



a connected world
annual report
april 2018

ETSI's Vision of a Connected World

ETSI's clusters provide a simple, easy to grasp overview of our wide range of activities in Information and Communications Technologies standardization, which, all together, help build a connected world. A new visual approach to the clusters has been developed in keeping with our branding.



ETSI is a producer of technical standards intended for global use for digital technologies, products and services. The high quality of our work and our open approach to standardization has seen our reach extend from European roots to the entire world.

ETSI is officially recognized by the European Union as a European Standardization Organization (ESO). Our activities are driven by time to market and our standards help ensure the free movement of goods within the single European market, allowing enterprises in the European Union to be more competitive.

ETSI is a not-for-profit organization created in 1988. We have over 800 member organizations worldwide, drawn from 66 countries and five continents. Our diverse membership includes some of the world's leading companies from the manufacturing and service sectors, regulatory authorities and government ministries, as well as Small and Medium-sized Enterprises and innovative start-ups, working alongside universities, R&D organizations and societal interest groups.

ETSI is a world-renowned organization with a solid reputation for technical excellence. Our standards are produced by our members, through active participation, co-operation and consensus in an atmosphere of openness and transparency, where all contribute as equals. We work in partnership with all relevant worldwide Standards Developing Organizations, particularly the other ESOs, as well as communities, fora and consortia. This ensures that our standards are aligned with those produced elsewhere and avoids the duplication of effort.

ETSI is at the forefront of emerging technologies. We have close relationships with research communities and other innovative organizations, addressing the technical issues that will drive the economy of the future and improve life for the next generation.

Annual Report 2017 (published April 2018)



Simon Hicks
*Chairman of the
General Assembly*

To anyone who is unfamiliar with the idea of ‘standardization’, the best example you can point to is surely the smartphone in their pocket.

That small but ubiquitous device represents the intersection of myriad separate technologies and Intellectual Property agreements. Similarly, that phone would not exist in today’s global market without the existence of hundreds of different technical standards, produced and curated by ETSI and other global bodies. These standards specify everything from the radio technology your phone uses to its power management strategies.

Standardization is no trivial task. By its very nature, it demands the effective orchestration of people, ideas and resources – often on a very significant scale. Our digital world is becoming more complex and more connected. And, at ETSI, our own task becomes steadily more challenging as we look to engage with a wider range of industries and vertical market sectors, each with its own demands and opportunities.

Tomorrow’s digital world will certainly be more complex. And, from the perspective of providers and end users, it will be smarter too.

This trend is reflected in the establishment of new groups to study topics such as Augmented Reality, Experiential Networked Intelligence and Context Information Management. We expect further developments in these and other related areas throughout 2018.

On a personal note, 2018 marks the end of my term as Chairman of the General Assembly. My thanks to all members and staff who I have had the pleasure to work with. My own association with ETSI will continue, albeit in a different role.



Dirk Weiler
*Chairman of the
Board*

In 2017 we completed the first full year of executing our Long-Term Strategy for 2016-2021. This initiative reinforces ETSI’s position ‘at the heart of digital’, as an enabler of standards that directly benefit both the market and end users. It also underlines our role as a technology leader for supporting European Union (EU) policies and initiatives around digitalization and Information and Communications Technologies (ICT) standards.

As a partner in the oneM2M initiative, we support the development of specifications for Internet of Things (IoT) technologies. In particular, oneM2M Release 3 addresses interworking support for a wide range of technologies. This parallels growing interest in our work from vertical markets and communities – such as the automotive industry and smart cities – that are actively engaging with ETSI to support their own needs.

We invested heavily in support of the EU, publishing 78 new and revised Harmonised Standards required for the new Radio Equipment Directive (RED) that was fully enforced in June. In parallel with this, co-operation with the European Commission was tightened via our participation in Horizon 2020 projects.

Within ETSI we pride ourselves on being the place where our membership – spanning the European Conference of Postal and Telecommunications Administrations (CEPT) states, network operators, equipment vendors, ICT giants and vertical industries – willingly contributes its best technologies to the standardization process.

As the richness and diversity of our digital environment grows, so does the importance of partnerships. A key part of our work is expressed through collaboration with other standards organizations around the world. This was evidenced in 2017 through expansion in our co-operation and partnership agreements with peer organizations.



Luis Jorge Romero
Director-General

2017 was an eventful year for ETSI and its growing membership. One of our most visible activities was in response to the RED, updating Europe’s single market rules for radio equipment. This undertaking also saw us reviewing our own process for production of European Standards, giving us the agility to work even more effectively in responding to EU Standardization Requests.

After a long gestation, 5G drew closer to commercial reality with the first release of system architecture and radio specifications by the Third Generation Partnership Project (3GPP™), an ETSI partnership project.

We continued to discuss and explore the use of Open Source methods to support standardization without compromising the integrity of ETSI’s current Intellectual Property policy. Much effort is being put into this, and so we are proud that our Open Source MANO (OSM) group gained industry recognition as ‘Best Open Source Development Initiative’ in October. We now look to other opportunities for the Open Source community to contribute to the quality and speed of standards-making.

Machine-to-Machine communications and the IoT remained dominant themes in our work, as did our interest in the rapidly expanding area of smart cities. All-round cyber security was another major point of attention, as we launched several initiatives in response to a dynamic, increasingly complex landscape of threat vectors.

As an organization, we are always looking to the future. Reflecting this, we announced or progressed new work in the areas of Artificial Intelligence and Zero Touch Network and Service Management that will play an important role in the efficient operation of tomorrow’s networks.

Past and Future – an Overview of 2017

Much of our activity in 2017 was centred on the three major topics of 5G mobile communications, the Internet of Things (IoT) and security, underpinned by ongoing work on radio systems. We also sharpened our focus on emergent and future technologies that will play an increasingly important role in supporting the evolution of our 'traditional' areas of standardization activity.



Realizing 5G

First 5G Specifications Delivered

2017 was a milestone year for the Third Generation Partnership Project (3GPP™) with the delivery of the first specifications for 5G in December. The 'Non-Stand-Alone' (NSA) NR new radio specification was completed, enabling chip design and network implementation by 2019, ahead of the nominal 2020 target proposed by the Radiocommunication sector of the International Telecommunication Union (ITU-R).

The Building Blocks for 5G

The realization of 5G represents a radically new approach to all aspects of network architecture, operations and management. Some features of 5G networks will rely on virtualization, a topic addressed by our Industry Specification Group (ISG) on Network Functions Virtualisation (NFV). Complementing this work, our Open Source MANO group developed an Open Source NFV management and orchestration layer, delivering two software releases during the year.

Our ISG on Multi-Access Edge Computing explores how placing computational functionality closer to the end user will reduce latency in a range of 5G applications. Newly-launched work on zero-touch networks will assist tomorrow's operators with automating a wide range of processes and tasks.

Our new group on Experiential Networked Intelligence will help operators leverage Artificial Intelligence (AI) techniques to address some of the challenges of future network deployment and operation. 5G will also be underpinned by an evolution of network protocols, an area explored by our ISG on Next Generation Protocols. The successful ETSI Summit on 5G Network Infrastructure in April 2017 explored how the development of core network infrastructure will complement radio access to meet overall 5G system requirements.

Optimizing Use of Spectrum

The advent of 5G will require fresh approaches to the efficient use of finite spectrum resources to meet projected growth in media-rich traffic. As well as ensuring compatibility between different uses in adjacent spectrum, we continue to

explore improvements in spectral efficiency and advances in spectrum-sharing techniques.

Of particular interest to 5G operators are as yet unexploited radio frequencies in the millimetre wave band. This is an area being explored by our ISG on millimetre Wave Transmission.

Our Technical Committee on Reconfigurable Radio Systems is investigating the opportunities for sharing unused spectrum among multiple services in a heterogeneous network environment of mobile broadband, satellite and the IoT.

Building the Internet of Things

Providing a common core interworking platform for the IoT, the development of oneM2M Release 3 focused on support for industrial technologies, plus improved support for 3GPP-standardized mobile technologies such as Narrowband IoT.

Digital Enhanced Cordless Telecommunications (DECT™) Ultra Low Energy (ULE) is another key enabler for the IoT. Similarly, the use of DECT for Ultra-Reliable and Low Latency Communications (URLLC) will be highly relevant to applications where there is a requirement for periodic, aperiodic and streaming data traffic.

Towards Smart Cities

Building on existing oneM2M standards and specifications, our new ISG City Digital Profile was launched to develop standards supporting the deployment and roll-out of smart city infrastructures.

Another enabler for smart cities will be the co-ordinated publication, discovery, updating of and access to context information – a topic explored by our ISG on Context Information Management.

Security

Security is all around us, mediating every aspect of our digital lives. During 2017 we supported implementation of the Network and Information Security (NIS) Directive. This was complemented by work on specific security topics including Lawful Interception, Quantum Safe Cryptography, Quantum Key Distribution, Electronic Signatures and Smart Cards/the Secure Element.

Enabling Market Access

Harmonised Standards for the Single European Market

We play an important role in enabling a thriving, unified European market by providing Harmonised Standards by which manufacturers can demonstrate that their products comply with a European Union (EU) Directive. In June 2017 the Radio Equipment Directive (RED) became mandatory, replacing the previous Radio & Telecommunications Terminal Equipment Directive. By the end of the year, we had delivered more than 200 new or revised Harmonised Standards to support the RED that is now fully enforced across Europe.



Creating a Better Life

Energy Efficiency for ICT

We continued to develop standards to help reduce the eco-environmental impact of Information and Communications Technologies (ICT) equipment, and to monitor the energy management of deployed broadband. Continuing our work on standards addressing the power requirements of ICT equipment, we studied renewable energy sources and the evolution of battery technology.

Increasing Digital Inclusion

We continued to develop a Harmonised Standard in support of the EU's Web Accessibility Directive (WAD) that mandates improved access to online content and applications for people with disabilities.

Public Safety

Addressing the needs of Public Protection and Disaster Relief and other Mission-Critical services, we continued to examine methods of enabling migration from narrowband Terrestrial Trunked Radio (TETRA) to broadband by enhancing existing standards for technologies such as LTE™ and 5G. Completed in 2017, 3GPP Release 14 added enhancements and further

service possibilities for Mission-Critical Push-To-Talk (MCPTT).

Transportation

We continued the development of standards to accelerate the introduction of Intelligent Transport Systems (ITS) services and applications, based on experience gained from early market deployments. We published the MirrorLink™ Specification as a Publicly Available Specification. We also addressed rail, aeronautical and maritime transportation, and the use of satellite communications standards for high speed Internet access to fixed terminals or terminals on the move, in an aircraft, on board a ship or in a vehicle.

Broadcasting and Content Delivery

In 2017 we maintained our focus on digital broadcasting and content delivery, creating or refining standards in areas of Ultra High Definition television (UHDTV), interactive TV, Digital Video Broadcasting (DVB) and Digital Audio Broadcasting (DAB). We also revised standards covering wireless audio transmission for TV and live events producers. With media consumption patterns changing rapidly, we continued to explore the convergence between traditionally separate mobile and broadcast industries.

Fresh work investigated how Augmented Reality will enable an exciting array of context-rich user experiences across industries from smart homes and cities to healthcare, education and more.

Networks

Our ground-breaking activities on Network Functions Virtualisation, Multi-Access Edge Computing, Next Generation Protocols, Experiential Network Intelligence and Zero Touch Network and Service Management are all helping to shape future 5G core networks.

Testing and Interoperability

Highlights of 2017 included further work on oneM2M conformance testing, and the promotion and evolution of an Open Source Test Description Language (TDL).



This annual report looks back at our achievements over the last twelve months. But, as much of our work in 2017 involved the exploration of new possibilities, there is a very real sense in which it looks forward to the future too.

New Beginnings

Our Long-Term Strategy continues to guide our work. To maintain our position as a leading standardization organization for Information and Communications Technologies (ICT), we must attract new technologies and industries, strategically positioned at the heart of digital, responding to global as well as European needs. We are therefore adopting new approaches to collaboration, adapting our working methods in a versatile and inclusive manner.



Supporting the Development of New Technologies

Industry Specification Groups

Our Industry Specification Groups (ISGs) bring together key stakeholders, including non-members of ETSI, to shape our industry. We have already nurtured a number of innovations in our ISGs, with outputs of these groups being developed in other ETSI committees.

In 2017 we established several new ISGs. These included cross-cutting Context Information Management for smart cities (ISG CIM), Experiential Networked Intelligence (ISG ENI), City Digital Profile (ISG CDP), Augmented Reality Framework (ISG ARF) and Zero Touch Network and Service Management (ISG ZSM).

Delivering the 5G Promise

The Third Generation Partnership Project (3GPP™) reached an important milestone in December 2017, with the delivery of the first 5G specifications. The specifications for a Non-Stand-Alone 5G NR radio system are the first implementable 5G specifications. They were accompanied by the specifications for the 5G system architecture. The complete set of initial 5G specifications, in 3GPP Release 15, was scheduled for delivery in June 2018.

With the first specifications now delivered and intensive standardization work accelerating, 5G is no longer a myth.

5G Network Infrastructure

Our annual ETSI Summit took place in April on the theme of 5G Network Infrastructure. While much of the attention on 5G is focused on radio systems, the network behind the radio access system will require more development in order to meet the ambitious requirements of 5G in terms of performance, reliability, energy efficiency and security.

Augmented Reality

Augmented Reality (AR) mixes real-time spatially registered digital content with the real world, enabling context-rich user experiences by blending sensors, wearable computing, the Internet of Things (IoT) and Artificial Intelligence (AI). Our

newly-launched Augmented Reality Framework ISG aims to synchronize efforts and identify key use cases and scenarios for developing an AR framework with relevant components and interfaces. Enabling exciting new applications across an array of industries and vertical market segments, AR will play an essential role in Industry 4.0 and the success of smart cities and smart homes. Mobility, retail, healthcare, education and public safety are just some examples of domains where AR can bring significant value.

Artificial Intelligence

AI is set to have a strong impact on the ICT industry. Our recently created Experiential Networked Intelligence (ENI) ISG is introducing the use of AI in telecommunications network management systems.

Open Source

Open innovation is a major trend in technology development. Working across traditional borders, for example with Open Source communities and foundations, can accelerate the development of new and innovative digital technologies.

Based on our experience with our very successful Open Source MANO (Management and Orchestration) Group – an ETSI hosted community – in 2017 we continued to explore how we can benefit from Open Source approaches, methodologies and frameworks. Our Centre for Testing and Interoperability (CTI) has assembled a package of online tools to assist our committees in their work, drawing heavily from the tools used by Open Source communities. These are available on a dedicated website, the ETSI Forge.

Our CTI experts have extended their use of Open Source-like software development approaches in the production of test specifications and platforms. The TDL Open Source Project (TOP) – hosted by our Methods for Testing and Specification Technical Committee (TC MTS) – provides our committees, our Secretariat and external parties with an integrated Open Source toolset for our Test Description Language (TDL).

From Research to Standards

Early standardization in the development of a technology or a product can be crucial to its market success. Standards activities can help bridge the gap between research and industrial development of products and services by facilitating the commercialization of research results. At the same time, research can also trigger new standardization activities and enable us to ensure that standards are in place when they are needed.

Horizon 2020

We continued to monitor activity related to Horizon 2020 (H2020), the EU research funding programme. We participated in relevant projects, as our resources allowed.

In order to provide further support to the H2020 programme and its project leadership, information material was assembled and made available to the European Commission (EC) for further distribution. The material includes a simple step-by-step approach on how research experts may engage with ETSI and the standardization process.

White Papers

In 2017 we produced new white papers on ENI, Software Radio Reconfiguration and Software for Multi-Access Edge Computing. We also published a joint white paper with GlobalPlatform and the Near Field Communication Forum on interworking between multiple Contactless Card Emulation Environments.

Workshops

Throughout 2017 we organized numerous workshops,

designed to bring communities together, inform about our work and invite input for future activities. Our workshops provide a platform for researchers to share their results and to identify next steps for standardization.

Highlights of this year's programme included the ETSI Summit on 5G Network Infrastructure in April, the third ETSI Security Week in June and our IoT Week in October. Other events included our June workshop on Making Smart Cities Sustainable, hosted by the Bordeaux Metropole and the city of Bordeaux, the fifth Quantum-Safe Cryptography workshop in London in September, the ETSI International User Conference on Advanced Automated Testing (UCAAT) in October and our November workshop on Future Evolution of Marine Communication.

