World Class Standards

annual report

april 2016

a connected world

ETSI's Vision of a Connected World

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 standardisation has seen our reach extend from European roots to the entire world.

ETSI is officially recognised by the European Union as a European Standards Organisation (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 EU to be more competitive.

ETSI is a not-for-profit organisation created in 1988. We have almost 800 member organisations worldwide, drawn from 63 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 organisations and societal interest groups.

ETSI is a world-renowned organisation 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 Organisations, particularly our sister 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 organisations, addressing the technical issues that will drive the economy of the future and improve life for the next generation.

Our 'clusters' (above) provide a simplified, yet comprehensive, way of identifying our different areas of expertise based on business relevance or application domain rather than our committee structure.

Each cluster represents a major component of the global Information and Communications Technologies architecture and brings together the work of those Technical Committees and other groups which share a common technological scope and vision.

It is this joint scope and vision that gives each cluster its own identity; collectively the clusters represent the totality of ETSI's work, and demonstrate the way that technologies are converging into a connected world.

Annual Report 2015 (published April 2016)

Every year, our work programme expands, both in our traditional areas of expertise, as well as in emerging technologies. With vast experience gained in the development of world-renowned standards, we are well placed to tackle new challenges. For example, we are already preparing for the advent of 5G and, alongside this, we have exciting new work in Network Functions Virtualisation (NFV), Mobile-Edge Computing and Millimetre Wave Transmission. Our Industry Specification Groups (ISGs) continue to prove very popular as a means of bringing together key stakeholders to create specifications to kick-start innovation.

ETSI is at the heart of Information and Communications Technologies (ICT) and there is much more to our work than simply writing standards. ETSI is also an enabler of standards. We help to set the ecosystem, creating the communities and conditions for the development of standards – before, during and after the writing of specifications. We provide standards that join up and ensure that key areas such as security and spectrum use are built in. Increasingly we are recognised as the place to go for strategic standardisation topics, as evidenced, for example, by our work on Cloud Standards Co-ordination or activities related to the Internet of Things (IoT). And, by collaborating with the research community, we are in at the beginning of the life of a technology, identifying where standards can help its commercialisation.

This report describes our achievements in 2015 – in both old and new technologies – and demonstrates our continuing impact in Europe and around the world.

Simon Hicks
Chairman of the General Assembly

During 2015, the Board, with input from the wider membership, has been drawing up a long term strategy for ETSI for the next five years. As part of this we have considered the emerging technology trends that will influence our standards-making and we have been open to new ways of doing things.

One key technology trend identified is the shift from hardware to software, virtualisation and the Cloud. While the use of hardware is, of course, indispensable, we have already begun work to support software-based products. For example, our ISG on NFV is developing an open NFV ecosystem, which will enable rapid service innovation for network operators and service providers.

In 2015 we also began to address the interplay of Open Source software and standards. ISG NFV is liaising with Open Source projects and we are looking into ways to allow Open Source developments inside ETSI.

We overhauled our process for transforming third party specifications into ETSI specifications and we are looking at adopting the Car Connectivity Consortium's leading industry standard for car-smartphone connectivity as ETSI specifications, assisting its future development.

We are firmly resolved to remain ahead of the ever-changing technological landscape but, as well as these new developments, we continue to deliver standards in established areas, including nearly 200 new standards required by the introduction of the Radio Equipment Directive.

Dirk Weiler
Chairman of the Board

ETSI's continuing success is built on the twin pillars of flexibility and quality. In 2015 we have proved again that we can adapt to changing market demand, that we are ready for the challenge of a new approach and new ideas, and that we will not settle for second best in anything we do.

As a result, we are widely acknowledged as a developer of world class standards, and our standards are being adopted all over the world.

For example, we are leading the drive for global standards for Co-operative Intelligent Transport Systems, and developing global Key Performance Indicators for the eco-efficiency of ICT equipment and networks. We are a founding partner of two global standardisation partnerships, the Third Generation Partnership Project (3GPP™), which has begun to address 5G mobile telecommunications, and oneM2M for Machine-to-Machine communications and the IoT.

We have a key role to play in the IoT. Building on our longstanding security work, we are now also committed to the security of the Internet, protecting the information it carries and the private and business users who rely on it. Our security standards will also play a key role in creating the consumer confidence necessary for the commercial success of new technologies, particularly in the IoT.

The following pages describe our work in 2015. For what we plan to do next, please see our Work Programme 2016-17.

Luis Jorge Romero
Director-General

Sowing for the Future – an Overview of 2015

While we continued to support the long-established technologies for which we first earned our reputation as a standards-maker, the scope of our work widened again in 2015. We also adopted different approaches to meet the needs of our members. As a result, we have begun to produce new fruit.

Nurturing New Technologies

We cultivated our links with the research community and academia, to ensure that standards are considered early in the development of new technologies, products and services, and we organised numerous workshops to disseminate research results and identify standardisation opportunities.

Our Industry Specification Groups (ISGs) are proving an effective mechanism for bringing together key stakeholders, including non-members of ETSI, to kick-start new technologies. Three new ISGs established in 2015 all focus on the technology needs of the future. One is addressing quantum-safe cryptography, anticipating the emergence of the quantum computer, another is specifying a new Compound Content system for next generation consumer electronic devices for moving pictures, and the third will look at the protocol needs of the connected society of the 21st century.

The Cloud and Virtualisation

Our ISG on Network Functions Virtualisation (NFV) made good progress with specifications to help facilitate the deployment and operationalisation of Virtual Network Functions, and we began to address the interplay between standards and Open Source software.

Increasingly we are seen as the 'go-to' place for priority standardisation activities. For example, at the request of the European Commission (EC), we led the Cloud Standards Co-ordination project, helping to shape the future of Cloud technology.

Wireless Systems

The Third Generation Partnership Project (3GPP™), of which we are a founder partner, began work on 5G mobile communications, and in ETSI we are helping to develop technologies which are expected to form some of the building blocks on which 5G will be based, with specifications, for example, on NFV, Millimetre Wave Transmission and Mobile-Edge Computing. We are also looking at the spectrum needs of both existing radio systems and 5G, including increasing efficiency by sharing spectrum.

The Internet of Things (IoT)

We play a key role in the development of the IoT. As part of oneM2M, the global standards initiative for Machine-to-Machine (M2M) communications and the IoT, we are helping to develop a global standardised platform by which devices and services can be connected, regardless of existing sector or industry solutions.

Within ETSI, we worked on smart appliances, smart cities, smart metering and smart grids, and we continued to address wireless industrial automation and eHealth. We produced our first specifications for Body Area Networks and we made good progress with the specifications for Co-operative Intelligent Transport Systems.

Security

Greater connectivity brings with it increased security risks. We have therefore prioritised issues such as security by default, privacy and data protection, threats in cyberspace, the embedded UICC and mobile contactless communication, electronic signatures and protection for Information and Communications Technologies (ICT) in critical infrastructures. Our standards for Lawful Interception and Data Retention play a crucial role in helping law enforcement agencies around the world to investigate crime and terrorism.

Towards a Better Life

As well as supporting business growth, we also aim to improve life for individual users. So we are developing standards for telecommunication quality and to widen access to ICT devices and services for the young, the old and those with cognitive and learning disabilities. We made good progress with public safety topics including emergency calling and alerting, and we specified a framework for the deployment of satellite-based emergency telecommunication networks at disaster sites.

We are tackling the eco-environmental impact of ICT equipment and developing tools to improve the energy management of networks, and we enhanced our specification for Ultra Low Energy Digital Enhanced Cordless Telecommunications (DECT™), the new networking technology developed particularly for M2M communications.

In the broadcasting area, we focused on digital broadcasting, especially Ultra High Definition television, protection and rights mechanisms and the transportation of video over powerlines.

We made good progress with optical fibre systems for home cabling, future networks and the transition to IPv6.

