



ETSI White Paper No. 63

# ***Standards in support of Europe's Digital Infrastructure Needs***

***ETSI perspectives***

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## Executive Summary

The whitepaper “How to master Europe’s digital infrastructure needs?” highlights the critical role of cutting-edge digital network infrastructure in driving economic growth, societal development, and innovation within the European Union (EU). Emphasizing secure and sustainable digital infrastructures as a key pillar of the EU's Digital Decade Policy Programme 2030, it underscores the importance of advanced connectivity for various sectors, including healthcare, agriculture, and manufacturing.

The paper stresses the necessity of high-performance digital infrastructures for enabling transformative technologies like Artificial Intelligence (AI), Virtual Worlds, and Web 4.0, while also addressing societal challenges such as energy, transport, and healthcare. It points out that the future competitiveness of Europe's economy relies heavily on advanced digital networks, which could contribute significantly to global GDP growth.

Moreover, it discusses the convergence of digital networks with cloud and edge computing capabilities, highlighting opportunities and risks associated with this transformation. It underscores the need for continued innovation in the digital infrastructure sector, advocating for a regulatory framework that incentivizes investments in fiber networks, 5G/6G, and cloud-based infrastructures.

This advocates for a strategic Union-wide approach to enhance the security and resilience of critical digital infrastructures, building upon existing legislative frameworks.

**In summary, the EC whitepaper highlights the imperative for strategic policy actions to incentivize the development of future digital networks, facilitate the transition to new technologies and business models, and ensure the competitiveness, security, and resilience of the EU's digital infrastructure.**

**Many of the abovementioned developments can and need to be supported by international and European standards. The role of this whitepaper is to underline the role of ETSI in the development of standards in support of EU policy and policies, as well as the role of standards in driving innovation.**

## Introduction to ETSI

ETSI, established in 1988, is a not-for-profit organization that produces globally applicable technical standards for ICT-enabled systems, applications, and services. These standards are widely deployed across various sectors of industry and society. Recognized by the European Union as a European Standards Organization (ESO), ETSI’s outputs cover Information and Communications Technologies, including fixed, mobile, radio, transportation, broadcast, and Internet technologies.

ETSI boasts 946 members from 64 countries (as of end 2023). These members include world-leading companies, regulatory authorities, government ministries, small/medium-sized enterprises, innovative start-ups, universities, R&D organizations, and societal interest groups.

The organization’s standards play a crucial role in ensuring the free movement of goods within the European single market, enhancing the competitiveness of enterprises in the European Union. Beyond Europe, ETSI’s influence extends globally due to its excellence in work and open approach.

**The European Single Market is a fundamental policy of the European Union, aimed at creating a unified market across member states. One crucial mechanism for translating this political ambition into practical action is standardization.**



## Harmonised Standards in support of EU Legislation

Harmonised standards are European standards developed by recognized European Standards Organizations such as ETSI, CEN, or CENELEC, and are created in response to requests from the European Commission and provide the technical detail necessary to achieve the ‘essential requirements’ of a Directive.

Manufacturers, economic operators, and conformity assessment bodies can use harmonized standards to demonstrate that their products, services, or processes comply with relevant EU legislation.

References to harmonized standards are published in the Official Journal of the European Union (OJEU).

**In summary, harmonized standards play a critical role in achieving the goals of the European Single Market by ensuring consistency, safety, and compatibility across products and services.**

**To-date, ETSI has delivered 98 Harmonised Standards to the EC, with another 245 work items in progress.**

## ETSI’s support to Europe’s Digital Infrastructure Needs

### Security standards for end-to-end connectivity

The increasing complexity of systems and networks, along with an evolving threat landscape, highlights the critical need for security and privacy in our digital world. Information and Communications Technologies (ICT) face challenges in maintaining security, especially with developments like the Internet of Things (IoT) and Industry 4.0. Additionally, technologies such as virtualization, cloud computing, and generative AI introduce specific security concerns.

Privacy awareness is growing due to media exposure of insecure products and services. To address these challenges, regulators are imposing stricter Cyber Security assurance and information threat sharing requirements on ICT manufacturers and operators. While some regulations remain optional, second-generation rules like the EU Cyber Resilience Act (CRA) will enforce mandatory standards.

