European spectrum regulation and the harmonised market of the European Union—An overview

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European Spectrum regulation
The three regions of the International Telecommunication Union (ITU)
ITU region 1 consists of Europe, Africa, Middle East (excluding Iran), Mongolia, all of the Russian federation
European Conference of Postal and Telecommunications Administrations (CEPT)

Albania, Andorra, Austria, Azerbaijan, Belarus (membership suspended), Belgium, Bosnia & Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Russian Federation (membership suspended), San Marino, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye, Ukraine, United Kingdom, and Vatican City
CEPT and its bodies

CEPT consists of three business committees—ECC, Com-ITU, and CERP—and its permanent Office—ECO.
CEPT membership

- "Who can be a CEPT Member?"
  - In accordance with the CEPT ‘Arrangement’, Postal and Telecommunications Administrations of the European countries which are Members of the Universal Postal Union or Member States of the International Telecommunication Union may be Members of CEPT.” [5]

- CEPT consists of countries
  - No entity or individual membership
Working areas of CEPT’s bodies

- **Electronic Communications Committee (ECC)**
  - “The ECC considers and develops policies on electronic communications activities in European context, taking account of European and international legislations and regulations.” [6]

- **Committee for ITU Policy**
  - “Com-ITU is responsible for organising the co-ordination of CEPT actions for the preparation for and during the course of the ITU activities of the Council, Plenipotentiary Conferences, WTDC, WTSA and other meetings as appropriate.” [7]

- **European Committee for Postal Regulation**
  - “The European Committee for Postal Regulation (CERP) is responsible for postal regulation and European co-ordination and preparation for Universal Postal Union meetings.” [8]

- **European Communications Office**
  - “ECO provides advice and support to CEPT to help it to develop and deliver its policies and decisions in an effective and transparent way.” [9]
Electronic Communications Committee
Electronic Communications Committee (ECC)

- ECC consists of …
  - Steering Group (SG)
  - Conference Preparatory Group (CPG)
  - Numbering and Networks Working Group (WG NaN)
  - Working Group Frequency Management (WG FM)
  - Working Group Spectrum Engineering (WG SE)
  - Project Team 1 (PT1)
What does the ECC do?

“The Electronic Communications Committee (ECC) develops common policies and regulations in electronic communications for Europe, and is a focal point for information on spectrum use. Its primary objective is to harmonise the efficient use of the radio spectrum, satellite orbits and numbering resources across Europe. It also prepares common proposals to represent European interests in the ITU and other international organisations.” [11]

“The ECC’s approach is strategic, open and forward-looking, and based on consensus between the member countries. It works with all stakeholders, the European Commission, and ETSI to facilitate the delivery of technologies and services for the benefit of society.” [11]
ECC deliverables

- **ECC Decisions**
  - “These are measures to **harmonise the use of spectrum** and numbering **across the CEPT membership**. This is to make the use of spectrum more technically efficient to improve market efficiency across Europe. **Drafted by consensus, ECC Decisions are widely supported and adopted by individual countries, even though they are non-binding**. This provides a sound basis for manufacturers and service providers to prepare to address the European market confidently. The ECC ensures **compatibility between its own Decisions and the binding [European Commission] Decisions** on the same subjects made between the 27 member states of the European Union. This allows the benefits of harmonisation to be fully realised across all 48 CEPT member countries.” [12]

- **ECC Recommendations**
  - “ECC Recommendations are measures that national Administrations are encouraged to apply. They are principally intended as harmonisation measures for those matters where ECC Decisions are not yet relevant, or as guidance to national Administrations.” [12]

- **ECC Reports**
  - “ECC Reports are the result of studies by the ECC. They are developed in support of ECC Decisions, ECC Recommendations or European Common Positions (ECPs) adopted on a voluntary basis by European countries at World Radiocommunication Conferences.” [12]

- **CEPT Reports**
  - “CEPT Reports are technical studies carried out by the ECC under mandates from the European Commission [EC]. These studies give results that are typically used as the technical basis of EC Decisions on spectrum policy matters.” [12]
Spectrum regulation in Europe

- Countries are sovereign over the use of the radio spectrum within their territory

- In Europe, ECC/CEPT harmonizes spectrum usage among its member countries
  - However, ECC/CEPT decisions are not binding

- ECC/CEPT member countries may voluntarily implement ECC/CEPT decisions and recommendations
  - When using or providing devices etc. users and manufacturers need to consult national regulations
  - A partial (not necessarily up-to-date) overview is available from [13]
6 GHz as an example

- ECC Decision (20)01 addresses license-exempt operation in the lower 6 GHz band (5945 MHz to 6425 MHz) [14], [15]
  - Permits CEPT member countries to open the lower 6 GHz band
- On 2021-09-01, the Federal Office of Communications (OFCOM) of the Swiss Confederation implemented ECC DEC(20)01 [16]
The European Union
Europe

- Europe is a continent
  - Consists of ca. 73 countries
  - Ca. 750 million residents
The European Union

- Today, the European Union (EU) has 27 member countries
  - Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden

- Third largest economy after the US and China
The European Union and related organizations

- EEA: European Economic Area (EEA)
- EFTA: European Free Trade Association
- GUAM: Organization for Democracy and Economic Development
- CEFTA: Central European Free Trade Agreement
- BSEC: Black Sea Economic Cooperation
What is the EU?