Testing and Interoperability

We continue to apply best working practices to our standards-making, to organise Plugtests™ interoperability events and to develop conformance test specifications. But in 2015 we also experimented with hackathons, our new Proof of Concept framework was applied successfully by several of our groups, and we launched a new testing language, Test Description Language.

Working in Partnership

We collaborated with partners all over the world, including our sister European Standards Organisations, CEN and CENELEC, and we worked closely with the EC in support of its policies and goals. For example, considerable effort went into developing the new Harmonised Standards required to support the new Radio Equipment Directive.

2015 was a year of new challenges, new opportunities and new ways of getting things done. We have sown new seeds for the future and we look forward to a bumper harvest.

New Beginnings

We are constantly looking for new ways to extend our activities and to keep up to date with the latest developments in Information and Communications Technologies (ICT). In this way we are able to provide our members with the standards they need to develop their businesses with innovative services and equipment.

In Touch with the Research Community

We make every effort to keep up to date with the latest R&D. This both triggers new standardisation activities and contributes to our ongoing work. In 2015 we continued to cultivate close relationships with academic institutions, we exchanged information with researchers and we took part in relevant conferences and other events where project results were presented. We maintained contact with European Technology Platforms, Public Private Partnerships and Joint Technology Initiatives, as appropriate, and we participated in European Commission (EC) funded projects.

We monitored activity related to Horizon 2020, the EU research funding programme, seeking to identify opportunities where we have something to add.

Standards can help bridge the gap between research and the industrial development of products and services by facilitating the commercialisation of research results. With this in mind, we began to organise a workshop entitled 'From Research to Standardisation' to be held in May 2016.

In 2015 we took part in several EC-funded projects:
As a sub-contractor on project SAGITER, which was completed in February, we developed Global Navigation Satellite System standards in response to the EC's 'Space Mandate' (M/415). In Project ANTILOPE we helped to address the adoption and take-up of standards and profiles for eHealth interoperability. We worked as a partner in the Electronic Simple European Networked Services (e-SENS) Large Scale Pilot Project, with the goal of developing an interoperable European solution for electronic public services, comprising eJustice, eID, eDelivery and eSignatures. This would enable cross-border government services and support the mobility of citizens and businesses.

In 2015 the EC accepted two Co-ordination and Support Action (CSA) project proposals with ETSI as a partner. ESPRESSO (systEmic Standardisation apPRoach to Empower Smart citieS and cOmmunities) is related to smart cities, and UNIFY-IoT fosters innovation ecosystems for the Internet of Things (IoT).

We maintained informal liaison with a number of other projects.

Workshops

Our varied programme of workshops provides a platform to disseminate our results and identify next steps for standardisation. These events also facilitate early consensus-building, stimulate new standardisation activities and fertilise our ongoing technical work.

In 2015 globally recognised annual events included our Intelligent Transport Systems workshop and the sixth annual Machine-to-Machine communications workshop which incorporated a second oneM2M Showcase. In June we extended our highly successful annual Security Workshop into a full Security Week with a workshop, meetings and other activities.

Other highlights included workshops on telecommunication quality beyond 2015 in Vienna, Austria, the third ETSI/Institute for Quantum Computing Quantum-Safe Cryptography (QSC) workshop in Seoul, Korea, and the ETSI International User Conference on Advanced Automated Testing (UCAAT), held for the first time on our own premises. In May we ran a workshop on mobile broadcast, and in June we hosted our workshop on ICT energy efficiency and environmental sustainability. Our summit on emergency communication in November attracted 115 participants. In partnership with the EC, we organised the last two in a series of four smart appliances workshops in Brussels, Belgium. A joint ETSI/European Broadcasting Union event, held in May in Sophia Antipolis, examined the future of the delivery of audio-visual media services, particularly in the context of 5G.

Supporting the Development of New Technologies

There are different ways to be an effective player in the standardisation landscape in addition to writing standards. We are therefore involved in several major initiatives to support the development of new technologies.

Industry Specification Groups
Our Industry Specification Groups (ISGs) continue to develop, offering standardisation in specific innovative areas. By their nature, ISGs can produce specifications quickly and easily to encourage innovation. Our ISGs have proved to be a flexible platform to bring together key stakeholders, including non-members of ETSI, to shape the industry. We have already nurtured a number of innovations in our ISGs and the output of some of our earliest groups is now being built upon in other ETSI committees.

In 2015 we set up three new ISGs. Our ISG QSC will assess proposals from industry and academia for QSC and develop specifications to prevent encrypted data from being decrypted by future quantum computers. Our new ISG on intelligent Compound Content Management will improve the brightness, contrast, and colours of standardised next generation UHD moving pictures while ensuring the scalability of the standardised solution for all screens from the cinema to television to smart phones. Our third new ISG, on Next Generation Protocols, will reinvent packet switching to overcome the limitations of the TCP/IP protocol stack to unleash the full potential of future 5G networks.

Supporting the Development of 5G
Interest in the next generation of cellular technology, or '5G', grew considerably in 2015 and the Third Generation Partnership Project (3GPP™), of which ETSI is a founding partner, began to draw up plans to develop a 5G standard system. In March, 3GPP endorsed a tentative timeline which would see its detailed specifications submitted to the IMT-2020 process by 2020. In September a 3GPP workshop in Phoenix, US, attracted 550 delegates. The event gave companies an opportunity to share their views on 5G, prior to 3GPP beginning an initial study aimed at identifying the requirements of IMT-2020 and the scope and requirements of the new radio technology.

5G is intended to support a very wide range of innovative services, but will be crucial to mobile broadband, supporting connectivity in the IoT, and where ultra-reliable/low latency communications are needed, such as for mission-critical applications. We are already involved in the development of standards in all these areas and we began planning our own summit, '5G: From Myth to Reality', to be held in April 2016.

We are also working on a number of activities that will form some of the building blocks on which 5G will be based. These technologies are considered key components of the next generation of connectivity. For example, it is evident that 5G networks will make significant use of virtualisation – an area being addressed by our ISG on Network Functions Virtualisation. To achieve very high performance and high availability, we will need much more spectrum. Our ISG on Millimetre Wave Transmission is undertaking studies into millimetre wave bands (30 - 300 GHz), where spectrum is more readily available than in currently popular bands below 6 GHz. Similarly, our ISG on Mobile-Edge Computing is looking to achieve very low latency by placing computational functionality as near as possible to the end-users.

Spectrum is a key parameter of any radio system, and is a major issue for 5G. Our main role in this regard is in ensuring compatibility between the different uses which may occupy adjacent spectrum. We are also looking for ways to improve spectral efficiency by using the latest methodology and advanced techniques for sharing spectrum. Our Reconfigurable Radio Systems committee (TC RRS) is a key player in this area.

As a result of this work, membership of both 3GPP and ETSI widened in 2015, as new members from categories where we have not previously enjoyed real input are now taking part in the standardisation process.

Shaping the Cloud Environment
Standardisation ecosystems can be extremely complex, and increasingly ETSI is asked to play a new role in analysing these ecosystems, fostering co-ordination and suggesting improvements. The Cloud Standards Co-ordination (CSC) project is one such example where we have helped to shape the future of a technology.

In 2013, at the request of the EC, we brought together more than 250 stakeholders in the CSC initiative, to assess the status of the Cloud computing standardisation eco-system and identify the standards needed to support EC policy objectives, in particular in critical areas such as security, interoperability, data portability and reversibility.

In February 2015 we launched Phase 2 of the CSC. While Phase 1 focused on cloud service providers, Phase 2 turned the spotlight on users (such as small businesses and administrations). We undertook a survey into customers' requirements. We also reassessed the maturity of Cloud computing standards and looked at the part standards and certification can play in supporting users' needs. We tackled key concerns, including security and interoperability, and we considered Open Source as an important contributing element to Cloud computing and how standards and Open Source are interworking in the field of Cloud.

In November we completed four Special Reports covering users' needs, standards and Open Source, interoperability and security, and standards maturity. The results of our work were presented at various events throughout 2015 and the final results were scheduled to be delivered to the EC early in 2016.