Education on Standardization

Work progressed on an EC-funded project on the development of teaching materials for education on ICT standardization. By the end of the project in December 2018, we aim to offer several teaching modules that can be integrated flexibly as part of curricula for engineering, business and law students. A team of external reviewers oversees the work.

We continue to provide twice-yearly ETSI Seminars, an intensive introduction to ETSI and our standards-making process.

ETSI webinars continue to be popular. Our committees value this platform to present their work to new, often international audiences.



Connecting Things



Integrating Objects to Create New Networked Services

A rapidly growing number of everyday machines and objects are now embedded with sensors or actuators with the ability to communicate over the Internet. Collectively they make up the Internet of Things (IoT). The IoT draws together various technologies including Radio Frequency Identification (RFID), Machine-to-Machine (M2M) service platforms and Wireless Sensor Networks. Potential applications and services include smart devices, smart cities, smart grids, the connected car, eHealth, home automation and energy management, public safety and remote industrial process control.



Industry analysts estimate that during 2017 over 8 billion IoT devices were in use worldwide. This figure is greater than the world's population and represents an increase of almost a third compared with the year before. With the number of connected devices forecast to reach over 20 billion by 2020, the IoT is already changing the way we live and work through new and innovative services. As a result, it offers unprecedented opportunities for creating and commercializing new devices and applications. As IoT devices continue to saturate society, standardization is key to achieving universally accepted specifications and protocols for true interoperability between devices and applications.

oneM2M

ETSI and oneM2M

ETSI is one of the founding partners in oneM2M, the global standards initiative that covers requirements, architecture, Application Programming Interface (API) specifications, security solutions and interoperability for M2M and IoT technologies. Formed in 2012, oneM2M brings together 13 partners including eight of the world's preeminent Standards Developing Organizations (SDOs), together with other industry fora or consortia and approximately 200 member organizations.

Further information at: www.oneM2M.org



oneM2M draws together the many diverse IoT-related business domains including telematics and intelligent transportation, healthcare, utilities, smart grid, industrial and home automation, smart homes, public safety and health. The initiative is developing specifications that will enable users to build platforms by which devices and services can be connected, regardless of the underlying technology used, thus enabling interoperability across IoT applications. In this way, oneM2M's specifications will reduce complexity for application developers and lower costs for service providers. Each oneM2M partner publishes oneM2M specifications as its own local specifications, thereby ensuring there is one global set of specifications, recognized in each region.



Work progressed on the third release of specifications in 2017, focusing on the use of oneM2M for industrial IoT. This includes interworking support for industrial technologies, as well as improved support for Third Generation Partnership Project (3GPP™) standardized mobile IoT technologies such as Narrowband IoT. Smart cities are also addressed. In addition, Release 3 will include support documentation and tools to assist developers.

Promotion of oneM2M's achievements remained an important aspect of its work, with members taking part in numerous conferences and exhibitions throughout the year. Other activities included executive briefings, interviews with key figures in the industry and continuation of the highly successful programme of webinars on business and technical aspects of oneM2M.

In 2017 a programme of Industry Days was initiated, collocated with oneM2M Technical Plenary meetings, where invited participants gave briefings on the take-up and deployment of oneM2M.

To support its continued roll-out, oneM2M introduced an interoperability programme, with several events taking place in 2017 and more planned for 2018. In addition, a oneM2M certification programme was launched by one of the partner SDOs. To support this, oneM2M continues to develop a set of standardized test specifications.

ETSI IoT Week

Held in October at our headquarters in Sophia Antipolis, our annual ETSI IoT Week focused attention this year on interoperability, interworking and security.

Following our M2M workshop series, the four-day event welcomed those involved in IoT solutions or standards management, plus IoT followers or users interested in promoting and adopting standard-enabled technologies.

Live demonstrations of real-world deployments using oneM2M specifications by leading IoT-focused organizations provided first-hand insight into how oneM2M is helping grow mass adoption of IoT technologies.

A Developers Tutorial presented by oneM2M provided expertise on common architecture and the specification-based development of IoT applications.

Smart Appliances

In the future, domestic and industrial appliances will be intelligent, networked smart devices, forming complete energy consuming, producing and managing systems. They will need open interfaces so that they can communicate with service platforms from different energy service providers and allow the addition of new appliances from different vendors, using 'plug and play' connectivity.

Our Smart M2M Communications committee (TC SmartM2M) is developing standards to enable M2M services and applications and certain aspects of the IoT. Work in 2017 focused primarily on SAREF, our smart appliances reference ontology that runs with oneM2M-compliant communication platforms. SAREF is designed to enable connected devices to exchange information with any energy management system.

We launched a series of investigations with a view to specifying semantic models to extend SAREF. This work considers smart cities, industrial and manufacturing domains, smart agriculture and the food chain, automation, eHealth/aging well and wearables.

We also began work on a multi-part Technical Specification (TS) to extend SAREF, adding semantic models for each of the domains being investigated. The first three parts of this TS, on the energy, environment and building domains, were published.

We also published a multi-part test specification to complement our work on SAREF.

In addition to SAREF-related work, TC SmartM2M is investigating virtualized IoT architectures, identifying new elements that are required to support a virtualized IoT service layer. This will add dynamic scalability to IoT platforms.

Low Power Wide Area Networks

Low Power Wide Area Networks (LPWANs) support long range communications at a low bit rate among connected objects, facilitating applications such as private wireless sensor networks or connecting objects in M2M and the IoT. Our Electromagnetic Compatibility and Radio Spectrum Matters committee (TC ERM) launched work on a new System Reference document (SRdoc) for LPWAN Chirp Spread Spectrum (LPWAN-CSS) operating in the UHF band.

Low Throughput Networks (LTN) is an ultra narrowband radio technology for very low data rates for ultra long autonomy devices. Work continued on use cases and system requirements, along with two TSs for LTN architecture and interface protocols, resulting in the publication of a Technical Report (TR) in October 2017.

Complementing this, we published an SRdoc for ultra narrowband Short Range Devices (SRDs) in the band below 1 GHz.

We also enhanced the Digital Enhanced Cordless Telecommunications (DECT™) Ultra Low Energy (ULE) specification, which was developed specifically for the IoT. This reuses the DECT physical layer, spectrum and channel structure, but with significant differences in the Medium Access Control (MAC) layer, security algorithms and channel selection. DECT ULE operates over exclusive license-exempt spectrum (1 880 – 1 900 MHz) which provides a more reliable service than the congested 2,4 GHz band. Target applications include home automation and energy control, remote switches, the control of smart appliances, smart metering and temperature controls, security, alarms and eHealth.



3GPP continues the development of its LPWAN solutions. Three solutions have been specified: Extended Coverage GSM™ IoT (EC-GSM-IoT), enhanced Machine Type Communications (eMTC) (also known as LTE™ Cat M1) and Narrowband IoT (NB-IoT). At the end of 2017, oneM2M published a white paper on boosting LPWAN revenues through oneM2M.

Building Smart Cities

Tomorrow's smart cities will be characterized by new services that improve the appeal of these connected urban environments to residents, businesses, investors and tourists.

The enormous scope of smart city applications will span health and social care, building management and connected homes, energy efficiency, waste management, transportation, mobility and environmental issues such as pollution and resource optimization.

Our newly formed City Digital Profile Industry Specification Group (ISG CDP) aims to develop standards that will support the deployment and roll-out of smart city infrastructures. The ISG is building on existing standards and specifications, including the work of oneM2M and TC SmartM2M.

Our Human Factors committee (TC HF) continued to study the human factors aspects of services in smart, accessible, sustainable cities and communities. Our Access, Terminals, Transmission and Multiplexing committee (TC ATTM) is developing standards for sustainable digital multi-service cities to support the deployment and roll-out of smart city infrastructures.



Context Information Management

From the digitizing of industrial processes to creating smart services for citizens, it is essential to accurately record data together with its context information, the so-called meta-data, and to transfer these without misinterpretation to other systems. Single-purpose solutions work well within a known context, but are not suitable for multi-system interoperability. Our new ISG on cross-cutting Context Information Management (ISG CIM) is developing Group Specifications (GSs) for applications to publish, discover, update and access context information, initially for a broad range of smart city applications and later for other areas.

In 2017 work progressed in five areas. These include the collection and analysis of use cases, the identification of a general architecture and an analysis of the huge range of existing guidelines, standards and context information formats. An initial definition of a flexible information model was agreed, which is compatible with linked data, the IoT and relational databases. A preliminary version of an API to enable almost real-time access to information coming from many different sources (in addition to the IoT) was nearing completion.

Wireless Industrial Automation

As part of our work to exploit the 5 GHz band, work continued on a new Harmonised Standard for radio equipment to be used in the 5,8 GHz band for Wireless Industrial Automation.

eHealth

In 2017 our eHealth Project (EP eHEALTH) drafted a new white paper. Presenting the path towards a standards-based global eHealth infrastructure, it reviews the global state of health, population demographics and the roles of technology/big data.

Acknowledging the significance of the IoT as an enabler for eHealth, we progressed a TR describing typical use cases and identifying gaps in standardization. Work also continued on a glossary of terms that will help counter confusion in the vocabulary used to describe eHealth issues.

Body Area Networks

Smart Body Area Network (BAN) technology uses small, low power devices to support a range of medical, health improvement, personal safety and wellbeing, sport and leisure applications. Our Smart BAN committee (TC SmartBAN) addresses the pressing need for global standards to support the successful market roll-out of BAN technology.

In 2017 we published a new TR providing a system description for SmartBANs, including a system overview and use cases. Work continued comparing the performance of SmartBAN with other short-range standards such as Bluetooth.

We published a TS on service, application and data representation, providing a high-level description of the infrastructure and mechanisms offering solutions for heterogeneity management in Smart BANs. Updates were completed on our TS on Smart BAN unified data representation formats, a semantic open data model and a corresponding ontology. We revised our TS on low complexity MAC and routing for Smart BANs, addressing relay and hub-hub communications.

Medical Devices

TC ERM made good progress on Harmonised Standards for wireless medical devices. We published a Harmonised Standard on Ultra Low Power Active Medical Implants (ULP-AMI) and began work directly on a revision to take account of new developments. Additional standards on paging services and Ultra Low Power Animal Implantable Devices (ULP-AID) were also published.

Work started on a new Harmonised Standard on wideband Ultra Low Power wireless medical capsule endoscopy in the UHF band, with publication expected in 2018.

A new SRdoc was initiated, considering SRD equipment using Nuclear Magnetic Resonance technology in the 1 - 50 MHz range.

Wireless Systems



Towards a Fully Connected Wireless World

Radio technology is an integral part of our daily lives. We use it for mobile phones, for broadcast radio and television, in Wireless Local Area Network and cordless technology, Global Navigation Satellite Systems (GNSS), Radio Frequency Identification (RFID) and Short Range Devices (SRDs). ETSI creates the standards which define many of these radio technologies and systems.

We also provide the standards which the regulatory authorities in Europe – and elsewhere – use to manage the radio spectrum environment and to ensure safe co-existence between all the systems which compete for use of limited spectrum resources.



Harmonised Standards and the Radio Equipment Directive

Equipment which complies with the Harmonised Standards for a European Directive is presumed to comply with the requirements of that Directive, and can then be placed on the market throughout the European Union (EU). By creating the relevant Harmonised Standards, we play an important part in helping to create a large, unified European market.

In June 2017 the Radio Equipment Directive (RED) became mandatory, replacing the Radio and Telecommunications Terminal Equipment (R&TTE) Directive that can no longer be used to access the European market. By this time, we had published 181 Harmonised Standards for the RED, of which 140 were cited in the Official Journal of the European Union (OJEU), and could therefore be used to demonstrate compliance. By the year end, these figures had risen to 204 Harmonised Standards published, of which 151 were cited in the OJEU.

Our Harmonised Standards are developed by our members in our technical committees, with much of the work being done in our committee for Electromagnetic Compatibility (EMC) and Radio Spectrum Matters (TC ERM).

Co-ordinating its work with other ETSI radio groups, TC ERM revised all parts (currently more than 50) of the existing multipart Harmonised Standard for EMC. We are also developing new Harmonised Standards for equipment not covered by the R&TTE Directive. This includes Digital Enhanced Cordless Telecommunications (DECT™), certain marine equipment, Private Mobile Radio (PMR)/Terrestrial Trunked Radio (TETRA), fixed link equipment, medical applications, SRDs and Ultra Wide Band (UWB) equipment. This work is being carried out in close co-operation with the European Committee for Electrotechnical Standardization (CENELEC) to avoid the duplication of effort. In addition, work continued on the development of two Harmonised Standards for the EMC of combined and/or integrated equipment for industrial and residential locations.

All of our Harmonised Standards for generic SRDs required revision to align with the RED. Most of these were published in 2017, with further revisions initiated for the remainder.



Managing Radio Spectrum

We are responsible for a range of issues relating to spectrum usage. Work continued on updating the Technical Report (TR) which includes detailed information on spectrum use and an overview of ETSI standards, reports and specifications, together with their applications and relevant frequency bands.

Our standards also enable administrations to ensure that users can use spectrum as widely as possible. We help the European Commission (EC) and the European Conference of Postal and Telecommunications Administrations (CEPT) to harmonize the use of spectrum throughout the EU and beyond (usually by producing System Reference documents (SRdocs)). We participate in CEPT, the Radio Spectrum Committee and the Radio Spectrum Policy Group (RSPG) to ensure full coherence between radio standardization and the developing policy framework.

In the area of measurement uncertainty, work progressed with the preparation of a new TR on the use and effect of mathematical operations on relative measurement uncertainties. We also finalized a TR on the definition of radio parameters in our standards, specifications and reports.

Reconfigurable Radio Systems

A significant amount of radio spectrum is allocated exclusively to organizations that do not take full advantage of it. For example, much is used only across certain areas or only at specific times. If this under-used spectrum could be shared, it could help free up spectrum resources to support the expanding needs of our connected world. Sharing will also play a key role in the development of 5G.

Reconfigurable Radio Systems (RRS) – intelligent radio devices which can characterize and act upon their environment – offer an opportunity for the sharing of unused spectrum among multiple services and radio networks.

In 2017 our RRS committee (TC RRS) sharpened its focus on information management in a heterogeneous network environment that may include mobile broadband, satellite and the Internet of Things (IoT). This includes examination of the possible extension of software reconfiguration technology to other network entities, such as small cells or Multi-Access Edge Computing (MEC) nodes.

We concentrated our efforts on solutions for mobile device reconfiguration and related certification, taking account in particular of where the RED includes new features impacting on the certification of user devices and other entities (e.g. network nodes) that employ RRS.

We provide input regularly to the European Commission Expert Group on RRS and work continued on a Technical Specification (TS) to define requirements for the dynamic recertification of reconfigurable radio equipment.

Over-the-air delivery of applications and software components to reconfigure the radio behaviour of a target device has significant implications for security, both for the end user and the network itself. We continued to address these challenges, ensuring the integrity of radio applications and preventing their use as attack vectors.

2017 saw the completion of an end-to-end security framework for mobile device reconfiguration, complementing our European Standard (EN) on mobile device information models and protocols. Together these standards will allow radio applications to be updated, or new applications to be installed on a device to support future radio access technologies.

Revised versions of our TR on security-related use cases and inherent security threats in RRS and our TS on security requirements were published. We also completed revisions of two ENs on radio reconfiguration architecture and requirements for adding new security elements to mobile devices. The scope of this work was extended with revisions to further ENs, spanning interface requirements.

Contextual information – whether users' physical location, their activity or the quality of the radio environment – can be used by radio systems to reconfigure their behaviour. Study continued with the development of a TR on a radio interface engine that will address the efficient acquisition and management of context information in a heterogeneous radio environment which might include satellite, mobile broadband and the IoT.

We published a specification for the support of Licensed Shared Access (LSA), the technology allowing for co-existence of the original incumbent with a new cellular operator in the same frequency band. This scope has now been extended to vertical applications such as Programme Making and Special Events (PMSE), eHealth, factory and process automation and public safety. We finalized a feasibility study into temporary spectrum access for local high-quality wireless networks.

Broadband Radio Access Networks

Our Broadband Radio Access Networks committee (TC BRAN) produces standards and specifications for various Broadband Wireless Access technologies in different frequency ranges.

In 2017 we published an updated version of our Harmonised Standard for Radio Local Area Networks (RLANs) operating in the 5 GHz frequency band which covers new technologies and the need for a common sharing mechanism to achieve equal and fair access between various RLAN technologies. While this update added coverage of receiver performance in accordance with the RED, we also published a TS with the same content to assist manufacturers.