### Cybersecurity

Mitigating the security landscape requires a reliable network infrastructure and user trust. Privacy, confidentiality, secure identification, and visibility of security are crucial considerations. Standardization, supported by legislative actions, plays a vital role in safeguarding communications and business. ETSI’s Cybersecurity Technical Committee (TC CYBER) develops market-driven solutions and provides guidance to regulators, users, manufacturers, and network operators.

ETSI and TC CYBER co-operate with numerous international, regional, and national organizations and governments involved in cyber security, including the European Cybersecurity Agency (ENISA), CEN, CENELEC, the International Telecommunication Union (ITU) and the International Organization for Standardization (ISO).

The security of consumer IoT has been a longstanding focus for TC CYBER. In 2023, the committee worked on revising the existing standard EN 303 645, which addresses Cyber Security for Consumer Internet of Things: Baseline Requirements. The updated version, initially published as ETSI TS 103 645 V3.1.1 (issued in January 2024), will progress to an update of the EN version during 2024. This update incorporates feedback from industry and test labs that use the current EN version and extends data protection provisions.



In anticipation of the proposed European Cyber Resilience Act (CRA), TC CYBER collaborated with other ETSI groups in 2023. They continued analysing the proposed legislation, provided comments to the European Commission on the draft Standardization Request, and developed a mapping to assess existing standards and identify further work required within ETSI to support the Act. The finalization of this effort is expected in early 2024, following the availability of the final draft of the CRA. EN 303 645 is poised to play a crucial role in ETSI's approach to standards addressing CRA requirement.

### Quantum Safe Cryptography

Quantum-safe cryptography is essential for securing sensitive data, access, and communications in the era of quantum computing. As quantum computers advance, they pose a significant threat to conventional cryptographic methods.

Quantum computers have the potential to break existing encryption methods, jeopardizing the security of information like bank account details.

ETSI's CYBER QSC Working Group focuses on practical implementation of quantum-safe primitives. Their work includes considerations related to performance, implementation capabilities, protocols, benchmarking, and practical architectural aspects for specific applications.

The group collaborates with other standards bodies like ITU, IETF, ISO, and GlobalPlatform.

CYBER QSC aims to address architecture, implementation, and protocols related to quantum-safe cryptography. However, the development of cryptographic primitives is not within their scope.

In May 2023, CYBER QSC published a Technical Report (TR 103 949 V1.1.1) offering recommendations for a quantum-safe cryptography migration strategy. This strategy specifically targets Intelligent Transport Systems (ITS) and Cooperative Intelligent Transport Systems (C-ITS) use cases.

**Quantum-safe cryptography is crucial for safeguarding our digital information against the future threat posed by quantum computers. ETSI's efforts contribute significantly to enhancing security in the face of evolving technology.**

### Quantum Key Distribution

There is a concern that today's network communications that are encrypted using conventional public key cryptography may be decrypted in the future when more powerful processors or new methods of cryptanalysis are available.

Unlike conventional methods, quantum cryptographic protocols should be resilient to all advances in computing and mathematics. The inherent security of quantum cryptography stems from the way it uses properties that quantum states derive from the Laws of Nature, rather than assumptions about the difficulty of certain mathematical operations.

Quantum Key Distribution (QKD) enables keys to be established securely over optical links, via the transfer of quantum states. The security of QKD protocols is based on quantum entanglement – or the impossibility of cloning/measuring the unknown quantum states transferred – rather than algorithmic complexity. Recently there has been remarkable progress in the deployment of quantum technologies in communication infrastructures, with several quantum key distribution (QKD) networks under construction around the world. The high level of current activity in quantum communications means that there is a pressing need to develop industrial standards for the technology.



ETSI's Industry Specification Group (ISG) on QKD is leading activities to help fulfil this need by developing common interfaces and specifications for the quantum communications industry that will stimulate markets for components, systems and applications.

The group's work is fundamental to enabling the future interoperability of the QKD networks being deployed around the world. Just as importantly, it will ensure that quantum cryptography is implemented in a secure manner that mitigates the risk of side channels and active attacks.

### Securing AI

The Industry Specification Group on Securing Artificial Intelligence (ISG SAI) has been responsible for developing technical reports and specifications to address threats related to AI deployment and AI system security.