- **A voluntary union of independent countries**
  - Started as economic community
  - EU and member countries are bound by treaties between them
- **Follows principles of subsidiarity**
- **The EU has own institutions**
  - Member countries delegate power to the EU’s bodies
- **EU develops EU legislation**
  - Member countries adopt this law
EU institutions

Decision making

- European Council
  - Defines general direction
- European Commission
  - “Government of the EU”
- European Parliament
  - Approves EU law
- Council of the European Union
  - Approves EU law

Controlling

- Court of Justice of the European Union
  - Reviews & interprets law, ensure EU members comply
- European Central Bank
  - Price stability, inflation
- European Court of Auditors
  - Assessment of EU actions
The European Commission (EC) is the “government of the European Union (EU)”
- Proposed and appointed by the Council of the European Union
- Approved and dismissed by the European Parliament
- EC proposes and enforces EU law

The Council of the European Union consists of 27 ministers
- One per EU member country

EU citizens elect
- Their national governments, and
- the European parliament
The European Commission

- Consists of 27 commissioners
- Enforces EU law
- Proposes law
  - Directives etc.
- Proposes & supervises the EU’s budget
- International representation of the EU
6 GHz as an example

- On 2021-06-30, the EC published decision 2021/1067 [21] in the Official Journal of the EU (OJEU)
  - Forces all EU member countries to make available 5945 MHz to 6425 MHz for license-exempt use from 2021-12-01 at latest

- On 2021-07-14, Bundesnetzagentur (BNetzA) [82], the regulatory authority of the Federal Republic of Germany, implemented decision (EU) 2021/1067 [22]
EC based its decision on ECC’s decision

EU 2021/1067 [21]
- “Techniques to access spectrum and mitigate interference that provide an appropriate level of performance to comply with the essential requirements of Directive 2014/53/EU of the European Parliament and of the Council shall be used. Where relevant techniques are described in harmonised standards or parts thereof the references of which have been published in the Official Journal of the European Union in accordance with Directive 2014/53/EU, performance at least equivalent to the performance level associated with those techniques shall be ensured.”

ECC DEC(20)01 [15]
- “An adequate spectrum sharing mechanism shall be implemented.”
Placing products on the market of the EU
Single market

- “EU countries may not prohibit the sale on their territory of goods which are lawfully marketed in another EU country.” [23]
  - Goods, services, money etc. move freely within EU
  - Free trade, no barriers
  - Once a product is put on the market of one EU member country the product cannot be blocked from entering other EU member countries
Harmonized requirements

- **Old, national approach posed many detailed requirements**
  - For example, few dial-up modems were approved for use in Germany

- **EU’s New Approach covered by New Legislative Framework (NLF) [24]**
  - Restrict legislation to essential requirements
  - E. g., performance or functional requirements

- **Clause 4.1.1 of [25]**
  - “Essential requirements define the results to be attained, or the hazards to be dealt with, but do not specify the technical solutions for doing so.”
  - “[...] Union harmonisation legislation is [limited] to the essential requirements that are of public interest. These requirements deal with the protection of health and safety of users (usually consumers and workers) but may also cover other fundamental requirements (for example protection of property, scarce resources or the environment).”
What is the CE marking?

- **CE marking** [26]
  - signifies that products “[…] have been assessed to meet high safety, health, and environmental protection requirements.”
  - holds “[…] all companies accountable to the same rules.”
  - of a product indicates that “[…] a manufacturer declares that the product meets all the legal requirements for CE marking and can be sold […].”

- CE marking applies to the European Economic Area (EEA)
  - EEA > EU, see page 16
Radio Equipment Directive
Directive 2014/53/EU

- Radio Equipment Directive (RED) addresses traditional aspects (transmitters, electromagnetic compatibility etc.) and new aspects (receivers) [28]
  - Consists of several articles
- The EC activates RED articles over time
  - Latest activation targets a common power supply/charger
  - Also recently, protection of privacy and against fraud
- RED is highly important for all products operating according to IEEE 802.11 or IEEE 802.15 standards

[29]
Traditional RED aspects

“1. Radio equipment shall be constructed so as to ensure:

a) the protection of health and safety of persons and of domestic animals and the protection of property, including the objectives with respect to safety requirements set out in Directive 2014/35/EU […]

b) an adequate level of electromagnetic compatibility as set out in Directive 2014/30/EU.”

[28]

- Similar requirements set out under previous “Radio and Telecommunications Terminal Equipment” (R&TTE) directive
- RED replaced the R&TTE directive
Receiver oriented aspects of the RED

2) “Radio equipment shall be so constructed that it both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference.” [28]

- Interference issues not limited to transmitters
  - Avoid complaints about interference caused by bad receiver designs
- Improving the quality of receivers improves spectrum efficiency
  - Better receivers reduce the need for guard bands etc.
- Therefore, RED not limited to transceivers, also addressing receiving devices
  - Frequency Modulation (FM) and Digital Audio Broadcast (DAB+) radios, DVB-T/S/C, and Global Navigation Satellite Service (GNSS) receivers, …
New aspects addressed by RED

- 2019-02-25, EC activated & detailed g) [30]
  - Mandatory support of Galileo GNSS in smartphones
- 2022-01-12, EC activated d), e), and f) [31]
  - Addresses cybersecurity
    - Privacy
    - Network resilience
    - ...
- 2022-12-07, EC mandates the use of a common charging solution [32]
  - USB-C

3) “Radio equipment within certain categories or classes shall be so constructed that it complies with the following essential requirements: [radio equipment]

a) […] interworks with accessories, in particular with common chargers;
b) […] interworks via networks with other radio equipment;
c) […] can be connected to interfaces of the appropriate type throughout the Union;
d) […] does not harm the network or its functioning nor misuse network resources, thereby causing an unacceptable degradation of service;
e) […] incorporates safeguards to ensure that the personal data and privacy of the user and of the subscriber are protected;
f) […] supports certain features ensuring protection from fraud;
g) […] supports certain features ensuring access to emergency services;
h) […] supports certain features in order to facilitate its use by users with a disability;
i) […] supports certain features in order to ensure that software can only be loaded into the radio equipment where the compliance of the combination of the radio equipment and software has been demonstrated.” [28]
Radio Equipment Directive Compliance Association (REDCA)