We published a new Harmonised Standard for direct air-to-ground communications systems using beamforming antennas and finalized a further update. We also published a revised version of our EN on Wireless Access Systems (WAS)/RLAN equipment operating in the 60 GHz band, which includes a Listen Before Talk mechanism to ensure co-existence with other WAS/RLAN equipment operating in the same band. We updated our Harmonised Standard covering broadband fixed WAS operating at 5,8 GHz.

We updated our Harmonised Standard on the use of White Space devices for WAS operating in the 470 - 790 MHz TV broadcast band.

Two new TRs were completed to support the possible extension of the current 5 GHz frequency allocation for RLANs. One involves sharing between RLANs and road tolling and Intelligent Transport Systems; the other presents the findings of a study into the central co-ordination of RLANs operating in the 5 GHz frequency band.



Ultra Wide Band

We completed the final part of our five-part Harmonised Standard for UWB on board aircraft. A new revision of the Harmonised Standard on Ground- and Wall-Probing Radio (GPR/WPR) determination devices was published.

We started work on a new TS to evaluate necessary changes for further revisions of the Harmonised Standard on measurement techniques for SRDs using UWB.

Two System Reference documents were published addressing medical applications and amended mitigation techniques for UWB. A new document was also initiated on radiodetermination applications in the 120 – 260 GHz frequency range.

RFID

The RFID Harmonised Standard was revised, with publication of a new version expected in 2018.



Satellite Communications

Satellite technology is an important delivery platform for services such as direct-to-home TV and mobile, high-speed Internet access and location services. It is particularly useful for rural and outlying regions, where it is difficult to deploy other systems on a commercial basis, and therefore plays a key role in ensuring that all European citizens are able to access high quality information services.

In 2017 we finalized a new Harmonised Standard on GNSS receivers in response to the RED to cover equipment which was not within the scope of the previous R&TTE Directive. We also revised specifications on GNSS-based location systems. We published a revised EN on radio frequency and modulation for the Telemetry, Command and Ranging of geostationary communications satellites.

We published TRs on Single-Carrier Frequency-Division Multiple Access based radio technology for the Ku/Ka band

fixed satellite service, and on a multi-link routing scheme in hybrid access networks with heterogeneous links.

As part of a pre-standardization effort on satellite systems for 5G, we initiated or progressed four TRs. These cover: protocols for resource management in high-throughput satellite systems between service provider and satellite operator; a Virtualized Network Functions data model for satellite communication systems; Edge delivery in 5G through satellite multicast; and integration of satellite and/or High Altitude Platform Station systems into 5G.

For compliance with the RED we updated three EMC ENs for satellite terminals, and revised an existing standard for hand-held terminals operating with existing Non Geostationary Satellite Orbit (NGSO) satellite constellations.

Incorporating feedback from manufacturers and test labs, we revised the Harmonised Standard for Ku band satellite broadcast reception equipment. This enables relevant kinds of equipment on the market to be tested appropriately.

We revised our System Reference document on NGSO earth stations in the Ku band.

Advanced Mobile Communications Technologies – 3GPP™

ETSI and 3GPP

ETSI is one of the founding partners of the Third Generation Partnership Project (3GPP), in which we come together with six other regional standardization organizations worldwide, plus market associations and several hundred individual companies, to develop specifications for advanced mobile communications technologies.



Based on the evolution of GSM™, which was defined by ETSI, 3GPP has developed the Universal Mobile Telecommunications System (UMTS™), LTE™, LTE Advanced/LTE-Advanced Pro and 5G technologies.

Learn more at www.3gpp.org

2017 was a milestone year for 3GPP, with the delivery of the first specifications for 5G in December following the freezing of Release 14 specifications in March.

While ‘the 5G effect’ was felt by almost all 3GPP groups in 2017, work focused on the new radio access technology, NR. Sitting on top of the LTE network, so-called ‘Non-Stand-Alone’ (NSA) NR was completed in December. This enables chip design and network implementation by 2019, ahead of the nominal 2020 target proposed by the Radiocommunication sector of the International Telecommunication Union (ITU-R).



5G systems will use not only the NR radio access technology and next-generation core network, but also enhancements to LTE and – implicitly – the Enhanced Packet Core (EPC). These were expected to be delivered as part of Release 15, the first 5G release from 3GPP, in mid-2018.

With work levels for 5G already exceeding those during the development of LTE, Release 15 is currently addressing some 170 top-level items – a third more than for Release 14.

In the completed Release 14, much of the normative work involved enhancements to existing features. These included improvements to Voice over LTE, location service technologies, radio technologies in general, Internet Protocol Multimedia Subsystem (IMS™) protocol alignments with the Internet Engineering Task Force (IETF) and some improved test methodology.

New frequency bands and channel aggregation combinations were added, as were improvements to charging, management and codecs. Release 14 also saw the addition of Multimedia Broadcast Multicast Service (MBMS) for Mission-Critical (MC) services, MC data and video services, emergency services over wireless Local Area Networks, lawful interception and security and extensive preparatory work for 5G.

While enormous efforts were expended on Releases 14 and 15, Release 16 stage 1 also started in 2017. By the end of the year around 25 studies were underway on topics as diverse as Multimedia Priority Service, Vehicle-to-everything (V2X) application layer services, 5G satellite access, Local Area Network support in 5G, wireless and wireline convergence for 5G, terminal positioning and location, communications in vertical domains and network automation and novel radio techniques. There were also new items on security, codecs and streaming services.

By the end of 2017 around a dozen Release 16 feasibility study TRs were being drafted or had already been approved, covering 5G subjects such as Local Area Network interworking, network slicing and the IoT, as well as studies for the enhancement of existing features (e.g. public warning systems and streaming services).

TRs were developed to document studies on broadening the applicability of 3GPP technology to non-terrestrial radio access (initially satellites, but airborne base stations are also to be considered) and to maritime aspects (intra-ship, ship-to-shore and ship-to-ship). Work started on new PMR functionality for LTE, enhancing the railway-oriented services originally developed using GSM radio technology that are now nearing end of life.

ETSI continues to support 3GPP through its Mobile Competence Centre (MCC) and additional personnel drawn from other departments for specific functions. The MCC also provides the secretariat for the European Friends of 3GPP (EF3), a group of ETSI members who fund the hosting of 3GPP meetings in Europe. EF3 provides a valuable service by sharing the cost of hosting meetings, reducing travel overheads and ensuring that 3GPP meetings are accessible to smaller European businesses.

Mobile Standards Group

Our Mobile Standards Group (TC MSG) provides the regulatory standards needed to support the deployment of GSM, UMTS and LTE networks in Europe.

We aligned our EN on International Mobile Telecommunications (IMT) cellular networks with 3GPP Release 13, adding major new features such as Narrowband IoT, Licensed Assisted Access, Machine-Type Communications and new bands for carrier aggregation. This will enable operators to introduce these new features in mobile networks, paving the way for the future development of 5G technologies. We completed our work on the three parts on base stations in this multi-part Harmonised Standard and made significant progress on the two other parts related to mobile communications, while initiating new work to add the Active Antenna System feature. Publication of all these parts was scheduled for 2018. We also updated our Harmonised Standards covering the GSM system to align with the requirements of the RED.



Millimetre Wave Transmission

Millimetre wave bands (30 - 300 GHz) offer enormous amounts of under-utilized bandwidth – as well as more spectrum for radio transmission than lower bands, and wider channel bandwidth, with fibre-like capacity. As a source of largely untapped spectrum resource, millimetre wave technologies are expected to be a major enabler of future mobile communications.

In 2017 our ISG on millimetre Wave Transmission (mWT) published a Group Specification (GS) on Band and Carrier Aggregation and Applications and use cases of Software Defined Networking (SDN), extending our work to cover the whole range of spectrum for wireless transmission products and networking aspects beyond pure radio aspects.

Progress was made on two Group Reports (GRs) on the W-band and D-band, providing an overview and proposals on spectrum management for the benefit of radio spectrum regulators.

A detailed interference analysis was prepared using realistic approach-based 3D ray-tracing tools, taking into account the typical geometry of a high, dense urban environment for systems in the V-Band employing Wireless Gigabit Alliance technology, again for the benefit of radio spectrum regulators.

Multi-Access Edge Computing

Multi-Access Edge Computing (MEC) technology – previously referred to as Mobile-Edge Computing – offers IT service and Cloud computing capabilities at the edge of the network. Shifting processing power away from remote data centres

and closer to the end user, it enables an environment that is characterized by proximity and ultra-low latency, and provides exposure to real-time network and context information.

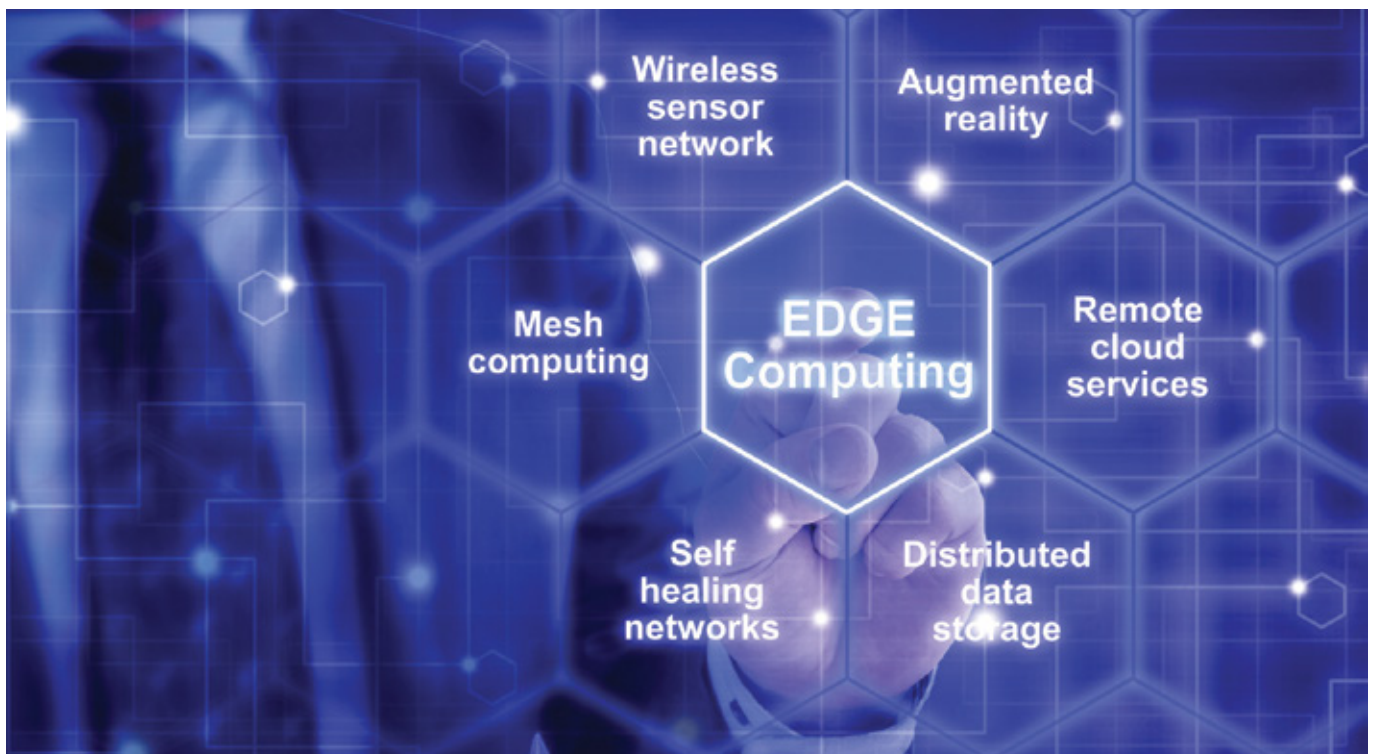
Giving access to a tightly-controlled set of services via standardized Application Programming Interfaces (APIs), MEC lets operators open their networks to authorized third parties, allowing them to rapidly deploy innovative new applications and services for use by subscribers and enterprises. MEC has been identified as a key enabler for the IoT and Mission-Critical solutions, from interactive gaming and Virtual Reality to Intelligent Transport Systems and the industrial Internet. MEC assists in satisfying the demanding low-latency requirements of 5G.

In 2017, our ISG on Multi-Access Edge Computing (ISG MEC) focused on completing the API specifications in MEC Phase 1: APIs for Application Enablement, Radio Network Information Service, Location Service, User Equipment Identity Service, Bandwidth Management Service and User Equipment Application Enablement.

Work on Phase 2 is now underway, addressing topics such as charging, regulatory compliance, support of mobility, support of containers, support of non-3GPP mobile networks, and key use cases such as automotive. A GR on the deployment of MEC in a network functions virtualization environment was also finalized.

We continued to use Proofs of Concept to demonstrate the viability of MEC implementations, with the results being channelled back into specification activities.

In September we published a white paper on developing software for MEC.



Security



Standards for Secure, Reliable Communications

Information Security standards are essential to ensure interoperability among systems and networks, compliance with legislation and adequate levels of security. They provide a means for protecting the user and creating a more secure and profitable environment for the industrial sector.



Cyber Security

Security lives everywhere, mediating all aspects of our digital lives. The rapid evolution and growth in the complexity of new systems and networks, coupled with the sophistication of changing threats, present demanding challenges for maintaining the security of Information and Communications Technologies (ICT) systems and networks. Security solutions must include a reliable and secure network infrastructure, but they must also protect the privacy of individuals and organizations.

Security standardization, sometimes in support of legislative actions, has a key role to play in protecting the Internet and the communications and business it carries. Our Cyber Security committee (TC CYBER) is addressing many of these issues.

In 2017 the committee produced a Technical Report (TR) on the Implementation of the Network and Information Security (NIS) Directive, providing advice on its implementation that lays down measures for a common high level of security of network and information systems across the European Union (EU).

Demand for end-to-end privacy from users presents some major challenges for telecom network operators, accelerated by the advent of 5G mobile, the Internet of Things (IoT), media/application service providers and 'encrypt everything' initiatives. This trend is manifested through increasing demand to encrypt traffic between end-points, where application servers interact directly with software clients on users' devices.

Accordingly, standards activities related to network gateway cyber defence have increased significantly due to an array of business and compliance obligations. A new TR on Network Gateway Cyber Defence gives recommendations on implementing 'middleboxes' into boundaries between networks, helping network providers to safeguard against viruses, malware and other threats.

We started work on a four-part Technical Specification (TS) to specify a middlebox security protocol: a protocol to enable trusted, secure communication sessions between network end-points and one or more middleboxes between them

using encryption. The specification is intended to facilitate implementation profiles for a wide array of implementations and applications.

We completed and published our reference TR on the Global Cyber Security Ecosystem, a comprehensive overview of cyber security resources including organizations, publications, reference libraries or discussion groups, at the global, regional or national level.

Following the publication in 2016 of our TR on protection measures for ICT in the context of critical infrastructure, we began developing a TS defining metrics for the identification and categorization of critical infrastructures.

In response to European Commission (EC) Mandate M/530 on Privacy by Design, we continued work on a TS on mechanisms for privacy assurance and the verification of Personally Identifiable Information together with a TS on identity management and naming schema protection mechanisms that will identify means to prevent identify theft and cybercrime. We also neared completion of a TR providing a practical introductory guide to privacy.

Work progressed on a TS on the application of Attribute-Based Encryption (ABE) for data protection on smart devices, Cloud and mobile services, and a TS which will specify the standard features needed to use ABE as Attribute Based Access Control. These specifications may help in supporting the EU's General Data Protection Regulation (GDPR).

Work also progressed on a specification for an interface to enable a trusted domain to perform sensitive functions coming from another domain.

We are updating our two-part TS on security methods and protocols, addressing countermeasures and Threat, Vulnerability and Risk Analysis methods. Part 1 was published with delivery of Part 2 to follow in 2018.



Smart Cards and the Secure Element

Our Smart Card Platform committee (TC SCP) considers the development and maintenance of specifications for the Secure Element (SE) and its interface with the outside world for use in telecommunication systems and for general telecommunication purposes as well as for IoT communications. Our work comprises the interface, procedures and protocol specifications between the SE and entities (remote or local) used in its management. It also includes interfaces, procedures and protocol specifications used between such entities for the secure provisioning and operation of services making use of the SE. It is important to note that the specifications developed by TC SCP are generic and application-agnostic; they can thus be used as specifications for any application designed to reside in an SE.

A main focus of our work in 2017 was on the next generation SE. In particular, this will be needed for the security functions provided by the Third Generation Partnership Project (3GPP™) for 5G. Trust and privacy in the IoT and mobile applications are essential to the market and our new Smart Secure Platform (SSP), incorporating this next generation work, can and will contribute significantly to help to achieve these two aims.