In response to the growing interest in AI, ISG SAI transferred its activities to the new Technical Committee on Securing Artificial Intelligence (TC SAI) in December 2023. TC SAI aims to contribute directly to standardization requests, including those related to the future AI Act, the Cybersecurity Resilience Act (notably Article 8), and NIS2. The committee will create standards to ensure secure and safe AI deployment, considering input from stakeholders such as end users, manufacturers, operators, and governments. Additionally, TC SAI focuses on protecting at-risk populations targeted by AI-generated content.

Key aspects addressed by ISG/TC SAI include:

- Securing AI from Attack: This involves defending AI components within a system.
- Mitigating Against AI: Addressing situations where AI itself is the problem or enhances other attack vectors.
- Using AI to Enhance Security Measures: Leveraging AI as part of the solution to improve conventional countermeasures.

**TC SAI's work is agnostic to specific AI system deployment use cases, emphasizing fundamental threats unique to AI systems. Their technical standards and reports serve as a baseline for ensuring AI system security, impacting stakeholders such as end users, manufacturers, operators, and governments.**

### Secure Elements Technology

ETSI's Technical Committee on Secure Element Technologies (TC SET) is responsible for developing and maintaining specifications for the Secure Element (SE) used in communication systems including the Internet of Things (IoT) and Machine-to-Machine (M2M) applications. TC SET develops 'agnostic' specifications that can find their way into other applications such as ID management, ticketing and cards with contactless interfaces used in financial services.

It is also home of the new Smart Secure Platform (SSP). Designed to cover needs from diverse industries (e.g. automotive, banking, telecom, IoT), SSP offers a more flexible platform than the UICC. It can be adapted to multiple different products and markets, while maintaining a common set of features and some of the characteristics of the UICC platform. SSP offers an open platform for multiple applications, a choice of physical interfaces and form factors to adapt to market needs, a flexible file system, and built-in capabilities to support multiple authentication methods (such as biometrics).



## Electronic Signatures and Trust Infrastructure

ETSI's committee on Electronic Signatures and Trust Infrastructures (TC ESI) addresses the requirements of digital signatures, including formats and procedures and policies for creation and validation, as well as trust service supporting the authenticity of transactions.

The committee's scope covers policy, security, and technical requirements for trust service providers (TSPs) such as certification authorities, time-stamping authorities, TSPs providing remote signature creation or validation functions, registered e-delivery providers, and long-term data preservation providers. The committee's work supports the eIDAS (electronic ID, authentication, and signature) regulation EU 910/2014, as well as general requirements of the international community to provide confidence in electronic transactions. This sees ETSI coordinating its eIDAS-related activities with CEN/CENELEC.

## Shaping innovation and standards in (mobile) Communications

### Supporting European (Mobile) Harmonised Standards

The primary responsibility of ETSI's Mobile Standards Technical Committee (TC MSG) is to perform work regarding areas of activity as requested by mandates from the European Commission and all other tasks attributed to ETSI in support of European regulation of related systems.

In addition, it identifies European regulatory requirements on cellular systems to be developed by 3GPP, TC MSG develops Harmonised Standards covering essential requirements under Article 3.2 of the Radio Equipment Directive 2014/53/EU and related ETSI deliverables for GSM as well as the IMT family of technologies and their evolution. The committee maintains close liaison with 3GPP, ITU, and IEEE, as well as other ETSI bodies that might be affected by deliverables produced by MSG.

TC MSG works alongside ETSI's Electromagnetic Compatibility and Radio Spectrum Matters Committee (TC ERM) in the joint **Task Force for European Standards (TFES)** for IMT-2000 and IMT-2020 (TFES). TFES has primary responsibility to develop European Norms (ENs) intended to become Harmonised Standards under the Radio Equipment Directive (RED) for members of the IMT family of radio interfaces (GSM, UMTS, LTE, NB-IoT and 5G NR), as defined in ITU-R Recommendation M.145

### 3GPP

The 3rd Generation Partnership Project (3GPP) unites seven telecommunications standard development organizations – ARIB (Japan), ATIS (North America), CCSA (China), ETSI (Europe), TSDSI (India), TTA (Korea), TTC (Japan) - known as "Organizational Partners". Together, the partners provide their members with a stable consensus-based environment that has delivered the technical specifications for the 3G – 4G – 5G mobile networks that billions of users depend on worldwide.