- REDCA [33] brings together
  - Manufacturers
  - Notified bodies
  - Test labs
  - Regulatory authorities
  - Consulting companies
  - …

The Radio Equipment Directive Compliance Association (REDCA)

The REDCA was formed under the requirements of the Radio Equipment Directive 2014/53/EU specifically for Article 26.11 and Article 38 for Notified Bodies. Membership of this association as listed on the Notified Body member’s page is deemed to demonstrate compliance with these articles. *See Note. In this context REDCA publishes Technical Guidance Notes – TGN that can be accessed by following the "Documents" menu tab above.

The REDCA provides a forum for people concerned with the compliance of radio equipment with regulations and technical standards in the European Economic Area, as well as in the Countries that have a Mutual Recognition Agreement with the EU, such as the USA and Japan.

The annual fee for REDCA Membership is €600.

The Association meets twice a year in a location within the EEA. All meetings are open for members only. These meetings are ideal to discuss matters with important players in the field such as representatives of the EU Commission, ECC, ETSI, ADEO RED and authorities from MRA countries.

The REDCA operates a mail server where only members can ask questions that will trigger answers and comments from the experts within the Association. These discussions provide material to be stored on the protected database for future reference by the members. Furthermore the Association has a specific protected area on the CIRCABC website, operated by the EU Commission, where all working documents are stored for access by the members only.

For further information about the Association or its activities, please send a message to the REDCA Secretary.

*Note: For the information of accreditation bodies:

For accreditation assessments of Radio Equipment Directive Notified Bodies, the Notified Body membership can be verified on this website. If a Notified Body is not on this list then they are not a member. Membership of the REDCA specifically enables the Notified bodies for the Radio Equipment Directive to demonstrate their compliance with Article 26.11 and Article 38.
REDCA’s goals

- “[…] formed under the requirements of the Radio Equipment Directive 2014/53/EU specifically for Article 26.11 and Article 38 for Notified Bodies (sectorial group of notified bodies) […]”

- “[…] REDCA publishes Technical Guidance Notes – TGN that can be accessed by members and in some case the general public.” [34]
How to sell a (radio) product?
Placing radio products on the market

United States

Federal Communications Commission (FCC)

Authorized test lab

(EU denotes its approved test labs as “notified bodies” [52])

Type approval

European Union

Manufacturers may issue a Declaration of Conformity (DoC) by themselves
From the Official Journal of the EU (OJEU) to Declarations of Conformity (DoCs) by self-assessment

- **OJEU contains a Harmonized Standard (HS) applicable to a product?**
  - Then, HS may be used to assess a product’s compliance with EU law
  - Avoids the need to consult a notified body

- **Notified bodies are independent experts that have knowledge and experience to admit a product to the EU market**
  - For their decisions, however, notified bodies might consider requirements in HSs

- **DoC by self-assessments saves cost and time**
  - In this case, the content of an HS determines a vendor’s options

- **HSs determine vendors’ options & influence notified bodies**
Self-assessment depends on Harmonized Standards (HSs)—What is an HS?

- “‘harmonised standard’ means a European standard adopted on the basis of a request made by the Commission for the application of Union harmonisation legislation” [48]

- An HS defines requirements for products targeting certain EU markets
  - HS shall be limited to essential requirements
  - An HS neither provides nor targets technical interoperability

- Examples: An HS may require ...
  - that the out-of-band emissions of a product must not exceed certain levels
  - that a product must stop transmitting after a certain duration
  - that a product must detect certain radar patterns and upon detection must cease transmitting
Example DoC

- Issuing a DoC depends on testing and finding a product to comply with all requirements in Harmonised Standards (HS) relevant to the product.
  - Because of the product’s Wi-Fi modules, HSs EN 300 328 [53] (2.4 GHz) and EN 301 893 [54] (5 GHz) are referred to.
  - In the present example, the manufacturer got support from a Notified Body [51].
Who develops Harmonized Standards?

“Harmonised standards are developed by recognised European Standards Organisations: CEN, CENELEC, or ETSI.” [36]
What is the relevance of Harmonized Standards?

- "Following harmonised standards in the design and manufacture of your products will ensure your products are in line with corresponding EU rules; this is known as ‘presumption of conformity’." [36]

- "[...] the use of harmonised standards remains voluntary. You are free to choose another technical solution to demonstrate compliance with the mandatory legal requirements." [36]
Relationship between EC, CEPT, and ETSI

- **MoU:** Memorandum of Understanding
Relationship between EC and ETSI

- “ETSI was set up in 1988 by the European Conference of Postal and Telecommunications Administrations (CEPT) in response to proposals from the European Commission.” [38]

- ETSI cooperates with EC and EFTA\(^1\)
  - ETSI supports EU regulations and legislation

- EC/EFTA issue standardization requests to ETSI
  - Targeting development of Harmonized Standards
  - ETSI may reject requests

- The EC provides 15% to 20% of ETSI’s budget

\(^1\)See page 18
Relationship between EC and ECC

- EC collaborates with ECC through its Radio Spectrum Committee (RSC)
  - Memorandum of Understanding signed in 2004 [39]
  - ECC provides expertise to EC

