the industrial workshop held on 5 October 2023, the respective outcomes of the CEPT and the ongoing work in the EUROCAE/RTCA groups. It has been subject to further updates considering the comments that have been received during and after a dedicated regulatory workshop of 26 October 2023. In addition, DG MOVE and DG CNECT sought the informal views of Member States and the EEA countries, in view of the possible adoption of future regulatory measures, respectively through the EASA Committee and the Radio Spectrum Committee (RSC). In November 2024, ECC published Report 362. The roadmap has been updated taking into account the conclusions from this report. Both Committees were invited in December 2024 and February 2025, to review progress in order to provide guidance on further developments. The 'EU roadmap' was subsequently adapted to consider, inter alia, the recent

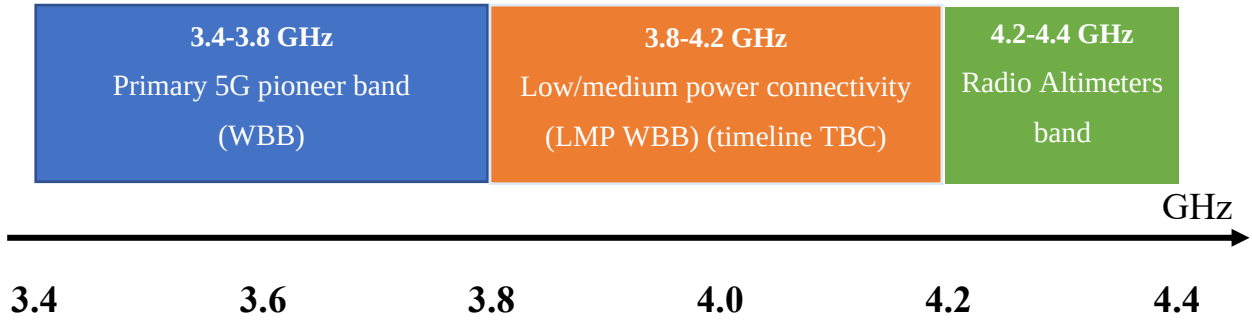
[1] Aircraft used in military, customs and police services qualify as State aircraft.

developments at CEPT level and subsequent updated actions in the aviation domain. Regular review will take place with respect to future developments and further inputs.

Changes in the activities of this EU Roadmap, with respect to the previous version are outlined in the Annex of this document.

3. The need for a coordinated approach and key assumptions

The picture below represents the use of spectrum (only in the context of this roadmap) within the frequency range 3.4-4.4 GHz, including the envisaged one in 3.8-4.2 GHz. RA specifications are under review currently to accommodate other usages in the adjacent bands below 4.2 GHz.



3.4-3.8 GHz band (primary 5G pioneer band) and 3.8-4.2 GHz band (LMP WBB)

5G networks are already deployed and operational in the Union using, inter alia, the primary 5G pioneer band 3.4-3.8 GHz, which has been harmonised through Commission Implementing Decision (EU) 2019/235 (amending Decision 2008/411/EC), based on CEPT Report 67. EASA so far has not identified conclusive evidence of an unsafe condition affecting the RA and caused by 5G networks already operating in Europe in this band. It is also highlighted that the CEPT has assessed in its ECC Report 362 the susceptibility of the RA to emissions from mobile networks operating in 3.4-3.8 GHz as well as in 3.8-4.2 GHz bands. The CEPT work stream on 3.4-3.8 GHz has not been subject to a European Commission mandate while the CEPT work stream on 3.8-4.2 GHz supported the work in response to the EC mandate on shared use by terrestrial (low-medium power / LMP) wireless broadband systems providing local-area network connectivity (see hereafter) in the Union. Therefore, as its scope is pertinent to ancillary activities identified in this roadmap, its final outcome will be considered accordingly. The outcome of this CEPT work and the EASA safety assessment may result, on one side, in the application of retrofit/forward fit of RA in at least some aircraft operating in the Union, and on the other side, in recommending measures such as temporary power limits around airports in the telecom domain (for the WBB base stations). CEPT and EASA should agree on such a coordinated approach and implement it in joint cooperation with EUROCAE/RTCA as appropriate.