Open Source

As virtualisation and cloud technology are shaping the next generation of network systems, it is increasingly necessary to work with Open Source software. We recognise the important role that Open Source software will play in future standards activities and, in November 2015, we held a summit which brought together leading organisations from both communities to exchange views on how standards and Open Source can work together.

The event drew attention to the fact that Open Source software and standards each have their own strengths and are complementary rather than competing. Open Source can be used to build reference implementations for evaluating and/or developing standards and to promote interoperability. In 2015 we continued to develop our comprehensive range of tools to provide end-to-end support for the standards-making process, including Open Source. Our Centre for Testing and Interoperability, for example, has begun to use a state-of-the-art Open Source tool chain to assist in the development of base standards and test standards, and a number of Open Source communities are already developing implementations of ETSI specifications.

We expect the discussions at the summit to lead to new activities in this area in 2016, including a workshop on the legal implications of Open Source.

Transportation

Bringing the Power of ICT to People on the Move

Information and Communication Technologies are revolutionising 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.

Intelligent Transport Systems

Our Intelligent Transport Systems committee (TC ITS) is playing a key role in the introduction of Co-operative ITS (C-ITS) services. C-ITS will enable vehicles made by different manufacturers to communicate with each other and with road infrastructure systems, helping to prevent accidents and improve the driver experience. We are co-ordinating our activities with other organisations around the world to achieve global standards for C-ITS.

In 2015, we fine-tuned our first release of C-ITS standards, taking account of feedback received. For example, we revised the relevant specification on mitigation techniques to help ensure that deployment of C-ITS in the 5,9 GHz frequency band would not have a negative impact on road tolling systems operating in the 5,8 GHz band.

The major work of the year, however, focused on initial studies for Release 2 of the C-ITS standards and preparation for automated driving. Release 2 will address new features and functionalities anticipated in future C-ITS to deal with more complex use cases and the interests of a larger group of stakeholders. We made good progress on pre-standardisation studies into Co-operative Adaptive Cruise Control, and the use of C-ITS to protect vulnerable road users such as cyclists and motor cycle riders. We also continued to address the spectrum requirements to support Release 2.

We completed our work on Cross Layer Distributed Congestion Control for the management of C-ITS, as well as a new specification on the communication system for the Tyre Pressure Monitoring System. Work began to specify the Co-operative Observation Service, through which road users can share sensor information.

We continued to develop conformance tests, a crucial factor in the commercial deployment of C-ITS, paying particular attention to test specifications for ITS security.

The seventh annual ETSI ITS workshop was held in Helmond, The Netherlands, in March 2015.

In November, we signed a co-operation agreement with the Car Connectivity Consortium, creators of MirrorLink®, the leading industry standard for car-smartphone connectivity, with a view to adopting MirrorLink as an ETSI standard.

We began work on a new European Standard (EN) on measurement techniques for automotive and surveillance Short Range Radar equipment using 24,05 - 24,5 GHz or 76 - 81 GHz.

Aviation

Work continued in our Aeronautics committee (TC AERO) to update the EN on the Advanced Surface Movement Guidance and Control System and to add a new part on multilateration equipment. We completed our work on ground-based VHF Digital Link radio transceivers for the aeronautical mobile service, publishing revised standards for both Modes 2 and 4.

Work began on a Technical Report on the use of professional unmanned aerial systems by film crews, for aerial surveys and by the police, and on three new ENs on surveillance radar. We also started work on a new EN for heli-borne obstacle detection radar equipment in the 76 - 79 GHz band.

We updated our existing standards on mobile communication on aircraft to include the Universal Mobile Telecommunications System (UMTS™) and LTE™ as well as the original GSM™.

Railways

Our Railway Telecommunications committee (TC RT) maintains the GSM-R (GSM for railways) standard. In 2015 we published a revised version of the specification for the detailed requirements for GSM-R networks.

We continued to work to resolve interference issues with public systems, and to incorporate Internet Protocol into the core network and interface specifications. We completed work aimed at incorporating the 3 MHz of additional spectrum allocated to GSM-R into the Third Generation Partnership Project (3GPP™) radio access standard. We began a feasibility study into the use of GSM-R radio performance enhancements and resource optimisation as a means of improving system capacity, spectrum efficiency and the robustness of the radio link.

We published a new specification which defines the General Packet Radio Service (GPRS)/Enhanced GPRS features needed to operate the European Train Control System, and began specifying the telecommunications commands necessary for the operation of mobile radio systems on railways.

We set up a new group on Next Generation Radio for Rail (NG2R) to develop standards for voice, data services and other applications over broadband and narrowband air interfaces.

We also established a group to look into the feasibility of operating C-ITS and Communication Based Train Control systems in the same frequency bands.

We continued to address the spectrum needs of GSM-R networks evolution which will involve an investigation into the use of dedicated land-mobile spectrum in the 400 MHz or 700 MHz bands.

Maritime

Work continued on ENs for Digital Selective Calling in the maritime mobile service, for man overboard devices and Maritime Broadband Radio links for ships and off-shore installations.

Integrating Objects to Create New Networked Services

An ever increasing number of everyday machines and objects are now embedded with sensors or actuators and have 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.

M2M and the IoT

oneM2M

ETSI and oneM2M

ETSI is one of the founding partners in oneM2M, the global standards initiative for M2M and the IoT. oneM2M brings together 14 partners including eight of the world's leading Information and Communications Technologies Standards Development Organisations, as well as representatives of different industry sectors. The Telecommunications Standards Development Society, India (TSDSI) joined in 2015, extending oneM2M's reach into the Indian market. By the end of the year, membership numbered over 200 companies.

Further information at www.oneM2M.org

oneM2M is developing specifications that will enable users to build platforms by which devices and services can be connected in the IoT, regardless of existing sector or industry solutions. oneM2M will provide a standardised interface, without changing the underlying network, to increase the scalability of IoT applications and services and thus their commercial viability. This interface will offer a means for sharing data and services across and between multiple organisations in different sectors and different geographical locations.

The first release of oneM2M specifications – the world's first global standards for IoT deployment – was delivered in January 2015. The ten specifications were subsequently published by ETSI and the other partner standards bodies. Release 1 addresses the basic elements of creating, deploying and managing M2M and IoT applications. It covers requirements, architecture, protocols, security solutions and mapping to common industry protocols, which together provide sufficient building blocks to enable today's generation of M2M and IoT applications to interwork with each other. Release 1 uses established protocols to allow applications across different industry segments to communicate with each other, and the platform that has been created is already useable over several underlying transport technologies, including Wi-Fi, Internet Protocol, fixed line and cellular.

Adoption began almost immediately and oneM2M began to revise Release 1 to take account of early implementation experience.

The collection of requirements for Release 2 was completed in 2015. Fourteen new specifications were identified, which will add new functionality and drive the deployment of various features including the enablement of smart factories and the smart home. Key elements in Release 2 are improvements to security and semantic interoperability to enable scalable IoT systems and services. Interoperability in the IoT is not just a matter of connecting devices. It is also about understanding the data being collected and distributed by different devices, and reusing it in a secure manner. oneM2M Release 2 includes a base ontology developed from work done by ETSI's SmartM2M committee.

Release 2 will also address interfaces for some of the most widely used IoT protocols, to create a larger library of interfaces, as well as application programming interfaces and guidelines for developers. Development of Release 2 was well under way by the end of 2015 with delivery planned for mid-2016.

The first oneM2M Application Identifier (App-ID) Registry was launched in 2015. Under the management of oneM2M partner, the Alliance for Telecommunications Industry Solutions (ATIS), the Registry provides a central source for application registrations and subsequent look-ups, enabling the generation of unique standards-based identifiers, centralised App-ID data management and the processing of thousands of concurrent transactions.

Promotion of oneM2M's achievements continued to be an important aspect of its work. Showcases were held in Tokyo, Japan, in Dallas, USA, and at ETSI. The IoT Week in Korea featured Open Source implementations of oneM2M solutions. Other communications activities included an executive briefing, interviews with key figures in the industry, webinars and a White Paper on oneM2M as the interoperability enabler for the M2M and IoT ecosystem.