Work continued on a requirements specification for the SSP. Technical realization of the SSP will consist of two parts in a multi-part specification, and work on these began in 2017, with completion expected by mid-2018 to meet the timelines of 3GPP.

We upgraded several existing test specifications to cover new releases of the respective core specifications, and reviewed a large number of existing test descriptions to take into account experience gained in the field.

As a device may contain multiple secure elements for mobile Near Field Communication (NFC), there is a need to achieve interoperability and avoid proprietary implementations. We therefore joined forces with GlobalPlatform and the NFC Forum to tackle these issues, and in January 2017 published a white paper on interworking between multiple contactless card emulation environments.

Security Algorithms

Our Security Algorithms Group of Experts (SAGE) is widely recognized for its work on authentication and encryption mechanisms. Responding to the needs of other committees, SAGE specifies cryptographic algorithms for use in standardized telecommunications systems. In 2017 we continued to develop security algorithms as needed to support our core standardization activities.

Work this year included initial consideration of the development of algorithm variants for 5G. While all the radio interface algorithms in 3G and 4G use 128-bit keys, it is likely that 5G will use (or at least support) 256-bit keys that offer greater resistance to attacks. If necessary, therefore, we will adapt our existing algorithms, as well as the MILENAGE Authentication and Key Agreement algorithm, to support 256-bit keys.

In 2017, we also delivered to 3GPP a new General Packet Radio Service (GPRS) 128-bit algorithm to provide greater protection for 'Extended Coverage GSM' (EC-GSM). This specialized adaptation of 2G supports integrity protection of user data as an optional feature – something that was never originally specified in GPRS.

Quantum-Safe Cryptography

The emergence of quantum computing will present a serious challenge to current cryptographic techniques. Previously secure encrypted information – such as bank account details, identity information and military security – will become subject to discovery and possible misuse. New 'quantum-safe' cryptographic techniques have emerged in recent years that provide protection against quantum threats.

We are addressing these security issues and developing recommendations and specifications for the transition to quantum-safe ICT applications. Interest in our work has grown since the original formation of our Industry Specification Group (ISG) on Quantum Safe Cryptography (QSC) in 2015, gaining sufficient support to justify the development of normative specifications. In March 2017, ISG QSC was therefore transformed into a Working Group on QSC within our TC CYBER, to continue this work.

By the end of the year, we had published four Group Reports (GRs) covering: basic quantum-safe algorithmic framework assessment; case studies and deployment scenarios; quantum-safe threat assessment; and the fundamental limits of quantum computing to attack symmetric key cryptography. We also published a TR providing a comprehensive study of quantum-safe key exchanges. Other new work is in progress on quantum-safe signatures and quantum-safe virtual private networks.

Earlier in 2017 we published an ETSI Guide (EG) to Quantum Computing that offers best practice advice to organizations – such as banks – on protecting their systems.

In September we held our fifth Quantum-Safe Cryptography workshop in London, UK, co-organized with the Institute for Quantum Computing in Waterloo, Canada.

Quantum Key Distribution

Quantum Key Distribution (QKD) enables digital keys to be shared privately without relying on computational complexity. The security offered by QKD will not be vulnerable to future advances in algorithms, computational power or the emergence of a quantum computer. With QKD, security keys are shared over optical fibre or free space links encoded on single photons or weak pulses of light. Demonstrator networks are now being constructed in several locations around the world and standards are needed urgently to enable adoption of these new security technologies. Our ISG on QKD is leading activities to help fulfil this need.

In 2017 we finalized a Group Specification (GS) on components and internal interfaces. In addition, we made significant progress on specifications describing the characterization of QKD transmitter modules, QKD deployment parameters and protection against Trojan Horse attacks.

Electronic Signatures

Our Electronic Signatures and Infrastructures committee (TC ESI) maintains standards and specifications published in response to European Commission (EC) Mandate M/460 on Electronic Signature Standardization.

The European Standard (EN) providing statements for qualified certificates was re-published. Standards on security and policy requirements for Trust Service Providers (TSPs) were reviewed after feedback from auditors, the latest specifications from the CA/Browser Forum and additional

requests in line with the 'eIDAS Regulation' on electronic identification and trust services for electronic transactions in the internal market.

We published a study on long-term data preservation services. Building on this, we began new standardization activities including the definition of policy, security requirements and protocols for TSPs offering long-term preservation of digital signatures or unsigned data using signature techniques.

We enhanced the CAAdES format to support the Evidence Record (ERS and XMLERS) and an update of our TS on cryptographic suites. This took into account inputs from the European Network and Information Security Agency (ENISA) and built on agreed cryptographic mechanisms from the Senior Officials Group – Information Systems Security (SOG-IS).

We developed ENs on Electronic Registered Delivery Services (ERDS) and Registered Email (REM) services. These define policy and security requirements within the EU scheme for the supervision of eDelivery services and specify the technical architecture, semantic contents, formats and protocol bindings.

During the year we continued developing specifications related to signature validation reports and TSPs providing AdES digital signature validation services.

We started work on remote signature creation services to create new technical specifications covering policy requirements for TSPs and protocols for creating digital signatures remotely.





Lawful Interception and Data Retention

Bringing together the interests of governments and law enforcement agencies (LEAs) as well as mobile network operators and equipment vendors, our Lawful Interception committee (TC LI) develops standards supporting international requirements for LEAs, including the interception and retention of electronic communications data sent over public communication services.

In 2017 we continued to update our LI and Retained Data (RD) standards, specifications and reports in line with the latest developments. This included our TS on the handover interface for the request and delivery of RD, and the seven-part TS on the handover interface and service-specific details for Internet Protocol (IP) delivery.

We continued work on a handover interface between Law Enforcement Monitoring Facilities to support (as a minimum) European Investigation Orders related to LI, including the handling of real-time and stored data transfers.

Work continued on defining an electronic interface for the exchange of information between systems relating to the establishment and management of LI. A new specification was published for an internal network interface X1 for LI-related messages over Handover Interface 1 (HI1), covering wide area connections between LI systems and – depending on the network – several network elements from different vendors. Work continues on further specifications for interfaces X2 and X3.

Further updates were made to a TS on the dynamic triggering of interception that is required as a result of the

diversification of service and network architectures. With work almost completed, publication was anticipated in 2018.

Interaction with other ETSI committees continued on the development of a new specification on security for LI and RD systems. This fundamental requirement is becoming ever more challenging as networks become increasingly IP service-centric, globally distributed and software-based. Our work on network functions virtualization, a key driver for studies in this area, intensified in 2017. Our recommendations on LI were also incorporated into the work of our ISG on Multi-Access Edge Computing (ISG MEC).

We updated our specification for an LI interface for Terrestrial Trunked Radio (TETRA), the communication system used by several emergency services. Latest enhancements address new LI capabilities in TETRA – notably the capture and recording of transactions over the network – bringing the specification in line with LI activities as a whole.

Security Indicators

In 2017 our ISG on Information Security Indicators (ISG ISI) launched or progressed work on three new GSs: an ISI-compliant measurement and event management architecture for cyber security and safety, to enable communication between diversified detection tools; guidelines for building and operating a secured security operations centre; and a description of a comprehensive security information and event management enterprise-wide approach involving all stakeholders within companies, from IT and security to business management and executive committees. We also revised our Key Performance Security Indicators for evaluating the maturity of security event detection, with the addition of application examples.

ETSI Security Week

An important industry event for over a decade, the ETSI Security Week, held in 2017 in June, addressed a range of short- and longer-term cyber security standardization challenges. Topics included support of legislation such as the NIS Directive, the GDPR, eIDAS and the proposal for a Regulation on Privacy and Electronic Communications Code. The event also explored new threats introduced by the virtualization of network functions and the means to mitigate them, plus the challenges of securing 5G networks and shaping related standards.

Better Living with ICT



Technologies for a Better Life

Technological progress is transforming the way we communicate – at home, at work and on the move. While it has opened up exciting new opportunities, we must be careful to minimize any adverse social consequences. Part of our work involves making products and services simpler to use, safer and more efficient.

We are also committed to identifying energy efficiency solutions that mitigate the impact on climate change of the growing use of Information and Communications Technologies (ICT). The ultimate goal is to ensure that ICT improve the quality of life for all.



Energy Efficiency for ICT

Much of our work on energy efficiency supports European Commission (EC) policies, regulation or legislation. Co-operation continued with the European Committee for Electrotechnical Standardization (CENELEC) in support of EC Mandate M/544. In April 2017 we published a new European Standard (EN) on the ecodesign requirements for the networked standby mode of interconnecting equipment.

Our Environmental Engineering committee (TC EE) continued its work with the European Committee for Standardization (CEN) and CENELEC in response to Mandate M/543 on material efficiency. An updated Technical Report (TR) on approaches, concepts and metrics for the Circular Economy is in preparation, following the publication of an initial edition in early 2017.

Collaboration continued between TC EE, our Access, Terminals, Transmission and Multiplexing (TC ATTM) and Cable (TC CABLE) committees, to develop standards in support of EC Mandate M/462, on enabling efficient energy use in fixed and mobile information and communication networks. TC EE's contribution includes new ENs for energy efficiency Key Performance Indicators (KPIs) for servers and for Radio Access Network equipment. Final drafts of the two new ENs were prepared.

We revised the ETSI Standard (ES) on measurement methods for the energy efficiency of router and switching equipment.

Work progressed on measuring the energy efficiency of wireless access network equipment with dynamic traffic loads. We published an update of our ES defining metrics and methods of assessment of the energy efficiency of mobile networks. Three new TRs are under development: one describing best practice in assessing the energy performance of future radio access network deployment, a second on studies into methods and metrics to evaluate energy efficiency for future 5G networks, and the third on energy estimation methods for mobile networks based on a statistical approach.

We made good progress with an ES to define appropriate methods for Network Functions Virtualisation (NFV) energy efficiency and began extending our ES on the 'Green Abstraction Layer' to NFV applications. This work is carried out in liaison with our NFV Industry Specification Group (ISG).

We published a new ES defining standardization terms and trends in energy efficiency.

Reducing Environmental Impact

Work progressed on revising the ENs for environmental classification and tests for telecommunication equipment. In November 2017 two ENs for the test methods for storage and transportation were published. Publication of the two ENs for equipment installed in weather-protected and non-weather-protected locations was expected in 2018.

A Technical Specification (TS) on liquid cooling for ICT equipment was finalized, as was a new TR on the study of test methods and the test severity of mechanical aspects for equipment installed on poles and towers.

We continued work on standards addressing the requirements of ICT equipment connected to a 400 V DC or AC power source. Progress was made with the ES on transient voltages at the 400 V DC interface; publication was expected in 2018. Work continued in co-operation with the Telecommunications Standardization sector of the



International Telecommunication Union (ITU-T) Study Group 5 on an ES which, when published, will specify the architecture for connecting renewable energy sources to 400 V power systems. Progress was also made on a new ES on the management of the migration of telecommunication site installations from existing -48 V DC power distribution to the new 400 V DC and on the new TS on the impact on the ICT equipment architecture of multiple AC or 400 V DC power inputs.

Work started on the revision of the EN for equipment powered by 48 V DC, to clarify the test conditions with redundant power sources. We continued to revise the associated ES on transient voltages on 48 V DC power networks.

Work continued on three new TSs on the evolution of battery technology for use with stationary ICT and telecommunication equipment. This work will have implications for smart cities and other applications which rely on batteries used in conjunction with alternative power sources; publication was expected in 2018.

Operationally Sustainable Networks

TC ATTM continued to focus on sustainable smart cities, the environmental demands of operational networks and sites and the energy efficiency of broadband transmission.

The committee works closely with our ISG on Operational energy Efficiency for Users (ISG OEU), sharing the aim of improving the efficiency of ICT services and increasing energy efficiency in operational networks and devices, as well as improving the management of ICT waste.

We made further progress in 2017 with Global KPIs to support the deployment of eco-efficient networks and sites and to monitor the energy management of deployed broadband. These new KPIs, which will be used to define green sites and networks for all industrial and commercial users, are outlined in a series of ESs based on our existing KPIs and TSs for energy efficiency in broadband deployment. The KPIs will provide ICT users with tools to monitor the energy management of networks and sites in full compliance with the Kyoto Protocol on climate change and the reduction of greenhouse gas emissions.

Our work in this area supports EC Mandate M/462 on efficient energy use in fixed and mobile information and communication networks. We began upgrading our ESs and TSs in 2016, with the aim of publishing them as ENs by 2018 to support potential new European legislation.

We also continued to develop a multipart TS on broadband deployment and energy management. In 2017 we published a subpart on multiservice street furniture, outlining processes to improve energy efficiency and to ease the deployment of smart new services in digital multiservice cities. We also published an update of the part on operator sites and data centres. Subparts on multi-tenant premises and single-tenant homes were also progressed.

An EN on broadband deployment and lifecycle resource management for the end of life of ICT equipment was finalized, with publication due in 2018.

ISG OEU published a specification which defines global KPI modelling for green smart cities. We published a Group Report (GR) providing guidelines for the technical organization of a Plastic Optical Fibre Plugtests™ event on the interoperability of networking equipment manufactured by different vendors. We also made progress on a report providing guidelines for the technical organization of a Glass Optical Fibre Plugtests interoperability event. Work continued on a GR on the deployment of fire extinguishing and alarm systems in ICT datacentre sites.

Usable ICT for All



Increasing the uptake of new technologies can benefit both individual members of society and industry. Accordingly, a goal of current human factors research and development is to explore innovative approaches that extend digital inclusion to the widest possible range of users, irrespective of their abilities or impairments.

The Joint Working Group on eAccessibility, which brings us together with CEN and CENELEC, allocated to our Human Factors committee (TC HF) the majority of the standardization work required as a result of the European Union's new Directive on the accessibility of the websites and mobile applications of public sector bodies, commonly known as the Web Accessibility Directive (WAD).

The WAD aims to ensure that people with disabilities – especially those with vision, hearing or cognitive impairments – should have better access to public websites, their contents and mobile applications. Thus, we continued to revise our EN on accessibility requirements for the public procurement of ICT products and services to incorporate additional user requirements and to transpose it into a Harmonised Standard supporting the WAD. At the same time, we integrated into the standard the results of our recent work on the needs of people with limited cognitive abilities using mobile ICT. We also added compliance tests for functional requirements. We continue to consider improvements to this EN for incorporation into a future revision.

We began work on a new TR on user requirements with regard to user-centred, joint agile system development and service deployment methods in future telecommunications network functionalities.

Our User Group continued its work on a user-centric approach to ICT, progressing a series of three TRs and an ETSI Guide (EG) characterizing this approach and providing guidance to users and service providers.

Media Quality

In 2017 our Speech and Multimedia Transmission Quality committee (TC STQ) continued to address growing demand for 'super-wideband' (bandwidth up to 14 kHz) and fullband speech communication and multimedia in hands-free and video phone applications. In addition, the Internet of Things (IoT) and the smart home gained greater focus.

We published revised versions of our four ESs on transmission requirements for narrowband/wideband Voice over Internet Protocol (VoIP) terminals (loudspeaking and hands-free/handset and headset) from a user's Quality of Service (QoS) perspective. We also published revisions to four TSs on transmission requirements for narrowband/wideband wireless terminals (hands-free/handset and headset) to optimize end-to-end quality. Work was finalized on super-wideband and fullband terminals, with publication expected in 2018.

We published a new TS on transmission requirements for wearable devices for speech communication. We completed a TS for the evaluation of multimedia communication performance under parallel physical and/or mental load (dual-task testing).

We published updates of our existing specifications on speech quality performance in the presence of background noise, and a new TS on objective test methods for super-wideband and fullband terminals in the presence of background noise.

We are updating two parts of our multi-part TS on reference benchmarking, background traffic profiles and

KPIs. To ensure the comparability of test results, reference benchmarking methods and background traffic load profiles are needed. An updated part covering the high-speed Internet was published, while a part covering VoIP and Fax over IP (FoIP) in fixed networks was finalized.

In the domain of mobile systems, we updated our TR providing guidelines for the use of video quality algorithms for mobile applications. We also continued updating and extending our TS on QoS aspects for popular services in mobile networks.

Work continued on a TS on the QoS aspects of Mission-Critical applications. We also progressed a TR on a framework for multi-service testing, a TR on bandwidth calculations and prioritization in VoIP systems, and three TRs addressing QoS aspects of services related to the IoT ecosystem, the 5G ecosystem and video services.