- EC may issue mandates to ECC
  - To “[…] ensure harmonised conditions for the availability and efficient use of radio spectrum.” [40]
Relationship between ECC and ETSI

- Ensure “that ECC and ETSI deliverables do not contradict each other” [42]

- Normally, new system/services are studied/proposed at ETSI
  - Results in an ETSI System Reference Document (SRDoc)

- If regulatory changes or spectrum are needed, ECC’s Working Group FM\(^1\) analyzes SRDoc
  - May create new Work Item leading to new regulation (Decision)
  - Sharing/compatibility studies are conducted in WG SE\(^1\)

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\(^1\)See page 10
6 GHz license-exempt operation—example collaboration between ECC and ETSI

Under Work Item DTR/ERM-570, ETSI TC BRAN developed TR 103 524

“Wireless access systems including radio local area networks (WAS/RLANs) in the band 5 925 MHz to 6 725 MHz”

TR 103 524 served as input for ECC’s WGs SE 45 and FM 57

Resulted in ECC DEC(20)01 [15]
European Telecommunications Standards Institute
What is ETSI?

- The European Telecommunications Standards Institute (ETSI) is an internationally recognized Standards Development Organization (SDO)
  - One of three European Standardisation Organisations (ESOs)

- ETSI develops standards for information and communication technology
  - Technical standards that provide interoperability
    - TETRA, DECT, GSM, 3G, 4G, 5G …
  - Harmonized Standards that describe requirements for the EU’s/EFTA’s harmonized market
Quick facts

- ETSI has >900 members
  - Entity-based membership
  - Full, associate, and observer membership
  - Membership fees depend on size of entity
- ETSI’s headquarter is located in Sophia Antipolis in France
  - It is a not-for-profit association under French law
- ETSI does not certify products
ETSIs development process

- ETSI Directives [49] detail process
  - Equivalent to combed IEEE SA bylaws, operations manual, IEEE 802 policies & procedures etc.

- Contribution driven
  - Documents may be for information, discussion, or decision
Committees, projects & other groups [50]

- Access, Terminals, Transmission and Multiplexing (ATTM)
- Broadband Radio Access Networks (BRAN)
- EBU/CENELEC/ETSI on Broadcasting (BROADCAST)
- Integrated broadband cable telecommunication networks (CABLE)
- Cyber Security (CYBER)
- Digital Enhanced Cordless Telecommunications (DECT)
- Environmental Engineering (EE)
- eHEALTH
- Emergency Communications (EMTEL)
- EMC and Radio Spectrum Matters (ERM)
- Electronic Signatures and Infrastructures (ESI)
- Human Factors (HF)
- Core Network and Interoperability Testing (INT)
- Intelligent Transport Systems (ITS)
- Lawful Interception (LI)
- Mobile Standards Group (MSG)
- Methods for Testing & Specification (MTS)
- OpenSource MANO (OSM)
- Reconfigurable Radio Systems (RRS)
- Railway telecommunications (RT)
- Safety
- Satellite Earth Stations & Systems (SES)
- Secure Element Technologies (SET)
- Smart Body Area Network (SmartBAN)
- SmartM2M
- Speech and multimedia Transmission Quality (STQ)
- TETRA and Critical Communications Evolution (TCCE)
- TeraFlowSDN (TFS)
- User Group
Industry Specification Groups [50]

- Augmented Reality Framework (ARF)
- euCommon information sharing environment service and Data Model (CDM)
- cross-cutting Context Information Management (CIM)
- Experiential Networked Intelligence (ENI)
- Encrypted Traffic Integration (ETI)
- 5th Generation Fixed Network (FSG)
- Multi-access Edge Computing (MEC)
- millimetre Wave Transmission (mWT)
- Network Functions Virtualisation (NFV)
- Non-IP Networking (NIN)
- Operational energy Efficiency for Users (OEU)
- Permissioned Distributed Ledger (PDL)
- Quantum Key Distribution (QKD)
- Reconfigurable Intelligent Surfaces (RIS)
- Securing Artificial Intelligence (SAI)
- TeraHertz technology (THz)
- Zero-touch network and Service Management (ZSM)
Development process

ETSI Work Item (WI) = IEEE SA Project Authorization Request (PAR)

- Scope description
- Two decision events
- WI adoption
- Approval

Interim (draft) stages
- Early
- Stable
- For approval

May 2023
Development process—Decision making

- Decision making defined in ETSI Directives [49]
- Consensus driven
  - Consensus is defined as the lack of objection
  - Follows EC’s regulation [48]
- Nothing less than 100 % approval is sufficient
  - No need to provide reasons
  - No interpretations
- At the discretion of the chair, a vote may be conducted
  - Very rare because of high hurdles to conduct a vote
- Remote consensus (RC) for taking decisions independent of meetings
  - RC must be open for 30 d
ETSI process—EN 303 687 as example (1)

- **Work Item creation period**
  - Initiates standstill period
  - EU member states informed to discontinue developing related national standards

- **Drafting stage**
  - Member contributions
  - Discussions etc.