In September oneM2M held its first interoperability event, when organisations implementing the Release 1 specifications came together to validate interoperability and end-to-end functionality via oneM2M interfaces. Work continued on the first oneM2M interoperability test specifications.

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.

In 2015, our Smart M2M committee (TC SmartM2M) focused on these 'smart appliances'. We published a Technical Specification (TS) defining a smart appliances reference ontology and oneM2M mapping. The specification was developed following wide consultation with stakeholders and is based on a European Commission (EC) funded study aimed at creating a reference ontology (a language) specifically for smart appliances. The ontology, called SAREF (Smart Appliances REFerence ontology), will allow devices in the home (anything from lamps and consumer electronics to white goods) to exchange information with any energy management system, which might be located in the home or in the Cloud.

We began a revision of this specification which will include the mapping on the oneM2M base ontology and, in December, work began on the evolution of SAREF, expanding it in response to feedback received from the industry and potentially including non-energy aspects.

We also published a specification describing a framework for smart appliances communication based on ETSI M2M and oneM2M specifications, and we embarked on the development of a full set of testing specifications for smart appliances.

Other Aspects of M2M
We updated our Release 2 M2M specification, and published a new TS providing interoperability test descriptions for the M2M interfaces.

We published a Technical Report (TR) on smart cities, analysing their impact on the IoT environment.

We began work on a gap analysis of the IoT standards landscape and European Large Scale Pilots.

In response to the EC Mandate on Smart Metering (M/441), we published a TR on the security of smart energy infrastructures with the ultimate aim of reducing energy usage.

We continued to participate in the work of the Smart Grid Co-ordination Group (SG-CG), in which we work together with the European Committee for Standardisation (CEN) and the European Committee for Electrotechnical Standardisation (CENELEC) on standards for smart energy grids. The group presented the results of our work in response to Mandate M/490 to the EC in February, identifying the standards required to implement smart grids.

The sixth annual ETSI M2M Workshop was held in December, focusing on smart living and eHealth, smart cities and the connected car.

Wireless Industrial Automation

As part of our development of standards 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 (WIA). We began work on a new specification on the methods and concepts for a WIA system approach. Work also continued on 2,4 GHz wideband transmission systems, mainly in response to the use of short range devices in factories, for example in robotic arms.

eHealth

Body Area Networks
Body Area Networks (BAN) technology, using small, low power devices, offers considerable potential for health and wellness monitoring, sports training, personalised medicine (e.g. heart monitors) and personal safety, such as fall detection.

Our Smart BAN committee (TC SmartBAN) is addressing the need for a dedicated technology optimised for BAN. In 2015 we delivered our first Smart BAN specifications, producing a TS which defines an ultra low power Medium Access Control (MAC) protocol for on-body communications between a hub and sensor nodes. This solution is simpler and involves lower power consumption (and therefore longer battery life) than previous generic solutions. A second TS, defining an ultra low power physical (PHY) layer for on-body communications, was published at the same time. We then began work verifying the performance of the Smart BAN communication system using simulations and real-life demonstrations.

We also completed a TS on the service and application enablers, data representation and transfer formats, identifying the required management and control information, to support interoperability over heterogeneous networks. Work continued on a system description for Smart BANs, including an overview and use cases, and on measurements and modelling of the Smart BAN RF environment.

Medical Devices
Our Electromagnetic Compatibility and Radio Spectrum Matters committee (TC ERM) continued to develop standards for wireless medical devices (including ultra low power active implants and medical BAN systems) and made good progress with a System Reference document on the spectrum needs of Ultra Wide Band in medical applications.

eHealth
Our eHealth Project (EP eHEALTH) is compiling a glossary of terms to clarify the vocabulary used for eHealth issues and is developing use cases for eHealth standards with a view to identifying gaps in standardisation.

Enabling the IoT

Many of the connecting objects in M2M and the IoT need only low throughput connectivity. TC ERM is developing standards for Low Throughput Networks (LTN), a new ultra narrowband radio technology for very low data rates for ultra long autonomy devices. Kick-started by one of our Industry Specification Groups (ISGs), LTN is now part of our mainstream standardisation activity. In 2015 work continued on use cases and system requirements, the LTN architecture and the protocols for LTN interfaces.

Many communications modules used for M2M applications are now connected and attached using Surface Mount Technology, a process whereby the module is soldered directly on the circuit board rather than through mechanical connectors. In 2015, the first modules came to market based on the mechanical and electrical aspects specified by our ISG on Surface Mount Technique (ISG SMT). We updated our specification to take account of feedback received and to include additional form factors and forward-looking electrical interfaces.

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

We provide a wide range of Harmonised Standards by which manufacturers are able to demonstrate that their products comply with a European Commission (EC) Directive, allowing them to be placed on the market or put into service. In this way, we play an important part in helping to create a large, unified European market.

The new Radio Equipment Directive (RED), which will replace the Radio and Telecommunications Terminal Equipment (R&TTE) Directive, will be applied throughout the European Union (EU) from June 2016. The RED covers all products that deliberately use radio waves for communication or for determining their position, regardless of primary function. This means, for example, any product which includes a satellite positioning system (e.g. GPS, Galileo), Bluetooth, RFID, Radio Local Area Networks (RLANs) or Near Field Communication function. Smart devices, which use radio for remote control or monitoring, are also covered by the RED. 'Connected' industrial machines, domestic appliances and even remotely-controlled light bulbs all now have to demonstrate that they use the radio spectrum efficiently and effectively.

The RED puts specific requirements on the performance of radio receivers that they do not use more of the spectrum than is necessary. Broadcast receivers, which had been specifically excluded from previous legislation, are covered by the RED. For the first time equipment operating at frequencies below 9 kHz and radio determination equipment (including GNSS) are also included. New Harmonised Standards are required in all these areas. As a result, throughout 2015 we were heavily engaged in standardisation to take account of the RED's requirements.

In response to EC Mandate M/536, we provided the EC with an initial work programme which listed the new standards and revisions required. This is updated on an ongoing basis. In total, we have over 180 existing Harmonised Standards to review and align with the RED. By the end of 2015, we had already completed drafts of 84 of them and work was well advanced on the others.

For example, we began developing new standards on aeronautical, maritime and meteorological radar, as well as revising our existing automotive radar standards that are used in Intelligent Transport Systems (ITS) to maintain a safe driving distance and to warn the driver of possible collisions. The standards under the RED for Co-operative ITS also ensure that such systems can co-exist with other systems used for road tolling. We are co-operating closely with the European Committee for Electrotechnical Standardisation (CENELEC) in this work to avoid any overlaps or gaps between our respective European Standards (ENs).

We organised various events to ensure our members – and others – understand the implications of the RED, including a workshop in November, entitled '53 shades of RED: how to place compliant radio equipment on the European market'. In August 2015 we published a guide for our committees on applying Harmonised Standards produced for the RED. A second guide, which focuses on multi-radio and combined radio and non-radio equipment, was expected to be ready by mid-2016. We also held a highly successful webinar on the RED in September, which attracted 240 live viewers and many more watching the recorded version.

Managing Radio Spectrum

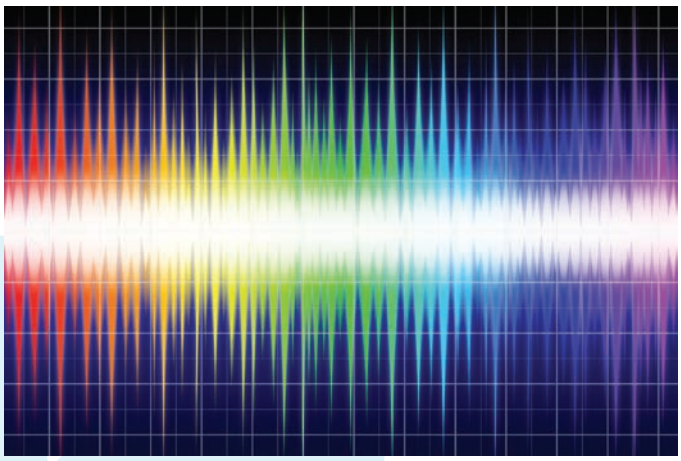
Our standards also enable administrations to ensure that users can use spectrum as widely as possible. We help the EC and the European Conference of Postal and Telecommunications Administrations (CEPT) to harmonise the use of spectrum throughout the EU and beyond (usually by producing System Reference documents). One example is a Technical Report (TR) on Cognitive Radio techniques to enable satellite communications systems and radio fixed links to make the best use of the shared parts of the Ka band (17,5 - 30 GHz) to provide superfast broadband connections to rural areas.