The European Commission plans to adopt a new technical implementing measure to harmonise the shared use of the 3.8-4.2 GHz frequency band for terrestrial networks capable of providing low/medium power (LMP) wireless broadband (WBB) electronic communications services (ECS)

for local-area connectivity, including local vertical applications[2], while protecting receiving satellite earth stations and other existing systems and services within the same band (while also ensuring the further development of the latter) and in adjacent bands, such as RA.

In this regard, the European Commission, under the Radio Spectrum Decision, mandated the CEPT to develop harmonised technical conditions for the shared use of the band and the corresponding CEPT Report 88 was provided in Q4/2024. This outcome is based on technical studies, simulations, and field measurements around airports to which also aviation representatives have contributed.

The CEPT Report 88, which refers to the ECC Report 362, includes proposals on how to ensure safety for aircraft equipped with Usage Category 1 (UC1) RA[3] with regard to terrestrial LMP WBB systems providing local-area network connectivity in the 3.8-4.2 GHz band without introducing undue constraints on the deployment of the latter. It also addresses the safe coexistence of mobile networks and RA (also in their evolution) by providing a reference to the relevant ECC Report 362.

On the basis of the ECC Report 362, the CEPT is developing an ECC Recommendation to provide relevant mechanisms/solutions which could be further implemented at national level to manage coexistence between terrestrial (LMP) WBB systems in the 3.8-4.2 GHz band and UC1 RA in the 4.2-4.4 GHz frequency band.

Overall, the ECC Report 362 (referring to the CEPT Reports 67 and 88) provides evidence based on data and expert assessment on the need for any follow-up measures. This allows Member States and the European Commission (DG CNECT and DG MOVE/EASA together with the RSC and EASA Committee) to take informed decisions at regulatory level.

This ‘EU roadmap’ sets out a coordinated approach for the deployment of mobile networks in the 3.4-3.8 GHz band and terrestrial LMP WBB systems providing local-area network connectivity in the 3.8-4.2 GHz frequency band, and measures on the aviation side. Particular focus should be given to orderly transition that needs to be organised well in advance to ensure that the use of the 3.8-4.2 GHz frequency band by LMP WBB networks in Europe will not cause an unsafe condition in aviation and that it won’t introduce undue delays in the deployment of mobile networks. Considering lessons learnt from developments in the US, if no coordination takes place and any necessary limitations are not applied, EASA may have to issue an Airworthiness Directive addressing all the fleet, which will result in an unorderly, disruptive, and expensive retrofit of the entire fleet. In addition, the lack of coordinated approach may result in the application of

[2] Local vertical applications refer to specific use cases and applications of WBB technology (5G) that are tailored to meet the unique needs and requirements of particular industries, businesses, or sectors within a localized or specific geographical area.

[3] In the ECC Report 362 , “only usage category 1 (UC1) Radio Altimeters have been considered as that category is “used in a wider variety of safety-critical systems that enable safe operation of commercial airliners in all-weather conditions” (as stated in AVSI Report Vol. I)”.