We are compiling best practices for throughput measurements, with publication of a new TR expected in 2018.

Progress was made on updating our TS on acoustic safety limits. Work commenced on a TS to develop methods for the objective prediction of listening effort, a TS to specify methodologies for simulating reverberation conditions and a TS on Dual Tone Multi-Frequency transmission over VoIP using Real-time Transport Protocol telephony events.

We also started work on a TS relating to voice-controlled devices that employ speech recognition.

Studies have shown that people with impaired hearing may find transmitted speech unintelligible for a variety of reasons including background noise, transmission impairment, the shape of their receiver and coupling between earphones and hearing aids. We therefore finalized a TR aimed at improving listening quality for people with impaired hearing, which will form the basis of a TS expected during 2018.

A successful workshop on Multimedia Quality in Virtual, Augmented or other Realities was held during May 2017 in Sophia Antipolis.



Home and Office



Connecting Devices in the Home and Office

The variety of devices that need to be interconnected is growing rapidly and most require broadband. The new services being developed are creating a 'Connected Home' and a 'Connected Office'.

Our standardization for home and office focuses on three aspects: home and office wireless, home and office interconnection, and home and office requirements, including Quality of Service (QoS) and security.

Cordless Voice and Broadband Communication

Our Digital Enhanced Cordless Telecommunications (DECT™) specification is the leading standard around the world for digital cordless telecommunications. Over 1 billion devices have been installed worldwide: the system has been adopted in over 110 countries and more than 100 million new devices are sold every year. The number one cordless system in Europe and the USA, DECT products now account for more than 90% of the world's cordless market. They are also sold in Japan, where a legislative change has provided more spectrum for license-exempt operation.

During 2017 we focused on two main work areas, DECT evolution and DECT-2020, which will both support home automation, industrial automation, the creative and culture industry (e.g. audio production), eHealth and conferencing.

DECT evolution is the shorter-term activity. It aims to provide a lower end-to-end latency, higher data rates and higher reliability based on the current DECT physical layer.

The longer-term activity, DECT-2020, is a new radio interface supporting Ultra Reliable Low Latency Communications (URLLC) and Machine Type Communications (MTC) as specified for International Mobile Telecommunications-2020 (IMT-2020) usage scenarios. The new DECT-2020 air interface will co-exist with the existing DECT system.

In 2017 we published a new Technical Report (TR) that collects requirements for the evolution of DECT. We developed a TR which examines the use of DECT for URLLC use cases for various industries and establishes URLLC data service profiles for periodic, aperiodic and streaming data traffic.

We continued to develop DECT Ultra Low Energy (ULE) technology for residential and building applications, primarily driven by low power requirements for battery operated devices. DECT ULE enjoys all the advantages of the DECT spectrum and technology as well as adhering to the technical parameters for the Internet of Things.

All eight parts of the DECT base standard and the Generic Access Profile standard were revised and several security



improvements related to the operation of repeaters were implemented.

Wireless Power Transmission

While consumers have taken wireless communications for granted for the last three decades, most users hunt for the nearest wall socket – and a power cable – when their devices need recharging. From smartphones to implanted medical devices and electric vehicles, wireless charging promises to 'cut the cable' for good. This year we completed a Harmonised Standard on wireless power transmission (WPT). In parallel with this, we made good progress with a new System Reference document on WPT systems operating below 30 MHz.

Home Equipment

The scope of applications for connected devices in the home continues to expand. Work progressed on new Harmonised Standards for equipment operating below 9 kHz, including metal detecting devices and robotic lawn mowers.

We completed a Harmonised Standard for social alarm equipment. These radio communication systems allow elderly or disabled persons in distress in a confined area to initiate an emergency call for assistance.

Our Powerline Telecommunications committee (TC PLT) merged into our Access, Terminals, Transmission and Multiplexing committee (TC ATTMM). This enables synergies in the preparation of Plugtests™ events on the co-existence of Digital Subscriber Line (DSL) and PLT technologies as well as for hybrid home networks.

Meanwhile, work progressed on single mode optical fibre systems for home cabling. New work began to align the content and terminology of the existing Technical Specification on the optical external network testing interface with new European Committee for Electrotechnical Standardization (CENELEC) standards.

Transportation



Bringing the Power of ICT to People on the Move

Information and Communications Technologies are revolutionizing the transport sector, increasing efficiency, reliability and safety and reducing energy consumption. ETSI supports road, railways, aviation and maritime transportation with activities which are carried out by key industry players and therefore reflect true market demand.



Road Transport

In the near future vehicles on our roads will share information and interact directly with each other and with the road infrastructure through Co-operative Intelligent Transport Systems (C-ITS). C-ITS are thus expected to significantly improve road safety, traffic efficiency and the comfort of driving.

Within Europe, full-scale deployment of C-ITS enabled vehicles is targeted for 2019. Standardization has a key role to play in this, both providing baseline standards and also reacting to feedback from practical deployments.

Our Intelligent Transport Systems committee (TC ITS) is helping to accelerate the introduction of ITS services and applications – and to maximize their benefits – by developing common standards and technical specifications for interoperability.

We continued to fine-tune our ITS Release 1 standards in response to feedback from early deployments. Meanwhile, work in 2017 focused on pre-standardization studies for C-ITS Release 2 and preparation for automated driving. Release 2 addresses new features and functionalities anticipated in future systems to deal with more complex use cases and the interests of a larger group of stakeholders.

We are developing a new Technical Report (TR) on the Collective Perception Service which will enable sensor information to be shared between road users so that, even when his or her own view is obscured, a driver can ‘see’, for example, pedestrians or older cars without C-ITS, which are visible to another driver.

Our Electromagnetic Compatibility and Radio Spectrum Matters committee (TC ERM) continued its co-operation with TC ITS, making good progress in aligning Harmonised Standards for ITS and transport/traffic telematics systems with the Radio Equipment Directive (RED). Work on further standards covering Dedicated Short Range Communication and ITS in the 60 GHz band was started.

We continued to address the spectrum needs of ITS, while developing a System Reference document on smart tachograph weight and dimension applications.



In October, the Car Connectivity Consortium (CCC) and ETSI published the MirrorLink™ specification as an ETSI Technical Specification (TS) using our Publicly Available Specification (PAS) process. This open standard for smartphone-car connectivity allows smartphone apps to be projected on in-vehicle infotainment systems.

Automotive Radar

We continued work on a new TS addressing receiver requirements for automotive and surveillance radar equipment.

Aviation

Our TFES joint Task Force produces Harmonised Standards under the RED for the International Mobile Telecommunications (IMT) family. In 2017 we updated our Harmonised Standard for Mobile Communication On Board Aircraft to align with changes in regulation.

Our main aeronautical work during the year related to the RED – notably the need to address the standardization of communications, navigation and surveillance equipment, such as radar, aspects of which were not covered under the

previous Radio & Telecommunications Terminal Equipment (R&TTE) Directive. This work included updates to existing standards for meteorological aids, for Ground Based Augmentation System VHF ground-air data broadcast, and for ground-based VHF/UHF radio transmitters, receivers and transceivers for the aeronautical mobile service.

We updated our Harmonised Standards on the Advanced Surface Movement Guidance and Control System for air traffic management equipment (A-SMGCS), including a new part on multilateration equipment.

We also started an update of our Harmonised Standards for VHF Digital Link Mode 2, and a TR on data link improvements.

A suite of Harmonised Standards for automotive and surveillance short range radar equipment was completed to take account of the RED, as well as the new Harmonised Standard for heli-borne obstacle detection radar equipment.

We continued to work on three Harmonised Standards required under the scope of the RED to address primary surveillance radar (PSR) in three operational bands, secondary surveillance radar and multi-static PSR. We also made progress with standards for meteorological radar in three operational bands and started work on a Harmonised Standard for the Data Link Services System.

Work progressed on a TR on the use of professional unmanned aerial systems in Europe for civil use – such as by film crews or for aerial surveys – and by the police.

Railways



The international railway community has long used enhanced GSM™ technology. Now there is a need to address the requirements for tomorrow's railway-based communications.

Collaborating closely with the European and global railway industries, our Rail Telecommunications committee (TC RT) maintains the GSM-R (GSM for railways) standard, adding new features including data and voice communications that work on trains that travel at speeds up to 350 km/h.

In the context of the Future Railway Mobile Communication System (FRMCS), in 2017 we worked on a TR examining end-to-end requirements for rail transportation supporting multiple access technologies. We continued to work with the Third Generation Partnership Project (3GPP™) and the International Union of Railways (UIC) on the introduction of use cases for FRMCS within the normative specifications related to Mission-Critical communications.

Other ongoing work included the harmonization – at least at European level – of the Extended GSM-R frequency range for use with FRMCS.

Work progressed on a technical solution for shared use of the 5 855 – 5 925 MHz band by ITS and urban rail applications.

In 2017 we completed the alignment of the requirements for GSM operation on railways with 3GPP Release 99.

We continued our liaison with the UIC and the European Union Agency for Railways on the communications aspects of Technical Specifications for Interoperability (TSIs) for the trans-European rail system.

Maritime

In 2017 we published a Harmonised Standard on maritime broadband radio links for ships and offshore installations.

Revisions were made to the multi-part Harmonised Standard on the use of Digital Selective Calling (DSC) in the maritime mobile service, and we updated the TS on interoperability testing for maritime DSC radios.

Work also began on a Harmonised Standard for maritime low power personal locating devices employing the Automatic Identification System (AIS), complementing the publication of a Harmonised Standard on maritime low power VHF personal locating beacons employing DSC.

We began drafting a new Harmonised Standard on radar equipment used on non-SOLAS vessels. Standards on navigation radar and maritime VHF used on inland waterways were published, and were followed by the start of revisions of each. We published Harmonised Standards on VHF coastal stations and VHF Class D DSC, along with a Harmonised Standard on maritime VHF for Global Maritime Distress and Safety Systems (GMDSS). Use of the UHF band for on-board communications systems and equipment was reflected in a new Harmonised Standard covering maritime mobile transmitters/receivers. Handheld DSC and Portable VHF marine radio (non-GMDSS) were also addressed in another Harmonised Standard.

Work was ongoing on standards related to radiotelex equipment operating in MF and HF bands, coastal surveillance, vessel traffic services and harbour radars, and active radar target enhancers. New work began on satellite personal locator beacons.

In November, we held a workshop on the 'Future Evolution of Marine Communications'. This successful event investigated how e-navigation and the evolution of GMDSS affect marine radiocommunication and navigation standardization in the medium to long term.

Content Delivery



Facilitating Content Consumption on Every Platform

The Internet, mobile communications and broadcasting are converging. But the standardization of these different areas has traditionally followed different paths, so they do not interoperate across the same platforms. We are addressing the urgent need to align the diverse specifications for content delivery in a converged environment supporting Internet Protocol Television (IPTV), Mobile TV and broadcast TV – for the benefit of the industry and consumers alike.



Broadcasting

Our standardization of broadcast systems, programme transmission and reception equipment is managed in JTC Broadcast – a Joint Technical Committee that brings us together with the European Broadcasting Union (EBU) and the European Committee for Electrotechnical Standardization (CENELEC). More than 95% of inputs to JTC Broadcast are standardized by ETSI, with CENELEC responsible for standardizing the functional requirements of radio and television receivers.

Television is a rapidly developing technology, and TV standards are expected to undergo significant changes in the near future. In 2017 we continued to focus on digital broadcasting, particularly in the areas of Ultra High Definition TV (UHDTV), interactive TV and radio.

In the audio area we further developed the Technical Specification (TS) for the Enhanced AC-3 codec by adding Common Media Application Format support. Object-based audio is a prevalent industry trend. We created a new specification for DTS-UHD delivery of channels, objects and ambisonic sound fields.

In the area of interactive TV, the committee created a new specification for Internet Protocol (IP) delivered broadcast channels and related signalling of Hybrid Broadcast Broadband TV (HbbTV) services. We also created a new multi-part specification for a high performance single layer High Dynamic Range (HDR) system for use in consumer electronics devices.

For radio, we continued simplification of the Digital Audio Broadcasting (DAB) set of standards to remove obsolete features and improve interoperability. Our Technical Report (TR) providing a guide to DAB standards was completely revised to reflect the latest status. New TSs were published for the transport of traffic and travel information via TPEG over DAB, and for minimum requirements and test methods for DAB receivers.

We updated the popular Digital Video Broadcasting (DVB) audio and video coding specification as used in DVB broadcasting. This latest version defines the implementation



of UHD-1 Phase 2 features: HDR, Higher Frame Rates (HFR) and Next Generation Audio (NGA). In addition, we started work on a new specification of subtitles based on Timed Text Markup Language (TTML). This will be complemented by a new version of the DVB Bitmap Subtitle Specification, and an update of the DVB Service Specification.

The maintenance of TV-Anytime specifications progressed with an update of the part on metadata schemas.

We continued work on broadcasting equipment, developing Harmonised Standards for radio and TV broadcast receivers, as well as transmitting equipment for Digital Radio Mondiale broadcasting and Terrestrial DAB (T-DAB). Harmonised Standards were published for TV broadcast transmitters and amplifiers for TV broadcast reception in domestic premises, as well as for FM and AM sound broadcasting.

Digital Audio for Content Creation

Taking account of the Radio Equipment Directive (RED), our Electromagnetic Compatibility and Radio Spectrum Matters committee (TC ERM) revised our Harmonised Standards for cordless audio devices at frequencies up to 2 GHz, as well as wireless microphones and audio for Programme Making and Special Events (PMSE) at up to 3 GHz. Work was ongoing on a new Harmonised Standard for wideband audio links, as used by broadcasters to transmit high-quality sound from live in-the-field programme production.

A new System Reference document (SRdoc) was published on wideband multichannel audio systems. Work was also initiated on revisions to the SRdoc on audio PMSE systems in the frequency range 25 MHz – 3 GHz, updating the current SRdoc to include conference and other systems.

Mobile and Broadcast Convergence

Television delivery has traditionally been dependent on broadcasting (one-way, one-to-many delivery networks to fixed TV sets). Today, however, new forms of media consumption dramatically increase the load on mobile networks. Interest is growing in exploring the potential for developing future mobile and broadcasting standards in a more converged way.

In the future, mobile devices will rely on a combination of local area, wide area and broadcast radio technologies. This convergence could mean that consumers will become less aware of the underlying technologies used to deliver their chosen content.

In our Industry Specification Group (ISG) for Mobile and Broadcast Convergence (MBC), work neared completion on a new Group Report providing a comprehensive overview of the converged mobile and broadcast market, encompassing a wide range of industry views. This covers market trends, drivers for convergence, use cases and deployment scenarios.

Protection and Rights Mechanisms

Our ISG on the Embedded Common Interface (ECI) for exchangeable Conditional Access (CA)/Digital Rights Management (DRM) solutions continued its specification of a framework for software based, easy-to-change protection and rights mechanisms for the delivery and consumption of media content on several types of user devices. This framework focuses on the specification of software interfaces to use CA/DRM clients after they have been downloaded to a device. The concept supports interoperability between services and devices, allowing consumers to continue using content and devices they have already paid for after a change of a service or network provider, or to consume content from multiple service providers on the same device.

In 2017, Part 3 of the core specification was published, covering the CA/DRM container, loader, interfaces and certification and revocation mechanisms. Also published, Part 4 provides the specification of a virtual machine, allowing multiple clients to run in parallel on the same device and providing a secured environment for executing CA kernels or DRM applications. A description of the underlying security concept was also completed. Work progressed on the development of an implementation guide for ECI.

Compound Content Management

Next generation UHD displays will offer not just increased resolution, but also support for features such as HDR and Wider Colour Gamut (WCG) that take advantage of new production techniques for the creation of film and broadcast content. However, legacy displays and television receivers will remain in use for many years to come. To ensure a

smooth transition between today's television standards and tomorrow's, a system is needed which allows backwards compatibility while also providing full performance for the next generation of HDR and WCG televisions.

Our ISG on Intelligent Compound Content Management (CCM) completed its work, publishing a Group Specification (GS) defining the additional functionality required in consumer devices for the reconstruction of an HDR/WCG signal using the 'Intelligent Compound Content Management' processing defined in the specification. Additionally the GS defines a method whereby this HDR/WCG signal and its associated metadata is transported over existing channels.

Augmented Reality

Augmented Reality (AR) mixes real-time spatially registered digital content with the real world. Our newly-launched Augmented Reality Framework ISG aims to synchronize efforts and identify key use cases for developing an interoperable Augmented Reality framework with supporting components and interfaces. We started with an analysis of the AR standards landscape. We plan to provide technical requirements for AR specifications, ensuring transparent interworking between different components that will be key to the successful roll-out of future services.



