



**Satellite Earth Stations and Systems (SES);
Study of potential updates to certain harmonised ENs due
to technology evolution, methods of measurements and
regulatory updates**

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Reference

DTR/SES-00485

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testing

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Satellite Earth Stations and Systems (SES).

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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Executive summary

The project reviews the contents of several Harmonised European Norms under the purview of ETSI TC-SES to ensure their requirements remain current amid the rapid expansion of satellite-based services. The study has focused on an initial list provided by the contractual requirements of ETSI plus additional ENs proposed by the Experts Group, in summary, assessing 14 HENs for continued compliance with the RED while identifying specific topics requiring further consideration due to technology evolution since the ENs were initially produced. The study also identifies solutions that strengthen the applicability and technological relevance of satellite earth stations ENs, enhance their use, and streamline modern compliance checks for manufacturers and laboratories.

1 Scope

The present document as part of the Experts Group activities aims to deliver a comprehensive report detailing the necessary technological updates and the assessment of currently adopted measurement methods in order to ensure the validity of the ENs in the current market environment, reducing uncertainties in the interpretation of requirements as well as facilitating the mechanisms (test methods) to demonstrate conformity with the Harmonised European Norms requirements.

Overall, it further provides recommendations on the prioritization of updates to the existing hENs, ensuring their continued relevance, clarity, and alignment with current and emerging satellite earth station technologies. The present document is the basis for selection of priority hENs which require updates and guide the priority elements which should be subject of further consideration when reviewing the hENs.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

- [i.1] ETSI EN 303 699: "Satellite Earth Stations and Systems (SES); Fixed earth stations communicating with non-geostationary satellite systems in the 20 GHz and 30 GHz FSS bands; Harmonised Standard for access to radio spectrum".
- [i.2] ETSI EN 302 977: "Satellite Earth Stations and Systems (SES); Harmonised Standard for Vehicle-Mounted Earth Stations (VMES) operating in the 14/12 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.3] ETSI EN 303 978: "Satellite Earth Stations and Systems (SES); Earth Stations on Mobile Platforms (ESOMP) communicating with satellites in geostationary orbit, operating in the 27,5 GHz to 30,0 GHz and 17,3 GHz to 20,2 GHz frequency bands; Harmonised Standard for access to radio spectrum".
- [i.4] ETSI EN 303 979: "Satellite Earth Stations and Systems (SES); Harmonised Standard for Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in non-geostationary orbit, operating in the 27,5 GHz to 29,1 GHz and 29,5 GHz to 30,0 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.5] ETSI EN 303 980: "Satellite Earth Stations and Systems (SES); Fixed and in-motion Earth Stations communicating with non-geostationary satellite systems (NEST) in the 11 GHz to 14 GHz frequency bands; Harmonised Standard for access to radio spectrum".
- [i.6] ETSI EN 301 427: "Satellite Earth Stations and Systems (SES); Harmonised Standard for low data rate Mobile satellite Earth Stations (MES) except aeronautical mobile satellite earth stations, operating in the 11/12/14 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU".