We continue to update the TR which includes detailed information on spectrum usage and an overview of our standards, reports and specifications, together with their applications and relevant frequency bands.

We are also developing the necessary standards to support the EU's longer-term policy for spectrum use, including the introduction of LTE™ in bands such as the Ultra High Frequency (UHF) TV band and the 2,3 - 2,4 GHz band, which is adjacent to the band used for Wi-Fi. For example, in 2015, at the request of the EC and in co-operation with CENELEC, we finalised an analysis of co-existence issues stemming from the 800 MHz 'Digital Dividend' Decision, including co-existence between cable television and new LTE mobile phones operating in the 800 MHz band. We worked with CENELEC in a joint working group to review and recommend improvements to the Harmonised Standards to control LTE interference with SRDs. We continued to contribute to work by the Radio Spectrum Policy Group on the future use of the UHF band (470 - 790 MHz), which formed the basis of an agreement at the World Radio Conference in November 2015.

Reconfigurable Radio Systems

Network resources are struggling to meet the growing demands of the Internet and mobile communications. Sharing under-used



spectrum could free up quality spectrum resources to support the various needs of our modern connected world, from Industry 4.0 to the many aspects of the Internet of Things (IoT). Spectrum-sharing will play a key role in particular in the development of 5G.

Reconfigurable Radio Systems (RRS) – intelligent radio devices which can characterise and act upon their environment – are opening up the opportunity to share unused spectrum among multiple services and radio networks. The RRS framework allows for installed radio applications to be updated, or for new applications to be installed on the device, making RRS a critical enabler for next generation Software-Defined Radio and Cognitive Radio networks.

In response to EC Mandate M/512 on RRS, our RRS committee (TC RRS) completed its work on TV White Spaces (TVWS, the areas of spectrum between allocated frequency bands that are unused by the spectrum owner over a given time in a given location). We published Technical Specifications (TSs) on the system architectures for TVWS use and for information exchange between different Geo-location Databases (GLDBs). This will enable the operation of white space devices while at the same time protecting the incumbent service. Both TSs were then converted and published as ENs, along with an EN to enable the operation of Cognitive Radio systems which are dependent for their use of radio spectrum on information obtained from GLDBs. We also published an EN on the interface between Cognitive Radio systems and the Spectrum Co-ordinator.

Licensed Shared Access (LSA) is creating opportunities for spectrum sharing by allowing for the co-existence of the original incumbent with a new cellular operator in the same frequency band. We completed a TS on the system architecture for the operation of mobile broadband systems in the 2 300 - 2 400 MHz band under LSA and then began defining the information elements and protocols for the LSA1 interface. We finalised the first part of a multipart EN on mobile device information models and protocols, addressing the Multiradio Interface. Good progress was made with the Reconfigurable Radio Frequency Interface and new work began on the Unified Radio Application Interface and the Radio Programming Interface.

In October, we contributed to the world's first LSA pilot demonstration organised by the EC's Joint Research Centre and the Italian Government in Milan, Italy. Using our RRS standards, the pilot showed that hardware which is already commercially available could be used to build a practical LSA solution.

The new capabilities of RRS bring new security challenges. We therefore began new work identifying security issues and proposing solutions, and on countermeasures to security threats.

We completed a survey to ascertain the level of interest in industry in the potential benefits of synergies between Public Protection and Disaster Relief, civil Private Mobile Radio and military and commercial domains.

Work continued on the system requirements for RRS operating in International Mobile Telecommunications-2000 (IMT-2000) and Global System for Mobile communication (GSM™) bands.

Broadband Radio Access Networks

In 2015, our Broadband Radio Access Networks committee (TC BRAN) addressed the standardisation of broadband Direct Air-to-Ground Communications systems. We continued with a revision of the Harmonised Standard for RLANs operating in the 5 GHz frequency band to include new technologies. We began to update our Harmonised Standard on Wireless Access Systems (WAS)/RLAN equipment operating in the 60 GHz band to include a Listen Before Talk mechanism to help ensure co-existence with other WAS/RLAN equipment operating in the same band. We completed a new TR on Broadband Wireless Access and backhauling for remote rural communities.

Ultra Wide Band

In July we published the second part of a multipart TR on Ultra Wide Band (UWB) signal characteristics. Work continued to describe the various different UWB regulations in place in different parts of the world. We also began two new TRs on time domain-based peak power and low duty cycle measurement for UWB. When this work is completed in April 2016, together these documents will provide a valuable reference tool for manufacturers seeking to enter cross-border markets.

Satellite Communications

Satellite technology is an important delivery platform for diverse 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 2015 the primary focus of our Satellite Earth Stations and Systems committee (TC SES) was on standards for high speed Internet access to fixed terminals or terminals on the move – in aircraft, on board ships or in vehicles. We completed a multipart TS on the SL satellite radio interface which is intended to form part of the satellite component of IMT mobile communication systems. New work began on the seamless integration of satellite and/or High Altitude Platform Station systems into 5G systems.

We developed a new EN on Earth Stations on Mobile Platforms (ESOMPs) operating with non-geostationary satellites in the Ka band for satellite broadband access on board aircraft or ships, and work continued aimed at adding new antenna types for ESOMPs operating with geosynchronous orbit satellite systems.

We finished our work on the interoperability and integration of GNSS with telecommunications systems for the provision of location-based services, completing a five-part TS, and we began new work on GNSS receivers.

We made good progress with energy efficiency and the environmental impact of satellite broadband networks, and we updated our System Reference document on Cognitive Radio techniques applied to satellite communications systems.

We continued to address the spectrum needs of satellite earth stations and systems, specifically in relation to non-geostationary orbit Earth stations in the Ku band and Cognitive Radio techniques for satellite communications.

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 standardisation organisations 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 and LTE-Advanced/ LTE-Advanced Pro technologies.

3GPP is supported by ETSI's Mobile Competence Centre (MCC).

Further information at: www.3gpp.org

The highlight of 2015 came in December when Release 13 of the 3GPP technical specifications for 2G (GSM/EDGE), 3G (UMTS, HSPA) and 4G (LTE) was functionally frozen. With Release 13, LTE took a significant step forward from LTE-Advanced to 'LTE-Advanced Pro'. The new term marks the point when the LTE platform was dramatically enhanced to address new markets and additional functionality was included to improve efficiency.

Release 13 comprises around 170 high-level features and studies. In addition to enhancements to existing services and features, this release saw the completion of the first set of specifications covering mission-critical services, in particular mission-critical Push-To-Talk, the essential functionality for LTE to be used by 'blue light' services for private mobile radio voice communication. A study was also completed on 'isolated E-UTRAN operation' (i.e. mobile-to-mobile) for public safety use, and the architecture for supporting emergency services over wireless local area networks was investigated.

Work continued on security issues to ensure that new services are free from the threat of hacking, denial of service attacks etc.

For the first time, serious investigations were conducted into network virtualisation and how this might be realised in the context of a 3GPP network.

3GPP continued to work on the characterisation of carrier aggregation across additional band combinations to provide increased bandwidth within the limited frequency allocations to individual operators. Radio propagation was further improved by studies on Multiple-Input Multiple-Output antennas for both uplink and downlink, and on ever more sophisticated beam-forming.