- **Harmonized Standard Technical Advisory Consultant (HASTAC) review**
  - Consultants to EC
  - Currently from EY [60]

- **EN - Approval Procedure (ENAP)**
  - Review, commenting, voting by National Standard Organizations (NSOs)
ETSI process—
EN 303 687
as example (2)

- 2<sup>nd</sup> HASTAC review
- ENAP recirculation (here, 2<sup>nd</sup> ENAP)
  - Review, commenting, voting by NSOs
- Immediate publication if no ENAP comments
  - Submission to EC
  - Request to publish in Official Journal of the EU
The role of the EC

- ETSI is sovereign over the content of its standards
  - The EC is an ETSI member
  - However, does not influence ETSI process

- In the past, the EC would list published HSs immediately in the Official Journal of the EU (OJEU)
  - Since several years, however, HSs are considered part of EU legislation (see Appendix for background information)

- The EC expects “legal certainty” of HSs

- Thus, HSs need to contain tests that
  - lead to binary results (pass/fail criteria)
  - are reproducible

- EC mandates to HASTAC reviews during HS development

- EC conducts legal review after publication
  - May bring further comments and questions
  - EC reserves the right to not publish an HS in the OJEU
HASTAC

- EC has budget for Harmonized Standard Technical Advisory Consultants (HASTAC)
  - Two mandatory reviews
  - When HS becomes mature (stable)
  - Before ENAP
- HASTAC provides suggestions, recommendations, and comments to ETSI groups
  - ETSI not required to concur with comments
  - However, comment resolution is mandatory  “Similar to IEEE SA ballot”
- Comments address various aspects
  - State of the art of technical solutions
  - Sufficient consideration of receiver requirements
  - Unambiguous tests leaving no choice to manufacturer
  - Absence of manufacturer declarations
  - …
European Norm Approval Process (ENAP)

- First ENAP stage (Public Enquiry) takes 90 d
- If comments are received they must be resolved
  - Afterwards, a “recirculation” of revised HS occurs
  - Takes 60 d
- If modifications beyond ENAP comments occurred, a ENAP might be initiated
- In case the HS is approved, ETSI must publish the unmodified HS within 10 d
National Standardization Organizations (NSOs)

- During ENAP, NSOs vote on HSs [67]
  - NSOs undertake national consultations [63]
  - Weighted voting, see [49]
  - Country dependent number of votes (number or residents etc.)
    - Germany, UK, France, Italy: 29
    - Spain, Poland: 27
    - ...
- Disapproval must be accompanied by comments
- Example: Deutsche Kommission Elektrotechnik Elektronik Informationstechnik (DKE) [62] represents Germany
  - Technical experts review HS
  - Agree on vote
  - Collect comments

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**[ENAP] CLOSED Public Enquiry / Weighted National Voting procedure**

**Current Detailed Results**

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- 1st ENAP on HS EN 303 687 as example
  - Here, voting details redacted
    - Accessible to ETSI members, only
  - Because of comments, ENAP failed
From Work Item (WI) to Official Journal of the EU (OJEU)

Milestones
- WI adoption
- HS drafting
- 1\textsuperscript{st} HASTAC review
  - Comment resolution
- HS completion
- 2\textsuperscript{nd} HASTAC review
  - Comment resolution
- Approval for ENAP
  - Comment resolution
- ENAP recirculation
  - Comment resolution
- HS publication
  - EC review
  - Resolution of EC comments

- The EC’s review of the final HS targets “legal certainty”
  - At this time, the HS cannot be modified anymore
  - If EC comments cannot be satisfied, the EC may deny listing the HS in the OJEU or the HS may be listed with comments
ETSI TC BRAN
Technical Committee (TC) Broadband Radio Access Networks (BRAN)

- WAS/RLAN related Harmonized Standards developed by TC BRAN
  - EN 301 893, 5 GHz
  - EN 303 687, 6 GHz
  - EN 302 567, 60 GHz
  - EN 303 722, 60 GHz
  - EN 303 753, 60 GHz
  - EN 301 598, TV Whitespace
  - ...

- Several other documents
  - Mesh Access Point performance testing
  - Coexistence in 5.8 GHz band
  - ...

License exempt Wireless Access Systems including Radio Local Area Networks (WAS/RLANs) represent the primary BWA technologies used for wireless internet access. With billions of devices already in operation, and the rapid growth expected to continue for the foreseeable future, and the demand for greater throughout to support Gigabit internet access and advanced wireless applications, the current spectrum allocations are insufficient to maintain an acceptable level of performance users are accustomed to.

Broadband Wireless Access includes a large variety of radio technologies and corresponding services therefore several ETSI technical committees are active in this area:

- **Broadband Radio Access Networks (BRAN)**
  - ETSI technical committee BRAN prepares and maintains Harmonised Standards for RLANs operating in the 5 GHz frequency band (EN 301 893), for White Space Devices (WSD) operating in the TV broadcast band (EN 301 508), for WPAN systems operating in the 60 GHz frequency band (EN 302 567), for WAS/RLANs operating in the band 5 925 MHz – 6 425 MHz (EN 303 687), for Wideband Data Transmission Systems (WOTIS) for fixed network radio equipment operating in the 57 GHz to 71 GHz (EN 303 722) and for WOTIS for Mobile and Fixed Radio Equipment operating in the 57 to 71 GHz band. If new frequency bands are allocated to BWA communications, then ETSI TC BRAN will most probably work on corresponding Harmonised Standards.
Current status of EN 303 687

Background

- During development of the HS, TC BRAN requested HASTAC review
  - Was not conducted because of a lack of EC budget
- 1st ENAP did not pass
  - Meanwhile, HASTAC program had restarted
  - TC BRAN requested HASTAC review
  - This brought comments in addition to ENAP comments
  - Hence, TC BRAN modified the HS beyond ENAP resolution
  - Therefore, ENAP restarted (90 d)

- Second ENAP will end on 2023-06-27
  - TC BRAN currently considering an initial ENAP comment review meeting on 2023-07-06
    - To be cancelled if no comments will be received
  - Next TC BRAN plenary meeting after IEEE 802.11 September 2023 interim
Current status of EN 301 893