Networks



Fulfilling the Promise of Unlimited Bandwidth

Today's consumers expect communications services to be easily accessible and available everywhere, on whatever devices they are using. Technically, this means networks must converge. We provide a comprehensive set of standards for access network technologies.



Network Functions Virtualisation

Network Functions Virtualisation (NFV) adapts standard IT virtualization technologies, consolidating heterogeneous network infrastructures based on disparate, ad hoc equipment types onto industry standard servers, switches and storage. This sees network functions running as software on a homogeneous 'off the shelf' infrastructure that can be introduced to various network locations as needed.

NFV simplifies the roll-out of network services, reduces deployment and operational costs, facilitates network management automation and encourages innovation. It is being adopted increasingly for network planning, deployment and evolution, and has become an essential element of modern network design. NFV also delivers significant benefits to service users and providers, especially in the area of emerging 5G networks.

During 2017, our Industry Specification Group (ISG) on NFV made good progress with its Release 3, addressing aspects such as license management, multi-site deployment, software updates and Cloud-ready software architectures for network functions. Our work also covered forward-looking topics such as Platform as a Service (PaaS) support in NFV, multi-domain orchestration and support of 5G network slicing. By the end of the year, our work programme had expanded to cover the specification of requirements, interfaces and information models supporting Release 3 features.



We are also committed to maintaining Release 2 specifications. This includes the addition of conformance testing specifications, and the availability of Representational State Transfer (REST) Application Programming Interface (API) formal descriptions that, together with the Unified Modelling Language (UML)-based information model descriptions, provide valuable mechanisms to ease the development of interoperable implementations and their validation.

Effective interoperability is the ultimate goal of any standardization activity. Collaborating with our Centre for Testing and Interoperability (CTI) team, ISG NFV organized a well-attended Plugtests™ event.

Open collaboration with other standardization bodies and with Open Source projects remained a priority for ISG NFV. 2017 saw tightened collaboration with our Multi-Access Edge Computing (MEC) ISG, and bodies dealing with 5G technologies, as well as our Open Source MANO (OSM) project, the Open Platform for NFV (OPNFV) projects and OpenStack, the reference Open Source implementation for Cloud management.

Open Source MANO

Two of the key components of the ETSI NFV architectural framework are the NFV orchestrator and the virtualized network function manager, known collectively as the NFV Management and Orchestration, or MANO. To enable accelerated standardization with a fast feedback loop to ISG NFV, our Open Source MANO group (ETSI OSM) is developing a software implementation example for the ETSI NFV MANO, according to accepted Open Source working procedures and using a software development platform which we host and manage.

ETSI OSM releases new versions of code approximately every six months. OSM Release TWO in April was followed by Release THREE in November. This latter release includes numerous enhancements in terms of scalability, performance, resiliency, security and user experience that facilitate its adoption in production environments.

Network Access

Our Access, Terminals, Transmission and Multiplexing committee (TC ATTM) addresses mainly the operational and physical parts of Information and Communications Technologies (ICT).

The committee published a Technical Report (TR) on small cells backhauling. At the request of the Telecommunications Standardization sector of the International Telecommunication Union (ITU-T) and the Broadband Forum, we are leading work on the standardization of Reverse Power Feeding, working now on a Version 2 of this Technical Specification (TS). Implementations of this technology are now becoming commercially available.

Work on Very-high-bit-rate Digital Subscriber Line 2 (VDSL2) continues, including updates to the TS on European technical requirements. We maintain ongoing liaison with both the ITU-T and the Broadband Forum on all aspects relating to xDSL technologies in the twisted pair copper access network.

Based on work defining a global Key Performance Indicator (KPI) for ICT sites, we progressed a multi-part TS on the general engineering of networks and sites.

We published a TS on Digital Multiservice Cities, focusing on Multiservice Street Furniture. This TS will form the basis for the development of future documents.

In the area of fixed radio systems, we completed a revision of a Harmonised Standard for multipoint equipment in line with the Radio Equipment Directive (RED). Our Multipoint antennas European Standard (EN) was also aligned accordingly. Following publication of the Harmonised Standard for point-to-point equipment and antennas, we commenced work on an update to include applications in the 80 GHz band and new millimetric wave bands in anticipation of 5G network needs.



Cable

Our Integrated Broadband Cable Telecommunication Networks committee (TC CABLE) continued to address the evolution of broadband cable network capabilities.

We published a new ETSI Standard (ES) for home routers, defining features that will allow multiple subscriber devices to gain access to high-speed data services using the Data Over Cable Service Interface Specification (DOCSIS). This core feature set allows both Internet Protocol version 4 (IPv4) and IPv6-enabled devices to connect to the Internet. We also published a three-part TS on DOCSIS 3.1.

We completed work on a new EN defining global KPIs for the efficient use of energy in hybrid fibre-coaxial (HFC) access networks, and their application in response to the European Commission's standardization request M/462 on energy efficiency in information and communication networks.

We continued work on our TS on measurement methods for the network performance of broadband data services which will enable consumers to compare the performance of different service providers.

Numbering, Naming, Addressing and Routing

Currently, most of us have an email address and a separate telephone number. Replacing these in the future with a single alphanumeric address may be more convenient for end users – but it creates fresh interconnection challenges for network service providers. Our Network Technologies committee (TC NTECH) published its study on the impact of alphanumeric user identifiers on interconnection scenarios.

The Transition to IPv6

Upgrading the Internet with the provision of additional public IP addresses is essential to maintain growth and allow new entrants to join. Developed to solve the problem of IPv4 address exhaustion, IPv6 provides enhanced features and enables new Internet services in need of end-to-end connectivity and security. It is also the key technology to enable the deployment of the billions of new devices that form the Internet of Things (IoT).

Our ISG on IPv6 Integration (ISG IP6) is addressing the transition from IPv4 to IPv6, bringing together stakeholders from all over the world to work on pre-standardization in a neutral environment, defining requirements and use cases, outlining best practices, gathering support and creating awareness of the impact of IPv6.

In 2017, we delivered four Group Reports (GRs) covering generic migration steps from IPv4 to IPv6, IoT deployment, enterprise deployment and IPv6-based industrial Internet leveraging 6TiSCH (IPv6 over Time-Slotted Channel Hopping) technology.



Future Networks

TC NTECH completed a TR on the application of the Generic Autonomic Network Architecture (GANA) reference model to wireless ad hoc and mesh networks. It also completed a parallel activity on the application of the GANA model to fixed broadband access and aggregation networks.

We continued to maintain our Next Generation Network (NGN) standards and updated a Diameter profile specification enabling retrieval of location information from an access network.

Next Generation Protocols

The TCP/IP (Transmission Control Protocol/Internet Protocol) suite can no longer provide the scale, security, mobility and ease of deployment required for the connected society of the 21st century. Developments in the technology of local access networks will not deliver their full potential unless, in parallel, the communications and networking protocols evolve.

In 2017, our ISG on Next Generation Protocols (NGP) continued work on requirements for future Internet protocols.

We developed a number of Group Specifications (GSs) and GRs including: scenarios the new protocol will need to support, requirements, a summary of relevant technologies, and self-organizing control and management planes. Work in progress included Identity Oriented Networks, Intelligence-defined networks, mobile deterministic networking, new

transport technologies, and KPIs that enable objective evaluation of the new protocols against operators' requirements.

Other work includes specifying new packet forwarding for the user plane, a major feature of which is the separation of the process of path set-up from that of packet forwarding. As well as dramatically reducing the size of headers, one of the original aims of NGP, this simplifies the forwarding process and allows better communication between applications and the network regarding the level of service needed, while also allowing much better security.

Experiential Networked Intelligence

The introduction of technologies such as Software Defined Networking (SDN), NFV and network slicing means that networks are becoming more flexible and powerful. The use of Artificial Intelligence (AI) techniques in the network supervisory and management system can help solve some of the problems of future network deployment and operation.

Our new ISG on Experiential Networked Intelligence (ISG ENI) develops standards that use AI mechanisms to assist in the management and orchestration of the network. In 2017 we neared completion of two GRs, spanning use cases and context-aware policy modelling gap analysis, as well as a GS on requirements.

Working with other standards developing organizations to reuse existing standardized solutions for legacy and evolving network functions, we also produced a white paper on improved operator experience.

ETSI Summit on 5G Network Infrastructure

In April 2017, our ETSI Summit on 5G Network Infrastructure explored technological solutions that will be needed to enable true scalable mobility, and to fulfil ambitious 5G requirements in terms of performance, reliability, energy efficiency and security.

Interoperability



Interconnecting in a Multi-polar World

Interoperability is driven by market demand. It is crucial in a multi-vendor, multi-network and multi-service environment – and is one of the reasons why we develop standards. It gives users much greater choice of products, and allows manufacturers to benefit from the economies of scale of a wider market. Interoperability is therefore a crucial factor in the success of modern technologies – especially in the introduction of new technologies.



An Innovative Approach to Technical Quality and Interoperability

Many years of experience has taught us that integrating validation and testing activities into the standards development process can contribute significantly to the production of interoperable standards and, ultimately, to the release of interoperable products based on those standards. Mutual feedback between the standardization process and the validation and testing activities helps to maximize the quality of both the implementations and the standards. Timely validation and testing can also reduce the overall development duration of a standard, leading to shorter time to market for interoperable products.

Our technical committees apply best working practices to ensure that our standards are well-specified and testable, and thus provide a solid basis for the implementation of robust and interoperable products. We also apply comprehensive validation of our standards through interoperability events, and we develop conformance test specifications to accompany a significant proportion of our standards.

Our Centre for Testing and Interoperability (CTI) is a centre of excellence, providing hands-on expertise. This includes supporting Proof of Concept programmes, organizing Plugtests™ interoperability events and hackathons, the development of test specifications and the application of 'best practice' specification approaches.

For example, in December 2017 the CTI organized an ETSI symposium on Achieving Interoperability – Best Practices in Standardization, held at the campus of India's Centre for Development of Telematics (C-DOT), Bengaluru, India, in co-operation with the Indian Ministry of Communications' Telecommunications Engineering Centre (TEC), the Telecommunications Standards Development Society, India (TSDSI), and the Cellular Operators Association of India (COAI).

We also continued to apply Open Source-like software development approaches to the production of test specifications and Application Programming Interface (API) definitions, encouraging feedback from a broad base of users.



Implementation-Driven Standardization

We are working with Open Source communities to encourage dialogue and the sharing of practices, with the goal of ensuring that the mutual benefits of well-respected procedures and dynamic innovation can be combined in tomorrow's technologies.

To support our Industry Specification Groups (ISGs) such as Network Functions Virtualisation (NFV), Multi-Access Edge Computing (MEC) and Zero Touch Network and Service Management (ZSM), we have set up repositories, collaboration tools and dedicated development environments for API definitions and other code-based specifications. These are made available through the ETSI Forge website.

In 2017 we established two new Open Source projects: one by our Methods for Testing and Specification committee (TC MTS) to develop a set of tools for the Test Description Language (TDL), the second being an Open Source demonstrator for multi-context Transport Layer Security (mTLS) under our committee for cyber security (TC CYBER).

The CTI continued to provide practical daily support to our Open Source MANO group (ETSI OSM).



Plugtests Events

In our Plugtests events, companies can interconnect prototype or production equipment to test for interoperability and, where needed, conformance to standards. These events provide a highly cost effective and practical way of identifying inconsistencies in an implementation, or in the standard itself. Our Plugtests events are often supported by the European Commission (EC).

In 2017 we organized ten Plugtests events, with varying formats to meet the needs of our members and the industries we serve. Highlights included:

Emergency Communications

Mission-Critical Push-To-Talk (MCPTT) has been specified in the Third Generation Partnership Project's (3GPP™) Release 13. Interoperability and MCPTT service harmonization are critical challenges for the successful deployment and operation of Mission-Critical communication services. In June 2017 our TETRA and Critical Communications Evolution committee (TC TCCE), in partnership with The Critical Communications Association (TCCA), organized the first MCPTT Plugtests event. The tests were based on 3GPP, ETSI and Internet Engineering Task Force (IETF) specifications.

Next Generation 112 (NG112) has been identified as a potential answer to the increasing requirements and demands of content-rich emergency calling. Held in March 2017, the second NG112 emergency communications Plugtests event saw a testing campaign based on the use cases developed by ETSI and the European Emergency Number Association (EENA) and focused on emergency calling with existing Rich Communication Suite (RCS) services such as video calling, instant messaging and file transfer.

Network Virtualization

The first NFV Plugtests event offered an opportunity for vendors and Open Source projects to assess the level of interoperability of their implementations and verify the correct interpretation of the ETSI NFV specifications. Over 30 companies and various Open Source projects joined the test

sessions covering Virtual Network Functions, Management and Orchestration (MANO) solutions and NFV Infrastructure with a pre-integrated Virtual Infrastructure Manager.

Smart Cities

In co-operation with the EC and Eurocities, demonstrations of solutions and concepts were shown at our workshop 'Making Smart Cities Sustainable from large scale pilots to real-life deployment', which took place in Bordeaux, France, in June 2017.

Internet of Things

We continued to support the development of the Internet of Things (IoT) and, together with our fellow Partners in the oneM2M project, we co-organized two oneM2M Interop events.

In addition, we carried out developer-oriented events for NFV and oneM2M in Europe, the USA and India to bring standardization closer to the implementers. These events included hands-on tutorials, developer guides and webinars.

Test Specifications and Frameworks

We continued to make use of tools commonly used in software development for our test suite repositories, bug tracking and quality control, as part of our strategic move towards more agile specification and testing approaches.

In 2017 we progressed work on oneM2M conformance testing. We continued development of Testing and Test Control Notation Version 3 (TTCN-3) specifications and methodologies for the conformance testing of mobile devices. Notable achievements included the delivery of tests for several LTE™ Advanced-Pro features in Release 13 – in particular Licensed Assisted Access to enable LTE operation in unlicensed spectrum, single-cell point-to-multipoint transmission, and Indoor Positioning Enhancements. In addition, we delivered conformance test cases for Narrowband IoT (NB-IoT) and enhanced Machine Type Communication (eMTC), also known as LTE Cat M1. This enabled the Global Certification Forum to extend its device certification scheme to NB-IoT and eMTC.

Core Network and Interoperability Testing

Interoperability is crucial to the provision of good Quality of Service and Quality of Experience in complex end-to-end systems such as Voice over LTE (VoLTE) that bring together Internet Protocol (IP) Multimedia Subsystem (IMS™), packet and circuit switched networks. Our Core Network and Interoperability Testing committee (TC INT) produces specifications to facilitate the implementation of IP-based networks that can carry both fixed and mobile services simultaneously.

In 2017 we validated test specifications for the Diameter protocol in the IMS for VoLTE, allowing faster connection of VoLTE networks with billing and charging systems. We also published a three-part set of test specifications for the S1 Application Protocol (S1AP) and Non-Access Stratum (NAS) protocols that will support faster roll-out of VoLTE networks.

Other existing test specifications relating to the IMS were upgraded from 3GPP Release 10 to Release 12.

Co-operation continued with the International Telecommunication Union for Internet-related performance measurements for fixed and mobile networks. We liaised with the GSM™ Association on activities relating to VoLTE implementation and testing.

Methods for Testing and Specification

TC MTS creates standards for testing and specification languages, and provides frameworks and methodologies to enable our other committees to produce documents that are easy to understand and easy to use. This work is critical to the success of our standards.

In 2017 we continued the evolution and maintenance of our enormously successful testing language, TTCN-3, along with its tool conformance test suites. We are introducing Object Oriented features to TTCN-3 to widen acceptance of the language and also support testing in new areas.

Test Description Language

TDL fills the gap between the simple expression of what needs to be tested, i.e. the test purposes described in prose or the Test Purpose Language (TPlan), and the concrete coding of executable tests with existing test specification languages such as TTCN-3.



TDL exploits the benefits of model-based software engineering and offers higher quality tests through better design and by making them easier to review by non-testing experts. It is thus improving and accelerating test development without sacrificing quality. TDL will be used primarily for functional testing, but could also be used for other types of testing.

In 2017 TDL was enhanced by the addition of support for extended test configurations. In October the TDL Open Source Project (TOP) was successfully launched at the 5th User Conference of Advanced Automated Testing (UCAAT). This project is developing an integrated Open Source toolset for TDL for use by our committees, the CTI and external parties.