3GPP specifications cover cellular telecommunications technologies, including radio access, core network and service capabilities, providing a complete system description for mobile telecommunications. The 3GPP specifications also provide hooks for non-radio access to the core network, and for interworking with non-3GPP networks. With the success of the LTE and 5G work, 3GPP has become the focal point for the vast majority of mobile systems across the globe.

In December 2023, the partners announced that 3GPP will develop the standard for the sixth Generation of mobile systems. The first ITU IMT-2030 (6G) study on the radio part is scheduled for mid-2025, with further 6G studies due throughout 2026. The first 6G Technical Specifications are scheduled for 3GPP Release 21, to be published after Q1 2029. As usual in 3GPP, previous Generations will continue to be enhanced, in parallel.





3GPP is uniquely positioned to develop the standard for the sixth generation of mobile systems or “6G”. The organization’s consensus-based process delivers the critical technical specifications that provide a complete system description for the mobile networks that billions of users depend on.

### Digital Enhanced Cordless Telecommunications (DECT)

ETSI’s Digital Enhanced Cordless Telecommunications (DECT™) specification is the leading standard around the world for digital cordless telecommunications. Originally developed by ETSI in the early 1990s, it is implemented in more than a billion short-range communication devices around the world.

The capabilities of DECT have evolved over the last three decades, with improvements to security and voice quality plus the addition of video telephony and broadband data streaming. In 2011 ETSI’s specification of DECT ULE (Ultra Low Energy) broadened the technology’s appeal to M2M markets such as smart metering and home automation.

**Interacting with the DECT Forum and ITU-R (WP5D), our DECT Technical Committee’s activities in recent years have been primarily focused on the development of the DECT-2020 NR (‘New Radio’) system.**

### TETRA - Terrestrial Trunked Radio

Developed to meet the needs of Professional Mobile Radio (PMR) users in public safety, security, transportation, military, governmental, commercial and utilities applications, TETRA (Terrestrial Trunked Radio) is the leading technology choice for critical communications users.

TETRA is designed to address a specific set of communication requirements. These include high reliability, single and group calling capabilities, PTT (Push-To-Talk), and the possibility for direct peer-to-peer communications in situations such as natural disasters and emergencies when the supporting network is unavailable. Accordingly, much of the work of our TETRA and Critical Communications Evolution committee (TC TCCE) is driven by the requirements of Public Protection and Disaster Relief and other mission-critical services.

**The committee will continue to maintain and further develop TETRA with user-driven standards for authority-to-authority secure voice and data services over broadband and narrowband air interfaces. This work has included the incorporation of a new set of air interface security algorithms, appropriate for a lifetime beyond 2040.**

### Broadband Radio Access Networks

ETSI’s Broadband Radio Access Networks committee (TC BRAN) produces and maintains standards and specifications for current and future Wireless Access System (WAS) and Radio Local Area Network (RLAN) technologies in different frequency ranges. The committee has primary responsibility for all aspects of standardization for broadband radio access networks.

**ETSI TC BRAN have prepared and maintain, inter alia, harmonized standards for RLANs operating in the 5 GHz frequency band (EN 301 893), for Broadband Fixed Wireless Access (BFWA) using the 5,8 GHz band (EN 302 502), for White Space Devices (WSD) operating in the TV broadcast band (EN 301 598), for WAS/RLAN systems operating in the 60 GHz frequency band (EN 302 567) and for Broadband Direct Air-to-Ground Communications (EN 303 316 and EN 303 339). If new frequency bands are allocated to BWA communications then ETSI TC BRAN will most probably work on corresponding harmonized standards.**



## Emergency Communications

Our Emergency Communications Technical Committee (TC EMTEL) is focused on the access to emergency services through different media, data transmission to public safety answering points, networks and IoT (Internet of Things) devices in the provision of emergency situations and in the context of the European Public Warning System. The scope of its work includes emergency communications between individuals and authorities/organisations; between authorities/organisations; and between individuals.

Much of the committee's activity is centred on IP-based emergency communications services, involving communications between IoT devices in emergency situations. This work includes the architecture (known as Next Generation 112 by the community), core elements and technical interfaces for network-independent access to emergency services.