- Considerations for WAS/RLAN operation in 5.8 GHz band included
  - Available in Czech Republic [64]
- HASTAC review conducted & comments addressed
  - Draft at version 51, now
- 2nd HASTAC review and initial ENAP outstanding

- TC BRAN members are discussing about a technical aspect considered highly important by many members
  - Some members are concerned about a certain relaxation that is assumed to cause unfair advantages, loophole
  - Other members are concerned about certain modes of operation being negatively impacted by stricter settings

- Hopefully, a compromise may be established at ETSI TC BRAN plenary meeting #119 [65]
Expectations for remainder of 2023

- Various ETSI TC BRAN members expressed their interest in developing a revision of EN 303 687
  - ETSI TBs/TCs cannot adopt a new WI until ETSI published the related HS
  - There is an interest in better consideration of several technical features
- It is hoped that HS EN 301 893 will enter 1st ENAP
- 1st ENAP and potential publication of HS EN 303 753
  - So far, this HS seemed to be uncontroversial to many TC BRAN members
2022 session distribution

<table>
<thead>
<tr>
<th>Committee</th>
<th>Duration in session</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAN</td>
<td>18 h 13 min</td>
<td>9,29%</td>
</tr>
<tr>
<td>EN 301 893</td>
<td>99 h 06 min</td>
<td>50,56%</td>
</tr>
<tr>
<td>EN 303 687</td>
<td>30 h 39 min</td>
<td>15,64%</td>
</tr>
<tr>
<td>EN 303 753</td>
<td>13 h 42 min</td>
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</tr>
<tr>
<td>TS 103 754</td>
<td>1 h 16 min</td>
<td>0,65%</td>
</tr>
<tr>
<td>TR 103 721</td>
<td>33 h 05 min</td>
<td>16,88%</td>
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<tr>
<td>EN 301 598</td>
<td>0 h 52 min</td>
<td>0,44%</td>
</tr>
<tr>
<td>Total</td>
<td>196 h 01 min</td>
<td>100,00%</td>
</tr>
</tbody>
</table>
License-exempt operation in the 5.8 GHz band in the Czech Republic

- The Czech Republic made available 5725 MHz to 5850 MHz at high power for license-exempt use
  - With minimal technical requirements, this band is available for non-specific Short Range Devices (SRD) in the EU
    - Limited to 25 mW EIRP
- Because of concerns, that WAS/RLAN products sold in the Czech Republic could operate at high power in the 5.8 GHz band in other EU countries, TC BRAN added a geolocation requirement for 5.8 GHz in HS EN 301 893
- The Czech Republic’s decision is an example for the sovereignty of countries over their spectrum
  - Nevertheless, the EU’s harmonized market may impact other countries etc.
Conclusion
In a nutshell …

- For Europe, ECC/CEPT develops spectrum regulation
  - Neither the European Commission (EC) nor ETSI define spectrum regulation

- For the EU, the EC issues directives forcing EU member countries to implement certain spectrum regulation
  - ETSI develops Harmonized Standards (HSs) based on a mandate by the EC

- HSs define requirements for placing products on the market of the European Economic Area (= EU & additional countries)
  - HSs do not define regulatory requirements

- If, and only if an HS is listed in the OJEU a manufacturer may use the HS to demonstrate compliance of its product with legal requirements
  - Thus, HSs are part of EU law
Appendix
Appendix A

Further information related to ETSI
Helpful insights—ETSI Seminars

- ETSI Strategy
- Discover the ETSI Environment
- Research, Innovation & Standards
- ETSI Membership
- Legal & Governance
- Standards and Regulation (Part 1)
- Standards and Regulation (Part 2)
- Standards and Regulation (Part 3)
- Technical Organization
- 3GPP Essentials
- Introduction to oneM2M
- Testing & Interoperability
- Specialist Task Forces
- ETSI Seminar Online Modules
The ETSI portal [55]
ETSI portal features (1)

- Access to partnership agreements, user & drafting guides, directives, templates
- Selection of different Technical Bodies/Committees (TCs/TBs)
  - E. g. TC BRAN
ETSI portal features (2)

- Member information
  - Contact data etc.
- E-mail list membership management, access, and archives

- ETSI voting tool
- Admission of new ETSI members
ETSI portal features (3)

Over the years ETSI has built up a portfolio of partnership agreements with fora, consortia and international and national SDOs around the world. Experience has shown that working with others is the best way to achieve alignment between our efforts. Cooperation reduces the overlap of effort and ensures that our work is widely accepted and implemented. Cooperation reduces the need for duplication of effort when dealing with the convergence of technologies. Our investment in partnerships is also an important means by which to meet market needs.

ETSI’s Partnership Engagement Process is described in the ETSI Directives (Technical Working Procedures area under 1.8.1 Partnerships).

*Note:* Access to the full text of ETSI's Partnerships is restricted to ETSI Members holding an ETSI On-Line (EO) account. To get an EO account, please send your request to partnerships@etsi.org.

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**BRAN Rules**

**Submission deadlines**
- Contributions uploaded to the ETSI portal less than 14 days (336 h) prior to the beginning of an ETSI TC BRAN meeting shall be marked as late contribution.
- Contributions uploaded to the ETSI portal less than 7 days (168 h) prior to the beginning of an ETSI TC BRAN meeting shall be marked as late contribution.

**Late contributions**
- During a meeting, a late contribution shall not be discussed or presented if an ETSI TC BRAN member objects to the late contribution being considered.
- Presentation or discussion of the late contribution shall be deferred to the next meeting of ETSI TC BRAN (or ETSI TC BRAN rapporteur's group meeting).