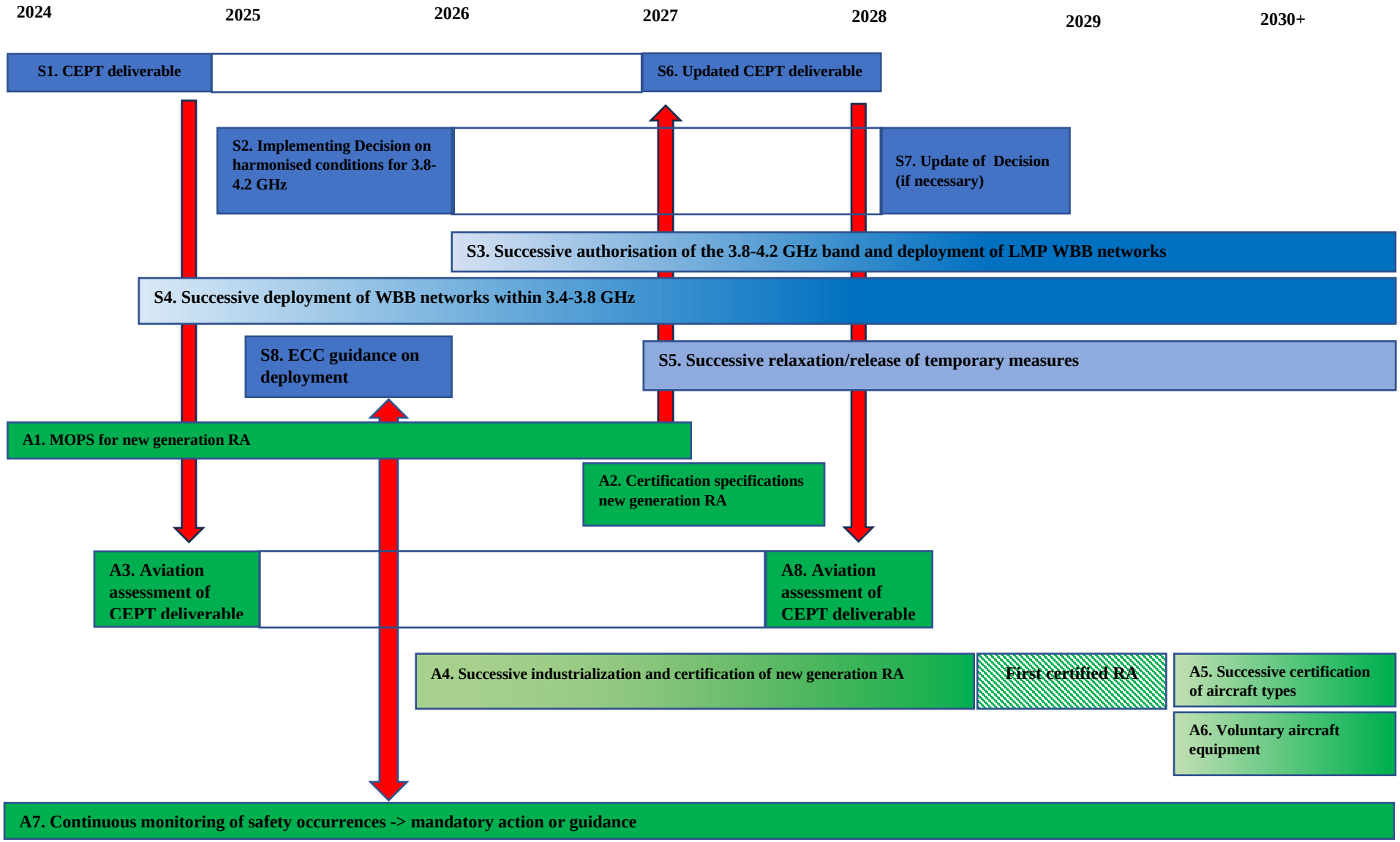
unforeseen restrictions that would be detrimental for the terrestrial (LMP) WBB systems' service provision and business development.

4. **European scope and global dimension**

While the applicability of the 'EU roadmap' is limited to the EU, it has to be developed and implemented considering also the global interoperability dimension of aviation, the mobile networks developments in other regions, and the lessons learnt from international developments in other regions (e.g. activities from FAA and FCC in the US, and the MLIT and MIC in Japan). Aircraft equipped with new generation RA should operate safely not only in the EU but in other regions where the power levels and the frequency bands used by mobile networks are different. Therefore, it is essential that the standards for new generation RA that are being developed by EUROCAE/RTCA consider the spectrum allocations identified and used for mobile networks at global level.