**Throughout 2023 the committee has maintained its liaison with organizations outside ETSI, such the Electronic Communications Committee of the European Conference of Postal and Telecommunications Administrations (CEPT ECC). It also follows the activities of organizations including the European Emergency Number Association (EENA), the Telecommunications Standardisation sector of the International Telecommunication Union (ITU-T), and various fora and consortia, including the Internet Engineering Task Force working group on Emergency Context Resolution with Internet Technologies (IETF-ECRIT).**

## Satellite Communications

The applications of satellite communications technology range from direct-to-home TV, location services and high-speed Internet access to fixed and mobile user equipment, especially for rural and outlying regions or onboard aircraft, ships or land transportation.

Our Satellite Earth Stations and Systems technical committee (TC SES) is the technical body within ETSI that is responsible for creating standards for satellite terminals (earth stations) and systems.

This work notably includes the development and revision of Harmonised Standards covering all aspects of satellite earth station fixed terminals or terminals on the move, whether in an aircraft, on board a ship or mounted on a vehicle.

**TC SES pursued compliance of our Harmonised Standards (ENs) with the Radio Equipment Directive, as part of the ongoing consultation process with the EC. The committee issued revisions to various Harmonised European Standards for access to radio spectrum, in order to ensure that language used is consistent with requirements for citation in the OJEU.**

## Broadband Cable Telecommunication Networks

ETSI's Integrated Broadband Cable Telecommunication Networks committee (TC CABLE) develops standards addressing the evolution of the capabilities of broadband cable networks. At the same time, it serves as the point of contact within ETSI for expertise in hybrid-fibre coax (HFC) network technology and systems.

The committee's work leverages close relationships with the Society of Cable Telecommunications Engineers (SCTE), CENELEC (especially TC209) and ITU-T (especially SG9). TC CABLE works with the wider global cable community to foster innovation and competitiveness, making technology available industry-wide based on voluntary standards.



Within ETSI, TC CABLE interacts with other Technical Committees, notably TC EE and TC CYBER, contributing its expertise on cable technologies on horizontal topics led by those committees and assessing potential impact on integrated broadband cable telecommunication networks and services.

## Sustainability and Accessibility

### Environmental Engineering

ETSI's Environmental Engineering Committee (TC EE) manages various engineering aspects of telecommunication equipment in different types of installation. These include climatic, thermal and other environmental conditions; physical requirements of equipment racks and cabinets; power supplies and grounding; Circular Economy (including lifecycle analysis) and energy performance measurement and assessment methods for different parts of radio access networks including data centres. The committee's work also embraces innovative energy storage technologies for ICT equipment – for example to provide resilience in sustainable smart cities.

The committee is in continuous interaction with ITU-T SG5 on the production of technically aligned deliverables, with a co-located meeting taking place in June 2023 at ETSI premises. A joint workshop on sustainability is currently being organized in collaboration with SG5, scheduled to take place in 2024.

During 2023 TC EE's activities continued to address four key areas: revision of environmental classes to consider climate change adaptation aspects; measurement methods for the energy efficiency of ICT equipment; standardization on eco-design aspects of servers and storage products; and requirements for power supply interfaces of ICT equipment.

**Much of our work supports European Commission (EC) policies, regulation and legislation on eco-design aspects, where we liaise with the European Committee for Electrotechnical Standardization (CENELEC) and CEN to develop relevant standards.**

### Human Factors

Human Factors is the scientific application of knowledge about human capacities and limitations to make products, systems, services, and environments effective, efficient and easy for everyone to use. It is a key factor for the commercial success of any ICT product or service in the digital networked economy.

In ETSI we are helping to achieve these objectives through the work of our Technical Committee on Human Factors (TC HF). The committee has primary responsibility to produce standards, guidelines and reports that set the criteria necessary to embed optimum usability in the emerging digital networked economy. Its work on the development of standards for accessibility of ICT products and services is conducted to support EU regulations, and in line with international best practices.

**TC HF co-operates with other groups within ETSI and outside, such as CEN/CENELEC/ETSI Joint Technical Board on eAccessibility, to assist in the production of standards and other deliverables in accordance with good Human Factors practice. Within ETSI it has a responsibility for 'Design for All', addressing all users including children, seniors and people with special accessibility needs.**



## Supporting Vertical Markets

### eHealth

eHealth includes the application of ICT (information and communications technologies) across the whole range of functions that affect the health sector. It promises to improve the quality of healthcare, reduce costs and help to foster independent living. However, its successful implementation relies on the widespread digitization of all sectors of society.