- [i.7] ETSI EN 301 442: "Satellite Earth Stations and Systems (SES); NGSO Mobile Earth Stations (MES) including handheld earth stations, for Satellite Personal Communications Networks (S-PCN) operating in the 1 980 MHz to 2 010 MHz (earth-to-space) and 2 170 MHz to 2 200 MHz (space-to-earth) frequency bands under the Mobile Satellite Service (MSS); Harmonised Standard for access to radio spectrum".
- [i.8] ETSI EN 301 443: "Satellite Earth Stations and Systems (SES); Harmonised Standard for Very Small Aperture Terminal (VSAT); Transmit-only, transmit-and-receive, receive-only satellite earth stations operating in the 4 GHz and 6 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.9] ETSI EN 301 447: "Satellite Earth Stations and Systems (SES); Satellite Earth Stations on board Vessels (ESVs) operating in the 4/6 GHz frequency bands allocated to the Fixed Satellite Service (FSS); Harmonised Standard for access to radio spectrum".
- [i.10] ETSI EN 301 459: "Satellite Earth Stations and Systems (SES); Harmonised Standard for Satellite Interactive Terminals (SIT) and Satellite User Terminals (SUT) transmitting towards satellites in geostationary orbit, operating in the 29,5 GHz to 30,0 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.11] ETSI EN 301 721: "Satellite Earth Stations and Systems (SES); Harmonised Standard for Mobile Earth Stations (MES) providing Low Bit Rate Data Communications (LBRDC) using Low Earth Orbiting (LEO) satellites operating below 1 GHz frequency band covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.12] ETSI EN 302 340: "Satellite Earth Stations and Systems (SES); Harmonised Standard for satellite Earth Stations on board Vessels (ESVs) operating in the 11/12/14 GHz frequency bands allocated to the Fixed Satellite Service (FSS) covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.13] ETSI EN 302 448: "Satellite Earth Stations and Systems (SES); Harmonised Standard for tracking Earth Stations on Trains (ESTs) operating in the 14/12 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.14] ETSI EN 302 574 (all parts): "Satellite Earth Stations and Systems (SES); Harmonised Standard for Mobile Earth Stations (MES) operating in the 1 980 MHz to 2 010 MHz (earth-to-space) and 2 170 MHz to 2 200 MHz (space-to-earth) frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU".
- [i.15] ETSI EN 303 984: "Satellite Earth Stations and Systems (SES); Earth Stations on board Aircraft (ESOA) communicating with non-geostationary satellite systems in the 10,7 GHz to 12,75 GHz and 12,75 GHz to 13,25 GHz frequency bands; Harmonised Standard for access to radio spectrum".
- [i.16] [ECC/DEC/\(17\)04](#) of 30 June 2017 on the harmonised use and exemption from individual licensing of fixed earth stations operating with NGSO FSS satellite systems in the frequency bands 10.70-12.75 GHz and 14.00-14.50 GHz.
- [i.17] [ECC/DEC/\(18\)05](#) of 6 July 2018 on the harmonised use, exemption from individual licensing and free circulation and use of Earth Stations In-Motion (ESIM) operating with NGSO FSS satellite systems in the frequency bands 10.7-12.75 GHz and 14.0-14.5 GHz.
- [i.18] [ECC/DEC/\(09\)01](#) of 13 March 2009 on the harmonised use of the 63.72-65.88 GHz frequency band for Intelligent Transport Systems (ITS).
- [i.19] Recommendation ITU-R SM.1541: "Unwanted emissions in the out-of-band domain".
- [i.20] [ERC/REC 74-01](#) of 1998 on unwanted Emissions in the Spurious Domain.
- [i.21] ITU Radio Regulations.
- [i.22] Recommendation ITU-R SM.329: "Unwanted emissions in the spurious domain".