**Meeting procedures**
- At the beginning of any ETSI TC BRAN related meeting, the meeting leadership (chair, vice-chair, rapporteur etc.) shall call the meeting to order.
ETSİ portal features (4)
ETSI portal features (5)

- Registration
- Meeting details
  - Type (Ordinary, plenary, rapporteur’s, ad hoc, …)
  - Duration
  - Location
ETSI portal features (6)

- Decision
- Discussion
- Information

Detailed view

Submitter

Submitters

- BRAN(22)115010
  - Submitted 2022
  - For meeting 115
  - Document number 010 at meeting #115
  - Reassigned to meeting #117

- Accepted (green)
- Rejected (red)
- Noted (olive)
- Available (blue)

Part of remote consensus

Submitted after deadline

For meeting 115

- Agenda
- Report
- LSin
- LSout
- Other
- Change
- Request (CR)
- …
Appendix B

Essential requirements—HS EN 301 893 as an example
Major aspects in EN 301 893 (1)

- Requirements for radar detection
  - Definition of pulse patterns
  - Rules for vacating radar channels
- Adaptivity (Medium Access)
  - Load Based Equipment (LBE)
  - Similar to IEEE 802.11
  - Frame Based Equipment (FBE)
  - May access medium at discrete times
  - Sensing but no backoff process

4.2.7.3.2.6 Initiating Device Channel Access Mechanism

Before a transmission or a burst of transmissions on an Operating Channel, the Initiating Device shall operate at least one Channel Access Engine that executes the procedure described in step 1) to step 8) below. This Channel Access Engine makes use of the parameters defined in table 7 or table 8 in clause 4.2.7.3.2.4.

A single Observation Slot as defined in clause 3.1 and as referenced by the procedure in the present clause shall have a duration of not less than 9 μs.

An Initiating Device shall operate at least one and no more than four different Channel Access Engines each with a different Priority Class as defined in clause 4.2.7.3.2.4.

1) The Channel Access Engine shall set CW to CWmin.

2) The Channel Access Engine shall select a random number q from a uniform distribution over the range 0 to CW. Note 2 in table 7 defines an alternative range for q when the previous or next Channel Occupancy Time is greater than the maximum Channel Occupancy Time specified in table 7.

3) The Channel Access Engine shall initiate a Prioritization Period as described in step 3) a) to step 3) c)

   a) The Channel Access Engine shall set p according to the Priority Class associated with this Channel Access Engine. See clause 4.2.7.3.2.4.

   b) The Channel Access Engine shall wait for a period of 16 μs.

   c) The Channel Access Engine shall perform a Clear Channel Assessment (CCA) on the Operating Channel during a single Observation Slot.

      i) The Operating Channel shall be considered occupied if other transmissions within this channel are detected with a level above the ED threshold defined in clause 4.2.7.3.2.5. In this case, the Channel Access Engine shall initiate a new Prioritization Period starting with step 3) a) after the energy within the channel has dropped below the ED threshold defined in clause 4.2.7.3.2.5.

      ii) In case no energy within the Operating Channel is detected with a level above the ED threshold defined in clause 4.2.7.3.2.5, p may be decremented by not more than 1. If p is equal to 0, the Channel Access Engine shall proceed with step 4) otherwise the Channel Access Engine shall proceed with step 3) c).

4) The Channel Access Engine shall perform a Backoff Procedure as described in step 4) a) to step 4) d)

   a) This step verifies if the Channel Access Engine satisfies the Post Backoff condition. If q < 0 and the Channel Access Engine is ready for a transmission, the Channel Access Engine shall set CW equal to CWmin and shall select a random number q from a uniform distribution over the range 0 to CW before proceeding with step 4) b). Note 2 in table 7 defines an alternative range for q when the previous or next Channel Occupancy Time is greater than the maximum Channel Occupancy Time specified in table 7.
Major aspects in EN 301 893 (2)

- Rules for channel bonding
- Maximum transmit power
- Spectral masks
- Detection thresholds for Listen-before-Talk (LBT)
- Description of various tests
  - Adaptivity, radar detection, sensing thresholds, channel bonding, …

### Figure 1: Transmit spectral power mask
What is new in version 2.1.1?

- **Until version 1.8.1**
  - Requirements focusing on device
  - Generic concept defining maximum transmit duration dependent on random medium access deferral
  - Simple tests measuring duty cycle etc.

- **From version 2.1.1**
  - Fixed channel raster
    - Temporal minimal bandwidth of 2 MHz
  - Testing system behavior
    - Channel access behavior of device under test (DUT) and companion
    - Duration of DUT and companion device transmissions not to exceed TXOP (Channel Occupancy Time, COT) threshold
  - Very detailed LBE requirements
    - Testing backoff behavior, measuring statistics etc.
  - Restricting user access to software and device behavior
    - Must not disable radar detection
  - Deferral to different modulated signals
    - Not only testing gaussian noise
**Important terminology**

- **HSs must be technology-neutral**
  - No technology specific exceptions or assignments
  - Therefore, EN 301 893 introduces some generic terms

- **A selection of terms most important to Load Based Equipment (IEEE 802.11) on the right**

- **Terms important to IEEE 802.11**
  - Initiating Device
    - TXOP owner
  - Responding Device
    - Device addressed by TXOP owner
  - Supervising Device
    - AP STA
  - Supervised Device
    - Non-AP STA
  - Channel Occupancy Time (COT)
    - TXOP
  - $p_0$
    - AIFSN
  - $q$
    - Backoff counter
LBE adaptivity

- **Emulating EDCA**
  - Prioritization period $\equiv$ AIFS[AC]
  - Backoff procedure $\equiv$ CW[AC] dependent random waiting
  - Virtual collisions etc.
- **DCF & “Post-backoff” behavior are permitted**
What are essential requirements?