One of the problems currently hindering the development of the virtual clinic is a lack of interoperability. Standards thus have a key role to play in assisting the development of new eHealth products and services.

A further critical role for eHealth is emerging with the introduction of Artificial Intelligence (AI) into many areas where eHealth presents important use cases.

**TC eHEALTH has primary responsibility to collect and define Health ICT related requirements from relevant stakeholders and to input the requirements to the concerned ETSI Technical Bodies and to identify gaps, where existing ETSI standards do not fulfil the Health ICT requirements, and suggest further standardization activities to fill those gaps.**

### M2M/IoT

M2M (Machine-to-Machine) communications are the foundations for a fast-emerging world of smart devices, appliances, homes, cities and communities.

TC SmartM2M (Smart M2M Communications Technical Committee) is the main Technical Body supporting ETSI's role in the oneM2M Partnership Project (onem2m.org). With much of its work focused on the IoT, the committee creates specifications and reports that enable users to build platforms allowing devices and services to be connected, regardless of the underlying technology used.

The committee's work enables connected devices to exchange information through SAREF, ETSI's Smart Applications REFERENCE ontology that runs with oneM2M-compliant communication platforms. Providing building blocks that allow separation and recombination of different parts of the ontology depending on specific needs, SAREF specifies recurring core concepts in the smart applications domain and the relationships between them.

SmartM2M has also continued to actively participate in CEN/CENELEC/ETSI Coordination Group on Smart Grids (CG-SG) and · CEN/CENELEC/ETSI Coordination Group on Smart Manufacturing.

**TC SmartM2M continues to support European policy and regulatory requirements including mandates in the area of M2M and the Internet of Things and identifies EU policy and regulatory requirements on M2M services and applications to be developed by SmartM2M, and the conversion of oneM2M specifications into European Standards.**

## Transport

### Rail Telecommunications

Working with the rail industry in Europe and worldwide, TC RT is responsible for the development and maintenance of ETSI standards related to GSM-R as required by applicable European legislation and its evolution (FRMCS).

ETSI is represented in the Joint Programming Committee on Rail, set up by ETSI/CEN/CENELEC in 1994. In addition, TC RT is also represented in the EU-Rail System Pillar Steering Group as well as the EUAR TWG STA (European Union Agency for Railways Technical Working Group on STandardisation).



TC RT liaises closely with the International Union of Railways (UIC) setting the Users Requirements and with 3GPP to standardize FRMCS, the successor to GSM-R. This request has led to an intensive Work Programme driving the development of an extensive set of new Technical Specifications for FRMCS, with ETSI playing a major role in the technical assessment of user requirements and organizing the transition and the evolution of the current normative specifications.

### Intelligent Transport Systems

Intelligent Transportation Systems (ITS) enable smarter, more coordinated and efficient use of transport networks with the potential to increase safety for travellers and the public, minimize environmental impact and improve traffic management.

ETSI's ITS Technical Committee (TC ITS) has primary responsibility to produce and maintain standards, specifications and other deliverables to support the development and implementation of ITS service provision across the network, for transport networks, vehicles and transport users – including interface aspects and multiple modes of transport and interoperability between systems, but not including ITS application standards, radio matters, and EMC.

Scope of this work includes communication media, and associated physical layer, transport layer, network layer, security, lawful intercept, and the provision of generic web services. In addition, the committee develops conformance test specifications which are crucial for the commercial deployment of the technology and are closely involved in radio spectrum requirements for ITS.

**TC ITS continues to work in cooperation with ETSI TC RT on Road ITS and Urban Rail applications in the 5,9 GHz frequency band. The purpose of this work is linked to the COMMISSION IMPLEMENTING DECISION (EU) 2020/1426 on the harmonized use of radio spectrum in the 5 875-5 935 MHz frequency band for safety-related applications of ITS.**

### Connecting to Research

Engaging in Standards groups at the appropriate stages of research and innovation cycles is crucial to the development of new and evolved technologies. It is important to identify research topics for standardization at an early stage of all research projects in order to ensure that the requisite standards are available to the industry when they are needed to take the relevant new technologies to market.