- [i.23] Recommendation ITU-R S.465: "Reference radiation pattern of earth station antennas in the fixed-satellite service for use in coordination and interference assessment in the frequency range from 2 to 31 GHz".
- [i.24] Recommendation ITU-R S.580: "Radiation diagrams for use as design objectives for antennas of earth stations operating with geostationary satellites".
- [i.25] Recommendation ITU-R S.524: "Maximum permissible levels of off-axis e.i.r.p. density from earth stations in geostationary-satellite orbit networks operating in the fixed-satellite service transmitting in the 6 GHz, 13 GHz, 14 GHz and 30 GHz frequency bands".
- [i.26] Reports ITU-R S.2278: "Use of very small aperture terminals (VSATs)".
- [i.27] Reports ITU-R S.2223: "Technical and operational requirements for GSO FSS earth stations on mobile platforms in bands from 17.3 to 30.0 GHz".
- [i.28] Recommendation ITU-R S.1503: "Functional description to be used in developing software tools for determining conformity of non-geostationary-satellite orbit fixed-satellite service systems or networks with limits contained in Article 22 of the Radio Regulations".
- [i.29] Recommendation ITU-R S.1717: "Electronic data file format for earth station antenna patterns".
- [i.30] Recommendation ITU-R S.1855: "Alternative reference radiation pattern for earth station antennas used with satellites in the geostationary-satellite orbit for use in coordination and/or interference assessment in the frequency range from 2 to 31 GHz".
- [i.31] [ECC Report 152](#): "The use of the frequency bands 27.5-30.0 GHz and 17.30-20.2 GHz by satellite networks".
- [i.32] [ECC Report 184](#): "The Use of Earth Stations on Mobile Platforms Operating with GSO Satellite Networks in the Frequency Range 17.3-20.2 GHz and 27.5-30.0 GHz".
- [i.33] [ECC/DEC/\(05\)01](#) of 18 March 2005 on the use of the band 27.5-29.5 GHz by the Fixed Service and uncoordinated Earth stations of the Fixed-Satellite Service (Earth-to-space).
- [i.34] [ECC/DEC/\(05\)08](#) of 24 June 2005 on the availability of frequency bands for high density applications in the Fixed-Satellite Service (space-to-Earth and Earth-to-space).
- [i.35] [ECC/DEC/\(06\)03](#) of 24 March 2006 on Exemption from Individual Licensing of high e.i.r.p. satellite terminals (HEST) operating with geostationary satellites and in the frequency bands 10.70-12.75 GHz or 19.70-20.20 GHz space-to-Earth and 14.00-14.25 GHz or 29.50-30.00 GHz Earth-to-space.
- [i.36] [ECC/DEC/\(13\)01](#) of 8 March 2013 on the use, free circulation, and exemption from individual licensing of Earth stations on mobile platforms (ESOMPs) in the frequency bands available for use by uncoordinated FSS Earth stations within the ranges 17.3-20.2 GHz and 27.5-30.0 GHz.
- [i.37] [Directive 2014/53/EU](#) of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.
- [i.38] [ECC/DEC/\(06\)09](#) of 1 December 2006 on the designation of the bands 1980-2010 MHz and 2170-2200 MHz for use by systems in the Mobile-Satellite Service including those supplemented by a Complementary Ground Component (CGC).
- [i.39] [ECC Report 197](#): "Compatibility studies – MSS terminals transmitting to a satellite in the band 1980-2010 MHz and adjacent channel UMTS services".
- [i.40] [ECC Report 233](#): "Adjacent band compatibility studies for aeronautical CGC systems operating in the bands 1980-2010 MHz and 2170-2200 MHz".
- [i.41] [Decision No 626/2008/EC](#) of the European Parliament and of the Council of 30 June 2008 on the selection and authorisation of systems providing mobile satellite services (MSS).

- [i.42] [Commission Decision 2007/98/EC](#) of 14 February 2007 on the harmonised use of radio spectrum in the 2 GHz frequency bands for the implementation of systems providing mobile satellite services.
- [i.43] [Commission Decision 2009/449/EC](#) of 13 May 2009 on the selection of operators of pan-European systems providing mobile satellite services (MSS).
- [i.44] [CEPT Report 013](#): "Report from CEPT to the European Commission in response to the Mandate on - Harmonised technical conditions for the use of the 2 GHz bands for Mobile Satellite Services in the European Union".
- [i.45] [ECC/DEC/\(05\)11](#) of 24 June 2005 on the free circulation and use of Aircraft Earth Stations (AES) in the frequency bands 14-14.5 GHz (Earth-to-space), 10.7-11.7 GHz (space-to-Earth) and 12.5-12.75 GHz (space-to-Earth).
- [i.46] [ECC/DEC/\(18\)04](#) of 6 July 2018 on the harmonised use, exemption from individual licensing and free circulation and use of land based Earth Stations In-Motion (ESIM) operating with GSO FSS satellite systems in the frequency bands 10.7-12.75 GHz and 14.0-14.5 GHz.
- [i.47] [ECC Report 279](#): "The Use of Earth Stations In-Motion (ESIM) operating to NGSO Satellite Systems in the 10.7-12.75 GHz and 14-14.5 GHz Band".
- [i.48] [ECC Report 271](#): "Compatibility and sharing studies related to NGSO satellite systems operating in the FSS bands 10.7-12.75 GHz (space-to-Earth) and 14-14.5 GHz (Earth-to-space)".
- [i.49] [ECC/DEC/\(06\)10](#) of 1 December 2006 on transition of terrestrial service operations from the Bands 1980-2010 MHz and 2170-2200 MHz in order to facilitate the Harmonised Introduction and Development of Systems in the mobile-satellite service including those supplemented by a Complementary Ground Component.
- [i.50] Recommendation ITU-T M.1036: "Frequency arrangements for implementation of the terrestrial component of International Mobile Telecommunications in the bands identified for IMT in the Radio Regulations".
- [i.51] Recommendation ITU-R S.1428: "Reference FSS earth-station radiation patterns for use in interference assessment involving non-GSO satellites in frequency bands between 10.7 GHz and 30 GHz".
- [i.52] [ERC/DEC/\(00\)08](#) of 19 October 2000 on the use of the band 10.7 - 12.5 GHz by the fixed service and Earth stations of the broadcasting-satellite and fixed-satellite Service (space-to-Earth).
- [i.53] [ECC/REC/\(25\)01](#) of 14 February 2025 on Emission limit requirements for Wireless Power Transmission (WPT).
- [i.54] Recommendation ITU-R S.728: "Maximum permissible level of off-axis e.i.r.p. density from very small aperture terminals (VSATs)".
- [i.55] Recommendation ITU-R SM.1539: "Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329".
- [i.56] [ECC Report 322](#): "Compatibility analysis (inter-service and intra service) for S-PCS below 1 GHz".
- [i.57] [ECC Report 273](#): "E.164 Numbering and Over-The-Top (OTT) Communications Services".