Considering the global dimension of aviation and telecom industries and also different regional initiatives for mobile usages below 4.2 GHz and potentially above 4.4 GHz, it would be desirable to promote further cooperation at regional and global levels between the aviation and mobile sectors.

5. Indicative ‘EU roadmap’ schedule (Gantt chart)



6. Key activities in the telecom/spectrum domain

ID	Activity	Responsible	Milestone and date	Dependencies/ /notes	Status
S1	CEPT deliverable to CNECT: a report in response to the European Commission mandate[4], as well as an update with regard to the EU-harmonised use of the 3.4-3.8 GHz frequency band for WBB. LMP WBB - Radio altimeters (RA) co-existence measures in the CEPT report on the harmonized technical conditions for the deployment of verticals in 3.8-4.2 GHz, in particular definition of technical compatibility criteria and parameters. Presentation of conclusions of CEPT studies on *"Compatibility between MFCN operating in 3400-3800 MHz and Radio Altimeters (RA) operating in 4200-4400 MHz"* to the RSC and the EASA Committee. The CEPT deliverables should indicate the magnitude of the problem in Europe, indicate if measures are required and propose those measures in aviation/telecom domains: temporary measures around airports to protect current RA (link with S4 and S5), and need to retrofit/forward fit part of or all the fleet (A3).	CEPT	Q4 2024	Dependency: MOPS[5] for new generation of RA to be considered (A1). The CEPT report will be based on the outcome of **work Item PT1_47** on the *"Feasibility and sharing studies on the shared use of the 3.8-4.2 GHz frequency band by terrestrial wireless broadband systems providing local-area (i.e. low/medium power) network connectivity".* CEPT agreed on 2 sets of RA parameters in September 2023 as outcome of cooperation between aviation and telecom industries. In mid-2024, the representatives of telecom and aviation industries agreed on the consolidated CEPT deliverables for final review and approval. In the upcoming CEPT report priority is given to existing RA. Retrofitted RA and future RA (based on MOPS for new generation of RA) to be considered by CEPT in a next deliverable to CNECT (S6). The outcome of the related **work Item PT1_40**, under which the CEPT is studying the *"Compatibility between MFCN*	Completed (Nov 2024)

[4] Mandate to CEPT on technical conditions regarding the shared use of the 3.8-4.2 GHz frequency band for terrestrial wireless broadband systems providing local-area network connectivity in the Union.

[5] MOPS: Minimum Operational Performance Standards.

				operating in 3400-3800 MHz and Radio Altimeters (RA) operating in 4200-4400 MHz", is not directly related to the European Commission mandate.	
S2	Commission Implementing Decision on the harmonised use of the 3.8-4.2 GHz frequency band – to ensure its use for terrestrial systems capable of providing LMP WBB ECS for local connectivity.	COM/RSC	End-2025	Dependency: Availability of CEPT deliverables (S1)	In progress (started in Dec 2024)
S3	Successive authorisation, across the EU, of the 3.8-4.2 GHz band, and deployment of LMP WBB considering harmonised technical conditions at EU level.	Member States, EEA countries / Undertakings (telecom industry, vertical users (e.g. airports, harbours), etc.)	In accordance with the EECC / Individual commercial decisions	Dependency: Commission Implementing Decision (S2) and ECC guidance (S8)	Not Started
S4	Successive deployment, across the EU, of WBB networks within the 3.4-3.8 GHz, including potential temporary measures at national level, taking into account CEPT studies.	COM/RSC / Undertakings	From 11/2024 onwards (as of adoption of ECC Report 362)	Dependency: Availability of CEPT deliverables (S1).	In progress
S5	Successive relaxation or release (as appropriate) of the potential temporary measures.	Member States, EEA countries/ Undertakings	Case-by case administrative decisions	Dependency: Authorisation (S4; if relevant S3) and ECC guidance (S8) Dependency: Successive voluntary aircraft equipage with new RA equipment (A6)	Not Started
S6	Updated CEPT deliverable to CNECT, based on MOPS for new generation of RA.	CEPT	Q1/2027	Dependency: MOPS for new generation of RA (A1). This activity item could potentially necessitate a follow-up action by the	Not Started