- **Basically, all “shall” statements**

- **Examples**
  - Radar detection
  - Unwanted emissions
    - Inside band
    - Outside band
  - Receiver blocking

- **Channel bonding, spectral masks**
- **Power density**
  - Max transmit power
- **LBT thresholds**
  - Deferral to modulated signals & noise
- **Backoff behavior**
  - Slot distribution
- **Maximum TXOP duration**
Example: Backoff test (1)

- EN 301 893 defines a Channel Occupancy Time (COT = TXOP) as sequence of transmissions having no gaps of more than 25 µs duration
  - Defined by occupied and unoccupied periods
  - Used to classify measurements
Example: Backoff test (2)

• EN 301 893 translates the adaptivity requirements on the truncated exponential backoff into discrete bins of certain duration
  • Depends on priority and device category (e.g. non-AP STA or AP STA)
Example: Backoff test (3)

- A Cumulative Distribution Function (CDF) describes a tolerable probability per bin
  - Devices fail if probability of bins are exceeded
  - Devices may always wait longer than permitted
    - Less aggressive behavior

\[
\begin{align*}
    p(n) &\leq \begin{cases} 
        0.05, & n = 0 \\
        0.12, & n = 1 \\
        0.12 + (n - 1) \times 0.0625, & 2 \leq n \leq 15 \\
        1, & n > 15 
    \end{cases}
\end{align*}
\]

For Class used for the test is 2, each cumulative probability \( p(n) \) of an individual test shall not exceed the following maximum probability.

If the UUT makes use of note 2 in table 7 in clause 4.2.7.3.2.4:

\[
\begin{align*}
    p(n) &\leq \begin{cases} 
        0.05, & n = 0 \\
        0.12, & n = 1 \\
        0.12 + (n - 1) \times 0.03125, & 2 \leq n \leq 29 \\
        1, & n > 29 
    \end{cases}
\end{align*}
\]

If the UUT does not make use of note 2 in table 7 in clause 4.2.7.3.2.4:

\[
\begin{align*}
    p(n) &\leq \begin{cases} 
        0.05, & n = 0 \\
        0.12, & n = 1 \\
        0.12 + (n - 1) \times 0.0625, & 2 \leq n \leq 15 \\
        1, & n > 15 
    \end{cases}
\end{align*}
\]

If the UUT makes use of note 1 in table 7 in clause 4.2.7.3.2.4:

\[
\begin{align*}
    p(n) &\leq \begin{cases} 
        0.05, & n = 0 \\
        0.09 + (n - 1) \times 0.03125, & 1 \leq n \leq 7 \\
        0.09 + (n - 1) \times 0.03125, & 8 \leq n \leq 15 \\
        1, & n > 15 
    \end{cases}
\end{align*}
\]
Do these requirements matter to IEEE 802.11 implementations?

- [80] finds many devices violating requirements defined in HS EN 301 893
  - A vendor must not place these products on the market of the EU by self-assessment
  - Should vendors intend to place these products on the market of the EU, a notified body permission is required

- Independently, [81] finds the same issues in current product implementations
  - Thus, confirming the results in [80]

- Without notified body approval, EU market surveillance may remove non-compliant products from the EU market
Appendix C

Guides by the European Commission
The EC’s Blue & RED guides, and the EC’s Vademecum

Blue Guide [69]
- Guide to New Legislative Framework (NLF)
- Discusses legislation for non-food products
- Review of making available and placing products on the market
- Modules and conformity assessments

RED Guide [70]
- Guide to Radio Equipment Directive (RED) [28]
- What is a radio equipment?
- Which devices apply to RED?
- Antennas, receivers etc.
- Fixed and vehicle installations, …

Vademecum [71]-[74]
- The role of the EC in requesting standards
- Standards request as an implementing act
- Roles of ESOs and stakeholders
- Preparation of standards & legal requirements to be covered
- Guidelines on executing standardization requests
- Development of standards
- Selection of normative references
- Compliance of standard with request
Appendix D

Background related to Harmonized Standards being part of EU legislation
The search for legal certainty

- In 2016, the European Court of Justice concluded [78] that HSs “form ‘part of Union law’” [77]
  - This decision has major consequences
- Thus, is the EC liable for HS developed based on its mandates?
  - See discussion [76]
- Because of the court’s decision, the EC lists HSs in the OJEU’s legislation series
  - In the past, EC listed HSs in the communication series of the OJEU
- From the court’s decision, EC concluded that it has special responsibility for HSs
  - Therefore, there is a push for “legal certainty” in HSs
References
References (1)


2. G. R. Hiertz, “A map of the world highlighting the International Telecommunication Union region 1,” derived from work created by M. Dörrebecker (Chumwa), licensed under CC BY-SA 2.5 https://creativecommons.org/licenses/by-sa/2.5. Original work available via Wikimedia Commons, accessed 2023-05-05. [Online]. Available: https://upload.wikimedia.org/wikipedia/commons/9/9b/International_Telecommunication_Union_regions_with_dividing_lines.svg

3. G. R. Hiertz, “A map of the world highlighting the members of CEPT,” derived from work created by M. Dörrebecker (Chumwa), licensed under CC BY-SA 2.5 https://creativecommons.org/licenses/by-sa/2.5. Original work available via Wikimedia Commons, accessed 2023-05-05. [Online]. Available: https://upload.wikimedia.org/wikipedia/commons/9/9b/International_Telecommunication_Union_regions_with_dividing_lines.svg


References (2)


References (3)


References (3)


References (4)