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACM	Adaptive Coding and Modulation
AES	Aeronautical Earth Station
AI	Artificial Intelligence
ANFR	National Agency of frequencies of France
BER	Bit Error Rate
BW	Bandwidth
CEPT	European Conference of Postal and Telecommunications Administrations
CGC	Complementary Ground Component
CMF	Control and Monitoring Functions
CW	Continuous Wave
DTP	Digital Transparent Processor
DUT	Device under test
EC	European Commission
ECC	Electronic Communications Committee
EIRP	Equivalent Isotropically Radiated Power
EIS	Effective Isotropic Sensitivity
EISMEA	European Innovation Council and Small and Medium-sized Enterprises Executive Agency
EMC	Electromagnetic Compatibility
EN	European Norm
EPFD	Equivalent Power Flux Density
ERC	Electronic Radiocommunication Committee
ESA	Electronically Steerable Antenna
ESIM	Earth Station In Motion
ESOA	Earth Stations on board Aircraft
ESOMP	Earth Station on Mobile Platform
ESV	Earth Station on Vessel
ETSI	European Telecommunications Standards Institute
EU	European Union
EUT	Equipment Under Test
FAR	Fully Anechoic Room
FCC	Federal Communications Commission USA
FES	Fixed Earth Stations
FS	Fixed Service
FSS	Fixed Satellite Service
GEO	Geostationary Earth Orbit
GMDSS	Global Maritime Distress and Safety System
GNSS	Global Navigation Satellite System
GSO	Geostationary Satellite Orbit
hEN	harmonised European Norm
HS	Harmonised Standard
HTS	High Throughput Satellite
IEC	International Electrotechnical Committee
IMT	International Mobile Telecommunications
IoT	Internet of Things
IP	Internet Protocol
ITU	International Telecommunications Union
LBRDC	Low Bit Rate Data Communication
LEO	Low Earth Orbit
LMES	Land Mobile Earth Station
LNB	Low Noise Block
M2M	Machine to Machine
MEO	Medium Earth Orbit
MES	Mobile Earth Station