A number of studies were conducted into the use of shared, unlicensed spectrum (particularly the 5 GHz Industrial, Scientific and Medical band), and a workshop was held in Beijing, China, to consider the designing of co-existence mechanisms for LTE to operate in unlicensed spectrum. This event did much to allay fears that Wi-Fi services might be negatively impacted by LTE in unlicensed spectrum.

Work then began on specifications to complement LTE coverage over a licensed Primary Component Carrier via a Secondary Component Carrier using unlicensed spectrum.

Other major advances achieved with the freezing of Release 13 included enhancements to machine-type communications, public safety features, small cell dual-connectivity and architecture, indoor positioning, single cell point-to-multipoint and work on latency reduction.

Following a workshop in Phoenix, US, at which companies were able to share their views on the subject, in 2015 3GPP began work on the next generation cellular technology, or '5G', with the aim of submitting a candidate technology to the IMT-2020 process.

Meanwhile, work started on Release 14 and, at the end of the year, over 50 features and studies had been defined including Multimedia Broadcast Supplement for Public Warning Systems, mission-critical video and mission-critical data services, LTE support for Vehicle-to-Anything (V2X), latency reduction, high power LTE for certain bands, channel modelling for LTE in bands above 6 GHz, robust call set-up for Voice over LTE (VoLTE) and next generation access technologies.

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. In 2015 our main focus was on revision of our existing Harmonised Standards to take account of the introduction of the Radio Equipment Directive (RED) and, by the end of the year, all relevant standards had been updated.

We also revised the ENs on GSM base stations and mobile stations in the GSM 900 and GSM 1 800 bands to introduce changes included in 3GPP Release 12, especially to support the medium range and local area multicarrier base station and Extended GSM-R (ER-GSM, GSM for railways) 900 band features. We also updated our Harmonised Standards for base stations and user equipment for IMT, which corresponds to 3GPP Release 11.

Work continued on conformance and interoperability testing for eCall, the in-vehicle emergency call service. We revised our existing standards on mobile communication on aircraft to include UMTS and LTE as well as the original GSM, and to take account of the RED.

Millimetre Wave Transmission

Future mobile and fixed networks will need to support vast numbers of applications and services, with capacity requirements thousands of times greater than current networks. Millimetre wave radio (30 - 300 GHz), with its larger channel bandwidths and delivering fibre-like capacity, thus offers significant potential for 5G and the IoT.

Our Industry Specification Group (ISG) on millimetre Wave Transmission (mWT) is a global pre-standardisation initiative which offers an industry-wide platform to create the conditions for large-scale usage in current and future transmission networks of this – as yet largely untapped – spectrum resource. The group held its first meeting in January 2015 and made rapid progress, publishing two reports by the end of the year. One defines relevant use cases of mWT, the other analyses antenna use cases for point-to-point and point-to-multipoint millimetre wave links. Work continued on the feasibility of using unlicensed band by analysing interference levels in the V-band at the street level.

We also completed two White Papers: a survey of worldwide regulations for the V-band and E-band and a paper aimed at increasing operators' confidence in the use of millimetre wave technologies by sharing the results of trials and early roll-outs on V-band and E-band. Work continued on a third White Paper, on the status and evolution of millimetre wave semiconductor technology.

Mobile-Edge Computing

Mobile-Edge Computing (MEC) can be described as a Cloud server running at the edge of a mobile network. MEC will enable operators to open their radio access networks to authorised third parties, allowing them rapidly and easily to deploy innovative applications and services. It is therefore expected to be a major enabler of the IoT, mission-critical vertical applications and 5G.

To achieve the huge market potential of MEC, a standardised, open environment is needed to allow the efficient and seamless integration of applications across multi-vendor MEC platforms. In 2015, our ISG on Mobile-Edge Computing began work on the necessary technical specifications, focusing initially on use cases. We made good progress with three specifications covering technical requirements, a framework and reference architecture, and terminology.

In October we initiated new work on metrics (e.g. latency, energy efficiency) that can potentially be improved by the use of MEC in both LTE-based and future mobile networks; the business drivers for the MEC value chain; and MEC market requirements for multi-vendor eco-systems, which will describe methodologies, tools and facilities to achieve interoperability.

We also published a Proof of Concept (PoC) framework and called for PoCs to demonstrate the viability of MEC implementations. By the end of the year, three PoCs had been accepted.

To stimulate interest in the potential of MEC, we published a White Paper and produced a webinar, and we have begun to put together a tutorial, aimed at a cross-industry audience, and a demonstration kit for use at conferences and exhibitions.

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

The Internet has become a critical infrastructure for both businesses and individual users and its security is therefore of paramount importance. Security is also a key to the modern connected world and a crucial factor in inspiring the consumer confidence necessary for the new technologies emerging in the Internet of Things (IoT) to achieve commercial success. The work of our Cyber Security committee (TC CYBER) is aimed at protecting consumers from the growing number and variety of cyber-threats which now infiltrate the daily lives of individuals and threaten the stability of the economy.

In 2015, we completed a Technical Report (TR) aimed at encouraging the development and adoption of 'secure by default' platform security technologies, and published a report cataloguing technical measures to counter cyber-attacks. We produced an overview of cyber security activities in other technical forums worldwide, and a TR on the security of Network Functions Virtualisation when used for Lawful Interception (LI) and Retained Data (RD).

Work continued on protection measures for Information and Communications Technologies (ICT) in critical infrastructures, specifically power and transport, security aspects of LI and data retention interfaces, and the impact of quantum computing on ICT security. We addressed the presentation of cyber-threat information in a standardised and structured manner, and began outlining a high-level structured ecosystem of security design requirements for communication and IT networks and attached devices.

Sensitive to growing concern about the privacy of individuals and their data, work continued on privacy assurance and personally identifiable information.

We are working with the European Committee for Standardisation (CEN) and the European Committee for Electrotechnical Standardisation (CENELEC) in response to European Commission (EC) Mandate M/530 on Privacy by Design. A joint work programme was submitted to the EC in November 2015 proposing the development of standards to manage privacy and personal data protection issues from the earliest stages in the design and development of security technologies and services as well as during production and provision.

Smart Cards

In 2015 our Smart Card Platform committee (TC SCP) enhanced the requirement specification for the embedded UICC (eUICC), with the addition of a set of requirements related to the local management of profiles. Work continued on managing profiles locally and we made good progress on security aspects and the technical description of a profile.

In 2015 we completed our series of tests for the interface specification with a new specification on the UICC aspects of the UICC/terminal interface testing. We also finalised tests for the remote management of the UICC which will be especially relevant for applications which are loaded, customised or deleted during the lifetime of the UICC – typically UICCs used as a secure element for mobile contactless communication or as an eUICC.

We continued to standardise the interaction between the Near Field Communication controller, the UICC and other (secure) elements. We approved a set of requirements to monitor the aging index of the UICC. This is particularly relevant for the management of Machine-to-Machine (M2M) devices, which can last much longer than consumer devices. We began work on the requirements for a new interface for the UICC to support more efficient communication protocols and data storage mechanisms.

We continued to maintain the application identity register for smart card applications on behalf of various other organisations.

Electronic Signatures

In 2015, our Electronic Signatures and Infrastructures committee (TC ESI) completed its work in response to the EC mandate on Electronic Signature Standardisation, M/460, which aimed to achieve mutual recognition and the cross-border interoperability of electronic signatures throughout Europe, by providing a Rationalised Framework for electronic signature standardisation. We co-operated with CEN on this mandate to ensure the alignment of standards and avoid overlapping work. Our contribution addressed the use of standards related to digital signatures, the creation and validation of signatures, trust service providers, cryptographic algorithms and trust application service providers.

During the course of our work, we harmonised our standards and specifications with the new 'eIDAS Regulation' on electronic identification and trust services for electronic transactions in the internal market. We also widened the potential impact of our standards globally by revising the terminology used and emphasising the distinction in the content between industry best practices and the regulatory requirements of the European eIDAS Regulation.