The Annual ETSI International User Conference on Advanced Automated Testing (UCAAT)

Organized with the support of TC MTS and the CTI, the 5th ETSI UCAAT conference was held in Berlin, Germany, in October 2017. Under the headline 'Tackling testing challenges in the age of connected things', the well-attended event was dedicated to application aspects of automated testing including model-based testing, Cloud testing, mobile testing, test methodologies, test management and standardized test specification by focusing on the practical challenges that are often faced in industry. Attendees enjoyed a unique opportunity to discover, share, learn and challenge modern test automation approaches, technologies and strategies.

Public Safety



Mission-Critical Communications to Rely on

Communication is a key factor in an emergency situation, whether small incidents such as a man overboard or major natural disasters.



TETRA and Critical Communications

Terrestrial Trunked Radio (TETRA) represents the solution to a specific set of Mission-Critical (MC) communication needs. 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.

TETRA is the leading technology choice for critical communications users, with a projected 5 million terminals in use by 2020. Use of the technology in business-critical markets such as the transportation, military, commercial and utilities sectors continues to increase.

Aside from its business applications, 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.

In 2017 a number of standards and specifications were revised in response to feedback from manufacturers and users. These include the completion of 15 documents relating to interworking at the inter-system interface (ISI) between two TETRA systems. This work involved revising the original ISI European Standard to take account of the introduction of Internet Protocol (IP)-based networks, dividing the content into several new parts to produce a family of specifications for IP, circuit switched networks and transport layer-independent aspects. We are now beginning to develop corresponding Technical Specifications (TSs).

Designed as a narrowband system, TETRA today cannot support the growing demands of emergency services and other 'blue light' users for Mission-Critical capabilities such as streaming high-quality video from the scene of an accident from a terminal – something that any member of the public can do with a smartphone. Reflecting these evolving needs – and an opportunity to benefit from the economies of scale of the mobile broadband ecosystem – the community of TETRA users asked the Third Generation Partnership Project (3GPP™) to determine how this functionality can be realized using LTE™ or 5G systems running over public network operators' licensed spectrum.



We are exploring 'hybrid' methods to integrate TETRA into current broadband solutions. To optimize the standardization process, existing standards for technologies such as LTE and later 5G will be enhanced by interfaces and applications that make them suitable for Mission-Critical applications. Published in October 2017, a new Technical Report (TR) discusses interworking between TETRA and 3GPP Mission-Critical services.

We are developing an architecture encompassing a range of application layer interfaces to LTE, defined in a set of TSs. In response to feedback from 3GPP, we revised the TS covering the mobile-to-network interface architecture of a critical communications application operating over a broadband IP interface. Work is also ongoing on the detailed specification for the mobile-to-infrastructure interface. Work continued on encapsulating TETRA speech coding, packet format and rate, end-to-end encryption synchronization and secure key management messaging for use in 3GPP Mission-Critical Push-To-Talk (MCPTT) over LTE systems.

We continued to work closely with the Critical Communications Broadband group of The Critical Communications Association. In 2017 a TR was approved on the user requirements specification on interworking between the Critical Communications Application and TETRA and migration of services from TETRA to broadband (LTE).

Security is an area of obvious concern in critical communications, where voice and data originating on a TETRA terminal may be handed over to a 3GPP broadband network. Effort thus focused on a TR addressing the security of interworking between TETRA and broadband critical applications.

Enabling Next Generation Mission-Critical Services

Providing a platform for MC communications and MC services has been a key priority for 3GPP in recent years.

Completed in 2017, 3GPP Release 14 added additional MC services and enhancements to its repertoire of standardized applications, specifically: enhancements to MCPTT, Mission-Critical data, Mission-Critical video and a general framework which facilitates standardizing additional Mission-Critical services.

Conformance test standards for MC services are also being developed within 3GPP. By the end of the year an initial set of test specifications on conformance testing Release 13 MCPTT features had been completed. Further test specifications for Release 14 and Release 15 feature sets will also be developed.

Private Mobile Radio

Private Mobile Radio (PMR) allows business users – such as taxi services – to keep in contact over relatively short distances with a central base station. PMR is also widely used by emergency services and other closed user groups. Networks consist of one or more base stations and a number of mobile terminals.

Work continued to update our Harmonised Standards for multichannel transmitter equipment for PMR, narrowband PMR, Citizens' Band (CB) and a variety of land mobile radio equipment.

The Harmonised Standard on analogue and digital PMR446 equipment was published, and work started to revise the Harmonised Standard covering broadband Public Protection and Disaster Relief. We also revised several TSs and one TR on Digital Mobile Radio, covering general system design, air interface protocol, data protocol, trunking protocol, and voice and generic services and facilities.

Emergency Calling and Alerting

In 2017 our Emergency Telecommunications committee (SC EMTel) focused particularly on emergency applications for smartphones, networks for emergency services and their conformance, and Internet of Things devices in the provision of emergency situations.

We completed our work on the requirements, the functional architecture, the protocol and the procedures for implementing the Pan-European Mobile Emergency Application. There are presently hundreds of emergency calling applications in use across Europe, but their use is constrained to the boundaries of the Public Safety Answering Point (PSAP) with which they are integrated. The resulting TS,

to be published in early 2018, will make it possible for data to arrive at the most appropriate PSAP, wherever the call is made.

In March 2017, in co-operation with the European Emergency Number Association (EENA), we organized the second Next Generation 112 (NG112) emergency communications Plugtests™ event. NG112 offers a potential solution to the increasing requirements and demands of content-rich emergency calling.

We continued to work on a TS and a TR related to networks dedicated to emergency services. The TS describes the core elements and corresponding technical interfaces for network independent access to emergency services. This work is complemented by a TR describing test cases and scenarios for interoperability testing of the core elements for independent access networks.

We completed a new TS providing guidelines for assessing the conformity of eCall in-vehicle system devices with regards to essential performance requirements. eCall is the in-vehicle emergency call service which automatically relays data about an accident from the vehicle to the emergency services. We also revised our high-level application requirements conformance test specification for eCall.

Work in response to European Commission Mandate M/493 on the location enhanced emergency call was completed, with the development of protocol specifications for retrieving and transporting emergency caller location. This service is intended to cover situations where different service providers and network operators must co-operate to determine the location of an emergency caller – such as when a user makes an emergency call using a Voice-over-IP service instead of a conventional mobile or fixed telephone.

Other Public Safety Activities

We continued our work on standards for maritime safety equipment, avalanche beacons and various mechanisms for road safety through the use of Intelligent Transport Systems.



Working in Partnership

Working with the European Commission

We value our partnership with the European Commission (EC) and the European Free Trade Association (EFTA) highly. As a European Standardization Organization (ESO), we provide world class standards and specifications to support European Union (EU) legislation and public policies.

The major mandated activity in 2017 was the continuation of the development and production of candidate Harmonised Standards under M/536 in support of the Radio Equipment Directive. This is a challenging task with ambitious targeted time schedules and a complex assessment process in place with the EC.

We also worked on a number of existing EC mandates and accepted a further two standardization requests: Standardization Request M/552 for Harmonised European Standards (ENS) in support of the new Electro Magnetic Compatibility (EMC) Directive and Standardization Request M/554 in support of the Directive on the accessibility of the websites and mobile applications of public sector bodies.

The EC uses the Annual Union Work Programme for European Standardization as a planning tool to prepare for possible future standardization requests and actions. The 2018 issue was released in August 2017 and, when preparing our work programme, we considered the areas where we could support EU policies and legislation.

We participated in all of the meetings of the EC's Committee on Standards which took place in 2017, as well as all the meetings of the Information and Communications Technologies (ICT) Multi-Stakeholder Platform. We regularly took part in meetings of the Task Force on the Rolling Plan for ICT Standardization and contributed to the drafts and final outcome for the anticipated ICT Rolling Plan 2018. We continued to attend as an observer at various Member State committees and their working groups.

3SI Programme

Societal stakeholders receive special recognition in the EU's Regulation on European Standardization. To increase the visibility of their interests in ETSI, we established the 3SI programme, on Societal Stakeholders, Small and Medium-Sized Enterprises (SMEs) and Inclusiveness.

Collaboration between the ESOs

Co-operation and collaboration with the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) continued in 2017. We participate in the CEN and CENELEC Technical Boards and attend their General Assemblies. The Joint Presidents' Group ensures management level co-ordination, in addition to direct links between our technical committees. By working together on appropriate topics, especially those which are the subject of EC standardization requests, we ensure that industry benefits from a more integrated European standardization system.

In 2017 we continued to work closely together in areas such as Intelligent Transport Systems, smart energy, smart metering and electronic signatures, to ensure the development of a coherent set of standards and to avoid the duplication of effort and overlapping work. Other significant areas of activity included EMC, combined equipment, energy efficiency and accessibility, cyber security, human factors and the Internet of Things (IoT).



Working with NSOs

We partner in our role and responsibility as an ESO with our network of National Standards Organizations (NSOs). About half of the NSOs are also members of ETSI, but all perform the important task of organizing national approval procedures for our ENs. In addition, NSOs are in close contact with local industry in their countries, especially with small businesses. NSOs distribute our standards, they act as information points on the status of our work, and they may accompany local SMEs in their first steps in standardization. Most of our NSOs are also members of CEN or CENELEC, and therefore play a part in ensuring alignment between our work and that of these other ESOs, especially in fields where ICT is an enabling technology for other industries.

In 2017 we continued to meet with the NSOs before each meeting of our General Assembly to exchange information and to encourage their participation in our work. During the year, the NSOs made useful contributions to our discussions on improving the EN Approval Process.



Partnership Agreements

Co-operation and collaboration is the best way to achieve alignment between our standards and those produced elsewhere, to avoid the duplication of effort and to ensure that our work is widely accepted and implemented. Establishing partnership agreements with fora, consortia and international and regional Standards Developing Organizations around the world is one of the key mechanisms we have adopted in working with others.

By the end of 2017, our partnership agreements portfolio numbered over 100 active partnerships. During the year, we established Memoranda of Understanding with the Broadband India Forum, the International Marine Electronics Association, the Center for Internet Security, the Digital Mobile Radio Association, the Federation of Electrical, Electronic and Communication Industries and Open Pan European Public Procurement Online (OpenPEPPOL).

Letters of Intent were signed with the 5G Infrastructure Association and the VR/AR Association. We renewed our partnerships with the China Communications Standards Association (CCSA), the DECT™ Forum, the ULE Alliance, the Global Certification Forum, the United States Department of Transportation, the Telecommunications Industry Association and the Office of the Assistant Secretary for Research and Technology (OST-R).

Seconded Experts in China and India

As increasing digitization brings societies and economies ever closer together around the world, we continue to place special emphasis on markets and regions beyond Europe. By the end of 2017, for example, we had 140 associate members from outside Europe. In partnership with CEN and CENELEC, the EC and EFTA, we have therefore appointed 'Seconded Experts' to raise the profile of European standardization and to intensify co-operation on standardization issues in the key regions of India and China.

India

In 2017 the Seconded European Standardization Expert in India (SESEI) continued to participate in workshops and other events to promote European standardization activities, particularly in strategic areas such as the IoT, smart cities,

cyber security, device certification and Network Functions Virtualization. ETSI is the project manager for SESEI.

Together with the EC and the Telecommunications Standards Development Society, India (TSDSI), we are a partner in a project on India-EU co-operation on ICT standardization.

Within this framework and as part of ongoing oneM2M awareness activities in India, we played a major role in a workshop promoting a standards-driven approach for future-proof smart cities with a Common Service Layer. The event, which gathered high-ranking officials from the government as well as key players in the IoT in India, focussed on the strategic role of oneM2M. Subsequently, a more technical event, targeted at developers, was held in June in New Delhi. Other similar events are now planned around the country.

The third oneM2M Industry Day was held in Bengaluru in September, while in December we organized a symposium on Achieving Interoperability – Best Practices in Standardization, also in Bengaluru.

China

In 2017, the Seconded European Standardization Expert in China (SESEC) project entered the last year of its third three-year iteration. The stakeholders agreed to continue the project into a fourth phase.

The SESEC continued to attend events to promote the European standardization and regulatory model and to explain European standardization developments in specific sectors. Key topics include the IoT, communication networks, cyber security and digital identity, smart cities, and electrical and electronic products. The SESEC project helps to enhance the EU-China dialogue and to facilitate co-operation in the field of standardization, ultimately assisting EU industry to do business in China. The SESEC also supported us in strengthening our links with Chinese partners, especially the CCSA and the China Electronics Standardization Institute (CESI). In March, the SESEC was a keynote speaker at the first workshop on European Standardization organized by the China Association for Standardization.

In June, our Director-General led a delegation to Beijing and Hangzhou, meeting key stakeholders including CESI and the CCSA, as well as representatives of industry, to assess the consequences and implications of the 2015 Chinese standardization reform on the dialogue between ETSI and China, and to continue to foster collaboration with both institutional and industrial players. As a direct result, ETSI was invited to participate in the 2017 Cybersecurity Summit in July and the 4th World Internet Conference in Wuzhen in December.

Forapolis™ Support Services

Drawing on over two decades of ETSI experience, in 2017 Forapolis provided customized Forum Management and IT support services to one third party organization in which ETSI members are involved. The service was provided without any cross-subsidy from the members' contributions. 2017 was the final year ETSI offered the Forapolis service.

Specialist Task Forces and other Funded Projects

Specialist Task Forces (STFs) are expert teams established under the direction of an ETSI committee to work together for limited periods on specific technical work. STFs accelerate the development of urgently needed standards or support strategic activities required by our members or by the European Commission (EC) and the European Free Trade Association (EFTA). A similar mechanism has been adopted to support 'Funded Projects' for the Third Generation Partnership Project (3GPP™) partners and to organize our participation in four Horizon 2020 (H2020) European Union (EU) Research and Innovation projects.

Altogether, 41 STFs and other funded projects were active in 2017, involving 117 service providers for a total spend of about 2,74 M€. Voluntary contributions equivalent to 169 k€ were provided by 3GPP Members and Partners.

EC/EFTA Funding

The EC budget line for standardization remained stable for 2017, hence the amount available for the Operating Grants of the European Standardization Organizations (ESOs) was not reduced. Indeed, our Operating Grant for 2017 (2,55 M€) saw a 4% increase compared with 2016. We were also able to report and achieve a 98,5% payment of the 2016 Operating Grant.

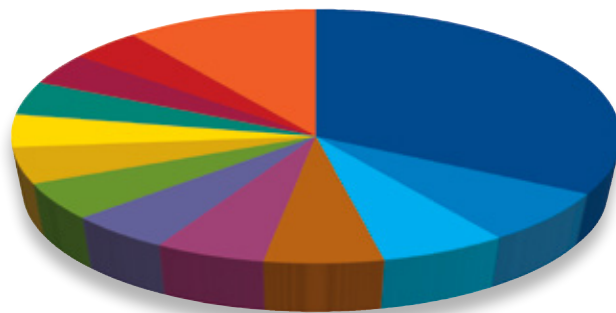
All new standardization action grants are now operated under the lump sum financing system. The lump sum unit value is updated every year based on an index agreed with the EC, and in 2017 this increased compared with 2016.

In 2017, the actions signed covered activities related to electronic signatures, human factors, radio spectrum matters for the aeronautical sector and SmartM2M. However, not all the proposals we submitted for EC evaluation could be funded from the EC standardization budget, and our pending requests will be resubmitted for consideration under the 2018 budget.

We also continued to manage the action grants signed prior to 2017, reported efficiently to the EC/EFTA on progress and closed actions started in 2015 onwards.

In 2017 the EC's Service for Foreign Policy Instruments, working with DG CONNECT and the European External Action Service, launched an action on International Digital Co-operation on Information and Communications Technologies (ICT) Standardization, with a view to strengthening the EU's position as a world-leader in the digital economy. ETSI was selected to implement this action, and was awarded financing from the EU of 2,5 M€ over the 36 months of the project, beginning in January 2018.