MIL	Military
MMES	Maritime Mobile Earth Station
MSS	Mobile Satellite Service
NCF	Network Control Facility
NGSO	Non-Geostationary Satellite Orbit
NTN	Non Terrestrial Network
OATS	Open Area Test Site
OJ	Official Journal
OOB	Out of Band
OTA	Over-the-Air
PCS	Personal Communications System
PER	Packet Error Rate
RAS	Radio Astronomy Service
RED	Radio Equipment Directive
RF	Radio Frequency
RR	Radio Regulations
RSPG	Radio Spectrum Policy Group
SAC	Semi-Anechoic Chamber
SCADA	Supervisory Control and Data Acquisition
SDR	Satellite Design Radio
SE	Spectrum Engineering
SIM	Station in Motion
SINR	Signal-to-Interference-plus-Noise Ratio
SIT	Satellite Interactive Terminal
SNR	Signal-to-Noise Ratio
STD	Standard
STE	Special Test Equipment
SUT	Satellite User Terminal
ToR	Terms of Reference
UAV	Unmanned Aircraft Vehicle
UE	User Equipment
VCM	Variable coding and Modulation
VMES	Vehicle Mounted Earth Station
VSAT	Very Small Aperture Terminal
WP	Work Package
WRC	World Radiocommunications Conference
XPD	Cross Polar Discrimination

4 Overview of Experts Group and WP2

4.1 Experts Group Objectives

The creation of an Experts Group to optimise Harmonised European Norms (hENs) for Satellite Earth Stations, is a strategic initiative funded under the European Commission's Grant Agreement 101260993. The project addresses the need to modernize, harmonize, and ensure the long-term applicability of the Harmonised European Standards developed under the responsibility of ETSI Technical Committee Satellite Earth Stations (TC SES). These standards support compliance with the Radio Equipment Directive (RED) 2014/53/EU [i.37], enabling manufacturers to demonstrate conformity with essential requirements related to efficient use of the radio spectrum and electromagnetic compatibility.

The satellite communications sector is undergoing a profound transformation driven by the emergence of multi-orbit constellations (LEO, MEO, GEO), new antenna architectures such as electronically steerable flat panel arrays, increasingly dynamic mobility scenarios (ESIMs for maritime, aeronautical, land mobile platforms), and evolving regulatory frameworks at European and international levels. As highlighted in the Terms of Reference, "there is still a need to improve the requirements, measurement methods and technology updates, based on new and future use cases, for satellite earth stations in the new ecosystem of Low Earth Orbit (LEO), Medium Earth Orbit (MEO) and Geostationary Earth Orbit (GEO) satellite networks". The Expert Group activity responds directly to this need by providing a structured, expert-driven framework for updating the relevant ENs.

The project is implemented through a dedicated Specialist Task Force (Experts Group) composed of technical experts appointed by ETSI. The Experts Group operates under the supervision of the Technical Committee Satellite Earth Stations (TC SES), which includes representatives from TC SES leadership and ensures alignment with the broader standardization roadmap, and works in close collaboration with TC SES Working Groups, particularly WG HARM, responsible for the maintenance and development of Harmonised Standards. In addition, the project benefits from voluntary contributions from TC SES members and from interactions with external stakeholders such as manufacturers, notified bodies, test laboratories, and satellite operators.

The activities of the Experts Group is structured into five Work Packages (WPs), each addressing a specific dimension of the project:

- **WP1 Project Management and Coordination:** Ensures administrative and technical coordination, planning, reporting, and liaison with ETSI and the European Commission. WP1 also oversees risk management, quality assurance, and the timely delivery of project milestones.
- **WP2 Identification of Use Cases and Technology Evolution:** The focus of this Technical Report. WP2 analyses the technological, operational, and regulatory evolution affecting satellite earth stations and identifies the updates required across the targeted ENs. It includes expert input collection, technology evolution analysis, gap identification, and the formulation of recommendations.
- **WP3 Deployment Scenarios and Potential Merging of hENs:** Examines overlaps between standards, maps use cases to ENs and identifies opportunities for consolidation or merging of standards addressing similar technologies or operational scenarios.
- **WP4 Elaboration of Revised hENs:** Produces updated versions of at least ten hENs and supports their examination within TC SES. WP4 ensures that the revised standards are technically robust, aligned with RED requirements, and suitable for citation in the OJEU.
- **WP5 Dissemination:** Ensures visibility of project results and promotes adoption by industry, notified bodies, national standardization organizations, and regulatory authorities worldwide.