In 2015, we published a TR on the framework for the standardisation of signatures, a European Standard (EN) enabling the conformity assessment of trust service providers and a Technical Specification (TS) on the building blocks for signature policy documents which are readable by humans. We also addressed Trusted Lists and extending the Rationalised Framework to cover registered eDelivery. Work was completed on all the other documents required for M/460; publication was expected by mid-2016.

Lawful Interception and Data Retention

Our LI and RD standards are being adopted around the world, playing a crucial role in helping law enforcement agencies to investigate terrorism and serious criminal activity.

Highlights of the year in our Lawful Interception committee (TC LI) included the completion of an important new TR on requests for the handover and delivery of real-time information associated with Cloud and virtual services, and a specification defining a specific electronic interface between two systems for warrants for the exchange of information relating to the establishment and management of LI. We made good progress with a TS on the dynamic triggering of interception, which is required as a result of the diversification of service and network architectures.

Nearly every network element has its own interface which may involve different transport protocols, authentication and encryption, commands etc. This makes every new connection both complicated and costly. We made good progress with a new specification for an internal network interface for LI which will cover wide area connections between LI systems and, depending on the network, several network elements from different vendors.

We completed a new specification to create a dictionary of common parameters.

Work continued on LI and RD system assurance and risk management. Other ongoing work included a guide to LI and RD standards and concepts, and guidance on LI for LTE™ in the form of Frequently Asked Questions.

Security Algorithms

Our Security Algorithms Group of Experts (SAGE) is universally recognised for its work on authentication and encryption mechanisms for different technologies. In 2015, SAGE provided advice to the Third Generation Partnership Project (3GPP™) security working group (SA3) on the design of possible new General Packet Radio Service (GPRS) algorithms to support 'Extended Coverage GSM™' (for more efficient service to the IoT).

Quantum-Safe Cryptography

Recent advances in quantum computing and quantum information theory mean that the emergence of the quantum computer is imminent. This will present a serious challenge to current cryptographic techniques which rely on the premise that certain types of problems are impossible for computers to solve efficiently. Such problems become trivial for a quantum computer, however, and some of the most widely-deployed public-key cryptosystems in security products today will therefore be broken by quantum computers. Previously secure encrypted information will then be subject to discovery, which could lead to the misuse, for example, of bank account numbers, identity information and items relating to military security.

New 'quantum-safe' cryptographic techniques have emerged in recent years that do provide protection against quantum threats. Our Industry Specification Group (ISG) on Quantum-Safe Cryptography (QSC) is assessing the current situation and developing specifications for the transition to quantum-safe ICT applications. In 2015, we began specifying a quantum-safe algorithmic framework and drawing up a threat and risk assessment for real-world use cases. We are also developing specifications on the characterisation of cryptographic primitives, benchmarking their performance and their suitability to a variety of applications.

Other Aspects of Security

We contributed to the work of 3GPP on the requirements for critical communications security, and continued to update the management rules for Terrestrial Trunked Radio (TETRA) algorithms.

Our ISG on Quantum Key Distribution (QKD) completed a new specification on the metrology of optical components for QKD systems. Component characterisation is vital to ensure the correct operation of systems and to develop supply chains for quantum technologies. We also addressed implementation security and protection against Trojan horse attacks.

Our ISG on Information Security Indicators (ISG ISI) produced new guidelines for testing the effectiveness of security risk detection capabilities. These guidelines complete a set of five specifications which together provide a reference model for the measurement and benchmarking of information security risks.

The ETSI Security Week

In June 2015 we expanded our highly successful annual security workshop into a full Security Week of events. Three thematic sessions focused on key areas for security standards: M2M communications and the IoT, security assurance in Intelligent Transport Systems and eIDAS.

The new format provided more time for networking, and the closing days of the week were dedicated to meetings of TC CYBER and TC ESI, which exceptionally were open to non-members of ETSI so they could see at first hand how our committees work.

Two ETSI White Papers were published to coincide with the Security Week: Security for ICT – an overview of our work in this area, which is updated annually, and a new paper on QSC and security.

Technologies for a Better Life

While technological progress has improved the way we communicate for both social and business purposes and opened up exciting new opportunities, we are careful to minimise 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

In 2015 we made good progress with standards for reducing the eco-environmental impact of ICT equipment in support of European Commission (EC) Mandate M/462 on energy efficiency in fixed and mobile information and communication networks. Our Environmental Engineering (TC EE) and Access, Terminals, Transmission and Multiplexing (ATTM) committees collaborated with the European Committee for Standardisation (CEN) and the European Committee for Electrotechnical Standardisation (CENELEC) and presented the EC with a proposed programme of work to fill identified standardisation gaps. This includes addressing the energy efficiency of servers and storage equipment, revision of our standard on the energy efficiency of radio base stations and the definition of the power targets for ICT equipment.

Work also continued in co-operation with CENELEC in support of M/544 on the eco-design requirements for networked standby.

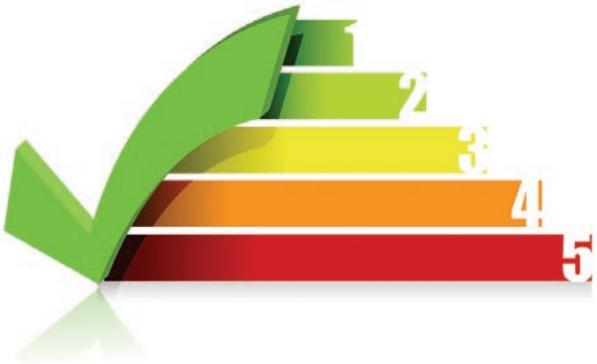
We produced a new ETSI Standard (ES) for the assessment of mobile network energy efficiency. The first standard to provide energy efficiency measurement methods and metrics for live mobile networks, it will enable uniform evaluation.

We continued to address the need to manage the end of life of ICT equipment. A revised version of the ES which outlines the environmental life cycle assessment of ICT goods, networks and services was published. This work was undertaken in co-operation with the International Telecommunication Union, with the aim of developing joint specifications for eco-environmental methodologies which are aligned worldwide. Our Industry Specification Group on Operational energy Efficiency for Users (ISG OEU) began work on a position paper aimed ultimately at the creation of a standard to define appropriate rules.

Network Functions Virtualisation (NFV) will transform telecommunication network architecture with decoupled software and hardware. Recognising that traditional measurement methods for energy efficiency will not be suitable for NFV, in 2015 we began to define new methods.

Work continued on the definition of standardisation terms and trends in energy efficiency, on telecommunications and the circular economy and on measurement methods for energy-aware networking. We began work on a new Technical Report (TR) to describe best practice in assessing the energy performance of future radio access network deployment.

In the area of energy efficiency, a new European Standard (EN) on measurement methods to assess the power consumption of broadband network equipment was published in April. It includes an assessment of the latest technologies in this sector such as vectoring.



We continued to address environmental classification and tests for telecommunication equipment, as well as the thermal management of equipment and central offices, and the control and monitoring of power and cooling systems used in telecommunication and data infrastructures.

Work progressed on a series of standards on the alternating current interface for ICT equipment connected to a 400V DC source, and with revisions to the standards for equipment powered by 48V DC. We published an EN on earthing and bonding.

We made good progress with a new ES on the colour and marking of DC cables and connecting devices. The first international standard on this subject, it will simplify the installation of equipment, improving both safety and efficiency.

New work started on the evolution of battery technology for use with stationary ICT and telecommunication equipment. This will have implications for smart cities and other applications which rely on batteries used in conjunction with alternative power sources.

We are developing tools to enable ICT users to improve their energy management of networks and sites in compliance with the Kyoto Protocol on climate change and the reduction of greenhouse gas emissions. In 2015, work continued on sets of ratios, or 'Global Key Performance Indicators' (KPIs), to support the deployment of eco-efficient networks and sites and to monitor the energy management of deployed broadband. These new KPIs will describe the best practices, most efficient equipment and solutions to build sustainable operational networks, sites and data centres (or 'green' data centres).