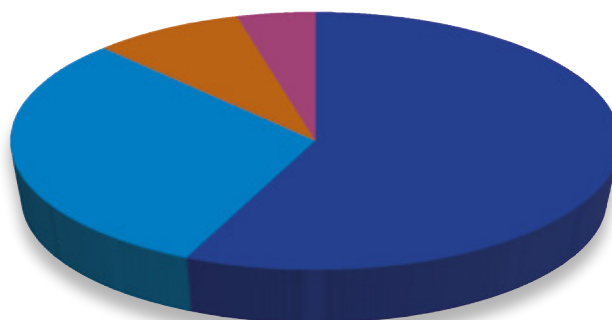
Technical areas in which funded resources were spent in 2017



| Technical area | Financial investment (k€) | % |
|---|---------------------------|-----|
| 3GPP | 898 | 33% |
| Access, Terminals, Transmission and Multiplexing (ATTM) | 198 | 7% |
| Methods for Testing & Specification (MTS) | 181 | 7% |
| Electronic Signatures and Infrastructures (ESI) | 173 | 6% |
| Intelligent Transport Systems (ITS) | 162 | 6% |
| H2020 | 144 | 5% |
| Smart Machine-to-Machine (SmartM2M) | 136 | 5% |
| Core Network and Interoperability Testing (INT) | 129 | 5% |
| Digital Enhanced Cordless Telecommunications (DECT™) | 118 | 4% |
| EMC and Radio Spectrum Matters (ERM) | 110 | 4% |
| Human Factors (HF) | 110 | 4% |
| CYBER | 108 | 4% |
| Others | 276 | 10% |
| TOTAL | 2 743 | |

Figures are rounded to the nearest k€.

Funding sources in 2017



| | |
|---------------|-----|
| EC/EFTA | 57% |
| ETSI Funding | 31% |
| 3GPP Partners | 8% |
| 3GPP Members | 4% |

Standards Production

In 2017 we published 2 760 standards, specifications, reports and guides, bringing the total published since our establishment in 1988 to over 44 000.

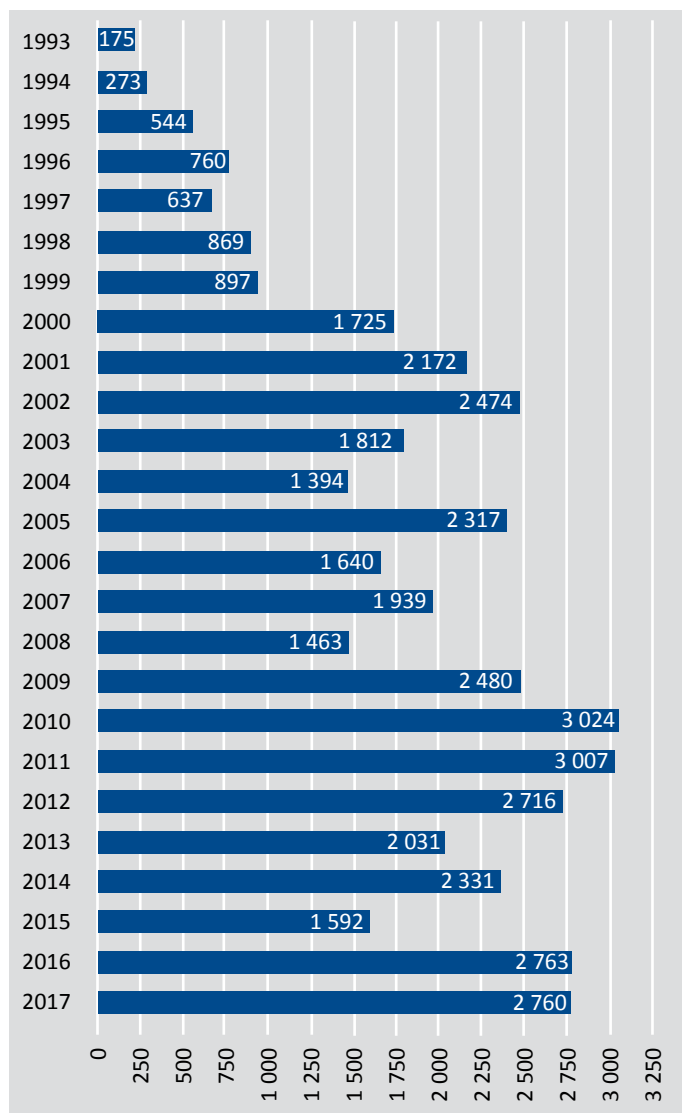
Intellectual Property Rights

Our Intellectual Property Rights (IPR) Policy is highly regarded around the world. To improve it still further, we consult widely with our members, the European Patent Office (EPO), the European Commission, the United States Government and relevant partner organizations, to reflect the needs of our members, public authorities and the Information and Communications Technologies community.

In 2017 our IPR Special Committee maintained its focus on increasing the transparency of patent declarations and the information we provide to members and the public. To support this, our legal department continued its review of the ETSI online IPR database, making further enhancements to improve its accuracy.

Throughout the year, we contributed the views and represented the interests of the standardization community on patents, standards and the interplay between them at conferences and workshops worldwide. Work also progressed on identifying and mapping the standardization process to patents activities.

The number of deliverables published, for each of the years 1993 – 2017



Distribution by type of published document

| | in 2017 | Total since 1988 |
|---|--------------|------------------|
| Technical Specification (TS) ¹ | 2 321 | 34 141 |
| Technical Report (TR) ² | 218 | 3 609 |
| ETSI Standard (ES) | 32 | 801 |
| European Standard (telecommunications series) (EN) ³ | 111 | 4 937 |
| ETSI Guide (EG) | 1 | 252 |
| Special Report (SR) | 4 | 100 |
| Group Specification (GS) | 41 | 173 |
| Group Report (GR) | 32 | 34 |
| TOTAL | 2 760 | 44 047 |

¹ Includes GSM™ Technical Specification (GTS)

² Includes old deliverable types: Technical Committee Reference Technical Report (TCR-TR), Technical Committee Technical Report (TC-TR) and ETSI Technical Report (ETR)

³ Includes amendments and old deliverable types: European Telecommunication Standard (ETS), Interim ETS (I-ETS) and Technical Basis for Regulation (TBR)

Membership

Overall ETSI membership (all categories) increased again in 2017. At the end of the year, we had a total of 830 members, drawn from 66 different countries and provinces across five continents. This was made up of 676 full members drawn from 43 European countries, 140 associate members drawn from 23 non-European countries and 14 observers. 124 of our members are Small and Medium-sized Enterprises (SMEs) and 89 are Micro-Enterprises. Small organization members now represent 26% of the overall membership.

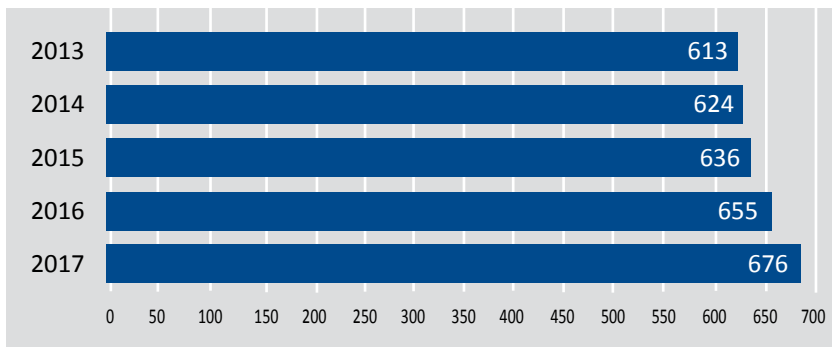
The European Commission and the European Free Trade Association Secretariat, which hold special roles as Counsellors, attend our General Assembly and the ETSI Board and continue to play an active part in our work.

We introduced a new system for approving applicant members via a quarterly online poll.

Our membership team continued to develop close relationships with our members, and work progressed on the drafting of a guide to help all new (and existing) members benefit fully from their membership.

Collection of contribution invoices in 2017 was performed with a rate of 99,25% of recovery.

Evolution of ETSI Full Membership

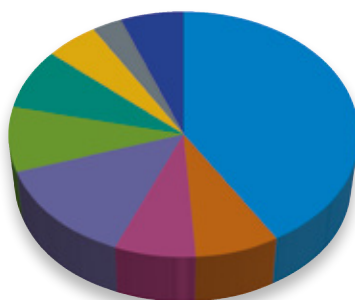


Membership by type

| | 1-1-2017 | 31-12-2017 |
|-------------------|------------|------------|
| Full Members | 655 | 676 |
| Associate Members | 131 | 140 |
| Observers | 18 | 14 |
| Total | 804 | 830 |

Full and Associate Membership by category

| | |
|-------------------------------|-----------|
| Manufacturers | 336 (41%) |
| Network operators | 65 (8%) |
| Administrations | 60 (7%) |
| Research bodies/ universities | 111 (13%) |
| Service providers | 71 (9%) |
| Consultancies | 63 (8%) |
| Users | 41 (5%) |
| Other Government bodies | 23 (3%) |
| Others | 46 (6%) |



Overall membership by country/province

| | |
|---|------------|
| Albania | 2 |
| Andorra | 1 |
| Australia | 6 |
| Austria | 17 |
| Belgium | 30 |
| Bosnia Herzegovina | 2 |
| Botswana | 1 |
| Bulgaria | 2 |
| Canada | 12 |
| China | 12 |
| – Taiwan (Province of China) | 13 |
| Croatia | 2 |
| Cyprus | 1 |
| Czech Republic | 5 |
| Denmark | 15 |
| Estonia | 2 |
| Finland | 16 |
| Former Yugoslav Republic of Macedonia (FYROM) | 1 |
| France | 105 |
| Georgia | 1 |
| Germany | 138 |
| Greece | 5 |
| Hungary | 4 |
| Iceland | 1 |
| India | 4 |
| Indonesia | 1 |
| Iran | 1 |
| Ireland | 19 |
| Israel | 10 |
| Italy | 29 |
| Japan | 8 |
| Jordan | 1 |
| Korea | 7 |
| Kosovo | 1 |
| Latvia | 1 |
| Lebanon | 1 |
| Lesotho | 1 |
| Lichtenstein | 1 |
| Lithuania | 1 |
| Luxembourg | 10 |
| Malaysia | 1 |
| Malta | 2 |
| Mexico | 1 |
| Moldova | 1 |
| Montenegro | 1 |
| Netherlands | 29 |
| Norway | 13 |
| Poland | 9 |
| Portugal | 4 |
| Qatar | 2 |
| Romania | 3 |
| Russian Federation | 8 |
| Serbia | 1 |
| Slovakia | 2 |
| Slovenia | 3 |
| South Africa | 3 |
| Spain | 29 |
| Sweden | 30 |
| Switzerland | 21 |
| Tunisia | 1 |
| Turkey | 9 |
| Ukraine | 1 |
| United Arab Emirates | 5 |
| United Kingdom | 106 |
| United States of America | 54 |
| Uzbekistan | 1 |
| 66 COUNTRIES OR PROVINCES IN TOTAL | 830 |

The Financial Situation

The management of the finances of ETSI is described by

- the budget report
- the financial statements (balance sheet and income and expenditure statement) which are established according to French laws and regulations.

Mr Anis Nassif, Concertaet, whose auditor's mandate was approved by the 68th General Assembly, has audited the 2017 ETSI accounts and certified that the annual financial statements are true, sincere and give a fair view of the activities carried out during the past financial year.

Budget Maintenance

In total, compared with 2016, income decreased by 0,4% or roughly 111 k€, while expenditure was down by 0,5% or 117 k€. After having made provision of roughly 22 k€ for Income Tax to be paid and of 1 400 k€ in credit notes to be issued to members to offset the excess of income over expenditure, the net surplus of the year is 117 k€. This compares with a net surplus of 91 k€ in 2016.

The key points of the budget management are the following:

Income

Members' contributions (16,2 M€ before credit notes) were 7,6% over budget and increased by 1,7% compared with 2016. They funded roughly 73% of the budget.

European Commission (EC)/European Free Trade Association (EFTA) funding amounted to 4 M€ to cover expenses related to the operation of the European standardization platform and standardization projects.

With the termination of some Partners' service contracts, income generated by support services supplied to fora and consortia (Forapolis™) amounted to 0,18 M€, which represents a 32% decrease compared with 2016. The decreasing trend will continue until the beginning of 2018, when these activities are planned to be terminated with a small delay to the original roadmap.

Expenditure

Secretariat costs were 3,3% under budget and lower by 0,5% compared with 2016.

In addition to the close monitoring of the expenditure budget along with delays in implementing some planned activities and projects that also contributed to the budget underspend, in 2017 no payment was made to the Pension Fund to cover ETSI liabilities with regards to 'Indemnités de Fin de Carrière', the current coverage being already sufficient to cover ETSI's liability.

It was confirmed that Partners' services were delivered without any cross-subsidy from the members' contributions.

3,4 M€ were spent for acquiring expertise for Specialist Task Forces and other standardization-related technical expertise.

2017 Budget Statements

| INCOME | (k€) | EXPENDITURE | (k€) |
|--|---------------|--------------------------|---------------|
| Members' contributions and Observer fees net of credit notes | 14 768 | Secretariat staff costs | 12 569 |
| EC/EFTA contracts | 3 979 | Other Secretariat costs | 5 454 |
| 3GPP™ Partners | 2 151 | Special projects | 156 |
| Voluntary contributions | 169 | European Friends of 3GPP | 503 |
| Forapolis | 178 | Provision and losses | 184 |
| European Friends of 3GPP | 566 | Experts' costs | 3 372 |
| Sales | 124 | | |
| Plugtests™ | 0 | | |
| Financial income | 55 | | |
| Other income | 365 | | |
| TOTAL INCOME | 22 355 | TOTAL EXPENDITURE | 22 238 |

In 2017, there was a net surplus of 117 k€.

Financial Statements for the Year 2017

The final accounts and the balance sheet are summarized below.

The fiscal accounting period is 1 January 2017 – 31 December 2017.

Statement of Income and Expenditure Year 2017

| | Income (€) | Expenditure (€) |
|---------------------------------|-------------------|-------------------|
| Income | 22 359 779 | |
| Purchases | | 8 244 597 |
| Expenses | | 14 021 958 |
| Financial income & expenses | 55 069 | 9 788 |
| Extraordinary income & expenses | 3 119 | 2 312 |
| Income Tax | | 21 942 |
| TOTAL | 22 417 967 | 22 300 597 |

There was a net surplus of 117 370 € in 2017.

Summary of the Balance Sheet

Assets

| Net amounts at: | 31 Dec 2016 (€) | 31 Dec 2017 (€) |
|---------------------|-------------------|-------------------|
| Fixed assets | 6 349 933 | 5 711 991 |
| Debtors | 15 643 371 | 15 492 971 |
| Securities/cash | 9 103 427 | 10 096 690 |
| Prepaid expenses | 157 798 | 250 299 |
| TOTAL ASSETS | 31 254 529 | 31 551 951 |

Liabilities

| Net amounts at: | 31 Dec 2016 (€) | 31 Dec 2017 (€) |
|--------------------------|-------------------|-------------------|
| Equity | 8 278 661 | 8 687 393 |
| Provisions | 435 098 | 394 571 |
| Balance carried forward | 408 732 | 90 934 |
| Surplus of the year | 90 934 | 117 370 |
| Creditors | 5 838 543 | 6 703 030 |
| Deferred revenue | 16 202 561 | 15 558 653 |
| TOTAL LIABILITIES | 31 254 529 | 31 551 951 |

Figures are rounded to the nearest €.



- 2G, 3G, 4G, 5G Mobile Communications
- Aeronautical Communications
- Artificial Intelligence
- Augmented Reality
- Automotive Radar
- Autonomic Systems
- Body Area Networks
- Broadband Wireless Access
- Broadcasting
- Cable Networks
- Cognitive Network Management
- Cognitive Radio
- Content Delivery
- Context Information Management
- Core Networks
- Cyber Security
- DECT™
- Digital Mobile Radio
- Digital Rights Management
- eHealth
- Electromagnetic Compatibility
- Electronic Signatures
- Emergency Communications
- Energy Saving
- Environmental Aspects
- Fixed-line Access
- Fixed Radio Links
- Human Factors
- Intelligent Transport
- Internet of Things
- Interoperability
- Lawful Interception
- Low Power Radio
- Low Throughput Networks
- Machine-to-Machine Communications
- Maritime Communications
- Millimetre Wave Transmission
- Mission-Critical Communications
- Multi-Access Edge Computing
- Network Functions Virtualisation
- Network Management & Automation
- Next Generation Networks
- Open Source Software
- Powerline Communications
- Protocols
- Public Safety Systems
- Quality of Service
- Quantum Key Distribution
- Quantum-Safe Cryptography
- Radio Regulations
- Radio Systems
- Rail Communications
- Safety
- Satellite Communications
- Security Algorithms
- Short Range Radio
- Smart Appliances
- Smart Cards
- Smart Cities
- Software Defined Radio
- Testing
- Terrestrial Trunked Radio (TETRA)
- Wireless Medical Devices

To find out about our plans for the future,
see our Work Programme 2018-19.

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