The organizational structure of the Experts Group reflects the need for both technical depth and cross-standard consistency. WP2 plays a central role in this structure by providing the analytical foundation upon which WP3 and WP4 build. Specifically, WP2 delivers:

- A comprehensive review of 14 targeted ENs, including the 10 hENs identified as requiring urgent revision.
- A structured methodology for collecting and consolidating expert input from relevant stakeholders.
- A detailed analysis of technology evolution, including changes in satellite architectures, antenna systems, waveforms, mobility patterns, and measurement techniques.
- An analysis of the required updates across the ENs identifying inconsistencies, outdated assumptions, missing requirements, and limitations in current measurement methods.
- Recommendations that guide the revision work in WP4 and inform the strategic decisions in WP3 regarding potential merging of standards.

The project also recognizes the international relevance of ETSI satellite standards. As stated in the ToR, "the adoption of ETSI TC SES standards by many countries around the world has brought ETSI and Europe at the front of leadership regarding satellite communications". Maintaining this leadership requires ensuring that the standards remain technically robust, internationally aligned, and responsive to emerging technologies and regulatory developments. The Experts Group work therefore incorporates considerations related to ITU and CEPT decisions, global spectrum allocations, and cross-border interoperability.

In summary, Experts Group activities provides a coordinated, expert-driven framework to modernize the Harmonised European Standards for satellite earth stations. WP2, through the technical analysis documented in the present document, establishes the foundation for the subsequent revision and optimization of the ENs, ensuring their continued applicability in a rapidly evolving technological environment and supporting the long-term competitiveness of the European satellite communications sector.

4.2 WP2 Objectives and Scope

The methodology adopted in WP2 for collecting, structuring, and validating expert input was designed to ensure technical completeness, traceability, and consistency across the 14 ENs under review. Given the diversity of satellite earth station technologies, operational scenarios, and regulatory environments addressed by these standards, the collection of expert contributions required a structured, multi-stage process capable of capturing detailed clause-level insights while enabling systematic consolidation and analysis. The approach followed in WP2 is based on four elements:

- Standardized expert template, ensuring uniformity in the structure and content of contributions.
- Controlled consultation process, engaging manufacturers, notified bodies, laboratories, satellite operators, and TC SES experts through an online survey hosted on the official ETSI website.
- Structured extraction and database workflow, enabling traceability and supporting the automated semantic consolidation workflow.
- Validation loop, ensuring technical accuracy and alignment with the objectives of the Experts Group activities.

This methodology ensures that the technical analysis presented in the present document is based on expert knowledge, and aligned with the evolving satellite communications ecosystem.

On the view of EISMEA, the following 10 harmonised standards need urgent revision:

- ETSI EN 301 427 [i.6].
- ETSI EN 301 442 [i.7].
- ETSI EN 301 443 [i.8].
- ETSI EN 301 447 [i.9].
- ETSI EN 301 721 [i.11].
- ETSI EN 302 340 [i.12].
- ETSI EN 302 448 [i.13].
- ETSI EN 302 977 [i.2].
- ETSI EN 303 984 [i.15].
- ETSI EN 302 574-3 [i.14].

The Experts Group has reviewed this list and concluded that an initial group of 14 hENs /ENs (including all the above listed ENs) should be part of the study carried out. The resulting full list of studied hENs/ENs is the following:

- ETSI EN 301 427 [i.6].
- ETSI EN 301 442 [i.7].
- ETSI EN 301 443 [i.8].
- ETSI EN 301 447 [i.9].
- ETSI EN 301 721 [i.11].
- ETSI EN 302 340 [i.12].
- ETSI EN 302 448 [i.13].
- ETSI EN 302 574-3 [i.14].
- ETSI EN 302 977 [i.2].
- ETSI EN 303 984 [i.15].

Additional list of ETSI EN considered by the Proposal Team:

- ETSI EN 301 459 [i.10].
- ETSI EN 303 699 [i.1].
- ETSI EN 303 978 [i.3].
- ETSI EN 303 979 [i.4].

As can be seen, a total of 14 hENs/ENs have been subject of the study reported in the present document.