Every ICT device, application or service implements standardized technologies, at many levels. Standards support interoperability across technologies. They help create global markets and enable networked development, where innovation occurs on top of existing technology platforms.

ICT standards embody a 'state of the art' of technology development. They are an essential resource for researchers in ICT. ICT markets are shaped by standards and if ICT research should lead to new products, new services, or whole new markets, then clearly research must result in standardization activities.

### Benefits of Research

Researchers benefit from interactions with ETSI's technical groups and gain early exposure and the feedback from the standards community that is essential to be considered before taking the results of research to full-market deployment. Research results need to influence standards in order to have a market impact.



Industry benefits from faster exploitation of relevant research results and feedback from a far wider community. Research input is highly relevant to the early study phases of product development when multiple alternative technical solutions have to be evaluated. Standards need innovative contributions from researchers to advance the state of the art.

### ETSI's Research Strategy

ETSI's Strategy identifies clear actions to "Strengthen the linkage between R&D and standardization". These include:

- Increasing the participation and contributions by (Horizon 2020 / Horizon Europe and other) research programmes / projects to ETSI Technical Committees (TCs) and Industry Specification Groups (ISGs) including 3GPP and oneM2M.
- Influence the work programme of research programmes in order to facilitate exploitation of the final research results in ETSI standards activities.
- Inform all ETSI members of new technological trends emerging from innovative research projects and seek to build bridges between such projects and ETSI activities.
- Inform and educate both Academia and the global research community of the ongoing ETSI technical work, so it may be used as a basis for their research activities.

### Current research-related work in ETSI

The following groups are actively engaged in bringing research topics into pre-standardization activities in ETSI.

#### ISG Integrated Sensing and Computing

ETSI ISG ISAC will provide an opportunity for ETSI members to coordinate their pre-standards research efforts on integrated sensing and communication technology across various EU/National funded collaborative projects, extended with relevant global initiatives, towards paving the way for 6G standardization of the technology. The ISG will prepare systematic output on 6G use cases, channel models, architecture and deployment considerations, KPIs and evaluation assumptions, for subsequent evaluation by standards organizations such as 3GPP future 6G releases and ITU-R IMT-2030 deliverables (e.g. capabilities, evaluation methodology).

#### ISG Reconfigurable Intelligent Surfaces

ETSI ISG RIS will focus on pre-standards work including the identification of technology and standards gap through the following activities:

- Identify Gaps and Recommendations of existing and required standards both inside ETSI and in other SDOs.
- Identify and describe RIS related use cases & specific scenarios, specify derived requirements and identify technology challenges in the following areas:
  - Fixed and Mobile Wireless Access, Fronthaul and Backhaul, Sensing and Positioning, Energy and EMF Exposure Limits. Security and Privacy.
- Document a networking e2e reference architecture including RIS elements.
- Describe RIS based specific deployment practice / guidelines.



- Provide a Gap Analysis for RIS microelectronics and enabling technologies.
- Provide and demonstrate PoCs and test case descriptions to validate standards-based approaches.

### **ISG TeraHertz**

ETSI ISG THz provides the opportunity for ETSI members to share their pre-standardization efforts on THz technology resulting from various collaborative research projects and being extended with relevant global initiatives, towards paving the way for future standardization of the THz technology.

The ETSI Industry Specification Group on Terahertz (THz) performs pre-standards work in several areas related to THz communications:

- Use Case Definition: Identifying relevant use cases for THz communications.
- Channel Mapping: Mapping selected use cases to appropriate channel measurement scenarios.
- Frequency Bands: Defining the frequency bands of interest.
- THz Channel Analysis: Examining existing work on THz channel measurements and modeling.
- Radio Channel Measurements and Modeling: Conducting measurements and modeling for various scenarios, including indoor and outdoor environments, mobility considerations, intra/inter-device measurements, integrated sensing and communication (ISAC), reconfigurable intelligent surfaces (RIS), and applying machine learning methods to analyze radio channels.
- Evaluation Methodology: Specifying the evaluation methodology for THz communication systems.

ETSI ISG THz concentrates on establishing the technical foundation for the development and standardization of THz communications (0.1 - 10 THz).



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