				European Commission to the mandate to CEPT on LMP WBB systems.	
S7	Update of Commission Implementing Decision on the harmonised use of the 3.8-4.2 GHz frequency band – to address next generation RA, if necessary, pursuant to CEPT input by Q1/2027.	COM/RSC	Q1/2028	Dependency: Updated CEPT deliverable to Commission (S6)	Not Started
S8	Development of ECC guidance (ECC Recommendation) to administration on the deployment of LMP WBB networks in the 3.8-4.2 GHz band.	CEPT	Q4/2025 (TBC)	EASA is invited to contribute to CEPT, in particular in relation to Activity A7	In progress

7. Key activities in the aviation domain

ID	Activity	Responsible	Milestone and date	Dependencies/ /notes	Status
A1	MOPS for new generation of RA. Sub-activities: A 1.1 Development A 1.2. Consultation A 1.3 Adoption by EUROCAE Council	EUROCAE/ RTCA	Publication of MOPS by Q1 2027 (TBC)	The outcome of the CEPT (CEPT Report 88 and ECC Report 362) to be considered in this activity. Design evolutions for the new generation RA to be included in the MOPS are highly more complex than filters required by the FAA in the US. The new generation of RA would be a long term (to last 20+years) and robust solution to mobile networks worldwide.	Updated
A2	Certification specifications (CS-ETSO) for new generation of RA. A 2.1 Planning and preparation (impact assessment, technical/operational work, …). A 2.2 Publication of Notice of Proposed Amendment (Consultation process). A 2.3 Executive Decision by EASA.	EASA	Publication by mid-2027 (TBC)	Dependency: EUROCAE MOPS (A1). It is anticipated that CS-ETSO would be largely based on the MOPS and can be expedited.	Updated
A3	Aviation assessment of CEPT studies. Assessment of the European context based on the results of CEPT studies to assess the need to include an activity in EASA EPAS (European Plan for Aviation Safety) and establishment of RMT (Rule Making Task).	EASA /MOVE/ EASA Committee	Indicative timeframe: Action 3.1 completed in January 2025.	Dependency: Availability of CEPT deliverable (S1)	Completed (02/25) Conclusion: no justification for a wide-fleet retrofit mandate.

ID	Activity	Responsible	Milestone and date	Dependencies/ /notes	Status
A4	Successive industrialisation and certification of new generation of RA (demonstration of compliance with certification specifications).	Equipment manufacturers and aviation certification authorities (EASA, FAA, ...)	Indicative date for first certified new generation RA: Q3 2028-Q4 2029 (TBC)	Dependency: Certification specifications for new generation of RA (A2). Industrial operation including system design, development, validation, integration, certification and production is a complex and lengthy process for safety critical avionics that could take 4-5 years. Duration will depend on the MOPS complexity. Some activities could be put in parallel (e.g. start developments/prototype on the basis of consolidated draft MOPS) to expedite the process.	
A5	Successive certification of aircraft types.	Aircraft manufacturers and aviation certification authorities (EASA, FAA, …)	Indicative date for first certified aircraft type: Q3 2029-Q4 2030 (TBC)	Dependency: Certification of new generation of RA (A4). Certification of aircraft types with new generation of RA would typically take 1 year. This activity includes retrofit (for existing aircraft) and forward fit (for new aircraft).	