5 Methodology for WP2

5.1 Expert Input Collection

5.1.1 Expert Template and Data Structure

To ensure consistency across contributions, all experts participating were required to use a dedicated Excel-based template specifically designed for it. The template captures detailed clause-level comments for each EN and provides a structured mechanism for identifying priorities, justifications, and proposed actions. The template includes the following key fields:

- EN Identifier - The specific EN and version to which the comment applies.
- Clause Number - The exact clause, including sub-clauses up to level 3.
- Technical Justification - A detailed explanation of the issue, including references to technological evolution, regulatory changes, or operational constraints.
- Priority Level - High, Medium, or Low, based on the impact on technological relevance and urgency of update.
- Action Type - Categorized as Technology Evolution (T), Numerical Corrections (N), Regulatory Alignment (R), Clarification (C), Obsolescence (O), or Measurement & Test Methods (M).

5.1.2 Stakeholder Consultation

The expert input collection process involved a broad range of stakeholders representing the full ecosystem of satellite earth station technologies. The consultation, endorsed by ETSI, was conducted through a questionnaire accessible on the official ETSI website and targeted:

- Manufacturers of satellite terminals, including GEO, MEO, and LEO systems, with expertise in mechanically steered antennas, electronically steerable arrays, and hybrid architectures.
- Notified bodies responsible for conformity assessment under the RED, providing insights into practical challenges in applying the ENs.
- Accredited test laboratories, contributing expertise on measurement methods, test setups, and limitations of current procedures.
- Satellite operators, including GEO and NGSO operators, providing operational perspectives on link budgets, interference scenarios, and mobility patterns.
- Members of ETSI TC SES, including rapporteurs and experts involved in the maintenance of the ENs.

This multi-source approach ensured that the review captured both theoretical and practical perspectives, including real-world challenges encountered during equipment testing and certification.

5.1.3 Contribution to WP2 Results

The methodology described above directly supports the technical outcomes of WP2 by:

- Providing a comprehensive database of expert comments across all 14 ENs.
- Enabling a systematic identification of required updates across the ENs, including outdated assumptions, missing requirements, and limitations in measurement methods.
- Supporting the technology evolution analysis by linking expert observations to emerging trends.
- Informing the prioritization of EN updates, ensuring that the most critical issues are addressed first.
- Feeding into the recommendations presented in clause 10, which form the basis for the revision activities in WP3 and WP4.

The methodology for expert input collection ensures that WP2 is grounded in a robust, traceable, and technically rigorous evidence base, enabling a comprehensive and forward-looking assessment of the ENs under review.

5.2 Data Processing and Database Construction

5.2.0 General

The analysis performed in WP2 relies on a structured and traceable process for transforming raw expert contributions into a consolidated dataset. Given the volume, heterogeneity, and technical depth of the comments received across the 14 ENs under review, a dedicated extraction and database construction workflow was developed to ensure consistency, accuracy, and full traceability of all inputs.

This workflow enables WP2 to move from individual expert observations to a coherent analytical foundation, supporting the technology evolution analysis (clause 7), the identification of required updates across the ENs (clause 8), and the activities carried out through the automated semantic consolidation workflow (clause 9). The extraction process ensures that every comment - regardless of its origin, priority, or level of detail - is captured, normalized, and linked to the corresponding EN, clause, expert, and version.

The extraction and database construction process is built on three principles:

- Uniformity, ensuring that all comments follow a consistent structure.
- Traceability, enabling full reconstruction of the origin and evolution of each comment.
- Scalability, allowing the system to handle large volumes of comments across multiple ENs and multiple experts.

5.2.1 Extractor Tool

To support the systematic processing of expert contributions, WP2 developed a dedicated software module referred to as the EXTRACTOR tool. This tool automates the ingestion, parsing, and structuring of the Excel-based expert templates- Its primary function is to convert heterogeneous expert inputs into a unified MASTER TABLE, which serves as the central analytical dataset for WP2.

a) Input Handling:

- The tool performs preliminary validation to ensure that mandatory fields (EN identifier, clause number, priority, justification, action type) are present and correctly formatted.

b) Parsing and Normalization:

- The tool applies to a set of normalization rules to ensure consistency across inputs, including:
 - Standardization of EN identifiers (e.g. "EN302448", "ETSI EN 302 448 [i.13]", "EN302 448" → ETSI EN 302 448 [i.13]).
 - Normalization of clause numbering formats.