ID	Activity	Responsible	Milestone and date	Dependencies/ /notes	Status
A6	Voluntary aircraft equipage with new RA equipment (e.g. procurement and installation during planned maintenance or on new aircraft). The equipment could become mandatory as result of assessment of future CEPT deliverables (Activity A8)	Airspace users	2030 +	Dependency: Successive certification of aircraft types (A5). Airspace users may equip during planned maintenance cycles for voluntary retrofit or ordering new aircraft with new generation of RA (forward fit) Needs to be discussed with airspace users.	Changed to "voluntary equipage" as no regulatory action is foreseen so far.
A7	Continuous monitoring of 5G related occurrences and issuance of mandatory action on specific aircraft types or radio altimeters and/or the issuance of non-mandatory guidance (e.g. Safety Information Bulletin).	EASA	Continuous	Whenever 5G Radio Altimeters incompatibility issue has been identified.	Ongoing

ID	Activity	Responsible	Milestone and date	Dependencies/ /notes	Status
A8	Aviation assessment of CEPT studies Assessment of the European context based on the results of new CEPT studies (Activity S6) to assess the need to include an activity in EASA EPAS (European Plan for Aviation Safety) and establishment of RMT (Rule Making Task).	EASA	Q1 2028	S6. Updated CEPT deliverables considering new MOPS is needed as input for this activity. A6. Equipment could become mandatory in 2030+ as result of this activity and possible subsequent regulatory actions	

8. Key inter-dependencies between both domains

The CEPT deliverables (Activities S1 and S6) should define technical parameters and criteria for EASA to assess the need for regulatory actions (Activities A3 and A8).

The MOPS for new generation of RA under development by EUROCAE/RTCA (Activity A1) should provide the basis for additional CEPT studies (Activity S6).

The ECC guidance on the deployment of WBB network stations around airports has to be coordinated with EASA considering mandatory actions (Activity A7)

9. Acronyms

AMC	Acceptable Means of Compliance
CEPT	European Conference of Postal and Telecommunications Administrations
CS	Certification Specifications
EASA	European Union Aviation Safety Agency
ECS	Electronic Communications Services
EDA	European Defence Agency
EEA	European Economic Area
EECC	European Electronic Communications Code
EUROCAE	European Organisation for Civil Aviation Equipment
FAA	Federal Aviation Administration (US)
FCC	Federal Communications Commission (US)
GM	Guidance Material
LMP	Low/Medium Power
MOPS	Minimum Operational Performance Standards
MIC	Ministry of Internal Affairs and Communications (Japan)
MLIT	Ministry of Land Infrastructure and Transport (Japan)
RTCA	Radio Technical Commission for Aeronautics (US)
WBB	Wireless Broadband

Version: 2
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Annex
Main changes in the activities of version 2 of the roadmap with respect to version 1 dated April 2024

Main changes in activities in the spectrum domain:

- Activity S1 (CEPT Deliverable) has been completed with the publication of ECC Report 362.
- A new Activity S8 on the development of an ECC Recommendation for LMP WBB deployment has been introduced.
- Activities S6 (new CEPT deliverable on the basis of new aviation MOPS) and S7 (possible update of Commission Implementing Decision on 3.8-4.2 GHz band) have been amended to reflect the updated timeline of Activity A1 (new MOPS to be available by 2027).

Main changes in activities in the aviation domain:

- Activity A1 has been updated to reflect the latest planning from EUROCAE and RTCA.
- Activities A2 and A4 have been updated to account for the revised timeline of Activity A1.
- In relation to Activity A3, EASA concluded that the ECC Report 362 does not provide sufficient justification for an implementing regulation requiring a fleetwide retrofit of radio altimeters. Activity 3.1 is completed, and as conclusion activities 3.2 through 3.6 are no longer required.
- Activity A6 has been updated to become a voluntary action by airspace users as no regulatory action is foreseen so far.
- A new Activity A7 is proposed to cover the continuous monitoring of occurrences and the issuance of mandatory action through an Airworthiness Directive, or issuance of non-mandatory guidance (Safety Information Bulletins). EASA therefore considers that if there is any actionable data raising concern related to the 5G deployment, mandatory corrective action may be required targeting a few aircraft types or radio altimeter models.
- A new Activity A8 on the assessment of CEPT deliverables prepared under Activity S6 has been introduced which may result in further actions on the aviation side.