We began new work aimed at recommending realistic limits for the energy consumption of ICT equipment in the context of current technology.

ISG OEU completed four Group Specifications in 2015. One addresses the measurement of energy consumption in equipment with copper and optical fixed access. Two others define sustainable levels of energy management in fixed broadband access networks and in ICT sites respectively. The fourth specification provides a definition of global KPIs for fixed access networks.

We continued to address the deployment of fire extinguishing and alarm systems in ICT sites and the measurement of energy consumption in information technology servers and memory units.

Work progressed with a specification to define global KPI modelling for green smart cities.

Our Integrated Broadband Cable Telecommunication Networks committee (TC CABLE) completed a TR which identifies the key energy-consuming components of the cable access network.

Access for All

Much research and development in human factors today is aimed at finding innovative approaches to extend digital inclusion. Increasing the uptake and use of new technologies can improve both the quality of our lives and the competitive position of businesses in global markets.

In 2015 our Human Factors committee (TC HF) continued to focus on 'Design for All', an approach aimed at ensuring that everyone has the same access to devices, systems and services. Across ETSI, we are working to include Design for All in all our relevant standardisation initiatives, in line with EC Mandate M/473.

We also addressed accessibility issues. For example, we are developing guidelines for the design of user interfaces and functionality, and identifying related standardisation activities, to meet the needs of people with limited cognitive abilities using mobile technology. We are also looking at the use of device and service interfaces to help people who cannot read or write. We made good progress during the year on the drafting of two documents. The first, a TR, will identify the functional needs of people with cognitive and learning disabilities (including dyslexia, dementia and other cognitive impairments). The second document, an ETSI Guide (EG), will provide recommendations for the design and development of applications, services and devices such as mobile phones, smartphones, touchpads and tablet computers which will enable users with learning disabilities and the elderly to exploit the potential of mobile technologies.

We updated our ES on the requirements for relay services in Europe to take account of the growth of mobile and Internet Protocol (IP)-based communications. These services enable people with speech or hearing impairments to communicate with users of standard telephony using other means of communication (such as video or text), either directly or through an interpreter.

In 2015 our Special Committee on Emergency Telecommunications (SC EMTEL) worked on various aspects of emergency calling and alerting messages for users with special needs.

Media Quality and the User Experience

In 2015, our Speech and Multimedia Transmission Quality committee (TC STQ) continued to work on terminals using super-wideband (bandwidth up to 14 kHz) and fullband for conversational services for teleconferences and audio-visual applications. Good progress was made with a revision of the Technical Specification (TS) on transmission requirements for super-wideband handheld (handset and hands-free) terminals to optimise end-to-end quality.

We published revised versions of the ESs which define the transmission requirements for narrowband Voice over IP (VoIP) terminals from a Quality of Service (QoS) perspective, bringing them into line with the latest international standards. We also updated our TS on the procedures for the identification and selection of common modes of de-jitter buffers and echo cancellers. A new TR on the QoS aspects of voice services in LTE™ networks was published.

We updated our documents on background noise simulation and sound field reproduction for terminal testing. We published three parts of a new four-part TS on referencing, benchmarking methods and background traffic load profiles, to ensure the comparability of test results. The three published parts relate to VoIP, the Universal Mobile Telecommunications System (UMTS™) and Voice over LTE (VoLTE), and IP Television (IPTV), web TV and Rich Communication Suite – enhanced (RCS-e) Video Share. Work continued on a fourth part, for high-speed Internet.

We continued to address design objectives related to transmission performance when a call is exchanged between the IP Multimedia Subsystem, the Public Switched Telephone Network Emulation System and VoLTE.

Work began on a new TS on evaluating the performance of wearable devices for speech communication, and on the technical aspects of net neutrality including broadband access. To improve the test sentences used in subjective testing, we started to investigate the possibility of detecting emotions in the measurement of telecommunication applications.

Other topics covered in 2015 included the handling of measurement uncertainties in the field of electro-acoustics, improving listening quality for people with impaired hearing, the acoustic output of terminal equipment, bandwidth calculations and prioritisation in VoIP systems.

We organised a workshop on 'Telecommunication Quality beyond 2015' which took place in Vienna, Austria.

Our User Group works with our other committees to ensure the needs of users are considered. In 2015 the group completed a TR on the needs of visually impaired people accessing ICT products and services. The group also addressed the quality of telecommunication services and service level agreements and began work on the Internet of Things and users' needs with regard to issues such as QoS, security, usability, flexibility and service level objectives.

Safety

Our Safety committee (TC SAFETY) monitors developments in electromagnetic fields (EMF), electrical safety and safety in cable television systems. In 2015 we focused particularly on changes brought about by the introduction of the Radio Equipment Directive and its implications for EMF.

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 standardisation 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, with DECT products now accounting for more than 90% of the world cordless market.

The main focus of 2015 for our DECT committee (TC DECT) was enhancement of the DECT specification for Ultra Low Energy (ULE), a new networking technology for homes and offices. 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. DECT ULE is not a minor adaptation of DECT but has been developed specifically for Machine-to-Machine (M2M) communications. It offers low power consumption, making it ideal for battery-operated devices and Personal Area Networks (PANs), as well as good QoS (a unique feature compared with other low power wireless standards) and wider coverage than competing technologies.

The target applications of DECT ULE in the first phase of its development were smart home and smart living applications such as home automation and energy control, remote switches, the control of smart appliances, smart metering and temperature controls, security, alarms and eHealth applications. For Phase 2, in 2015 we published the second part of the DECT ULE specification, enabling additional applications for the home including those with mixed data and voice capabilities such as intercoms and pendants with audio capabilities, as well as office and industry automation, smart cities and PANs. The specification also enabled increased data-rate applications, with an extension up to 5 Mbit/s with current DECT technology.

We continued work on the specification in response to feedback received after implementation, to include No-Emissions Mode and to add more functionality for operation with repeaters.

At the same time, we updated our existing standards to take account of the introduction of the Radio Equipment Directive and to add new features to the DECT base standard. In March we published a new version of the European Standard (EN) for the DECT Packet Radio Service which contains improvements and clarification for better support of the handset firmware upgrade service and light data services.

Maintenance of the New Generation DECT specifications for Internet Protocol-based networks and services included a revised version of the relevant part of the Technical Specification (TS) for Software Update Over The Air (SUOTA), to guarantee backward compatibility of new equipment with older products.

We worked with the European Conference of Postal and Telecommunications Administrations (CEPT) to extend the standard frequency band for DECT in Europe of 1 880 - 1 900 MHz up to 1 920 MHz to provide additional capacity for various M2M applications, smart appliances and streaming audio.

At the end of 2015, we began to look to the future of DECT, collecting requirements for the evolution of DECT and studying implementation possibilities.

Powerline Communications

Our Powerline Telecommunications committee (TC PLT) produced a TS on the co-existence of narrowband powerline telecommunication (PLT) technologies for smart grid applications.

We continued to address the co-existence of Digital Subscriber Line (DSL) modems and PLT at customers' premises, beginning work on a test specification for the measurement of interference between PLT on Very-high-bit-rate DSL 2 (VDSL2) and the G.Fast Recommendation.

PLT and Premium TV Services

We have also been addressing the transportation of video over powerlines, in response to the advent of 4K video streaming and video on demand services for Ultra High Definition Television and new advances in technology such as High Efficiency Video Coding (HEVC), which rely on high performance PLT modems.

We began work on two new specifications: one will provide recommendations for the transportation of very-high-bit-rate services in home networks; the other concerns the transcoding of HD and UHD video over powerline networks, to improve network coverage.

We completed our investigations into the Powerline High-Definition Multimedia Interface (PHDMI) for short range powerline modems. Possible applications of this technology would be to simplify the installation of home cinema as well as for video surveillance in smart cities. In the first step in the development of the specifications for short range powerline modems, we published recommendations to fill the standardisation gap between existing PLT modem specifications and video compression standards.

Content Delivery

Facilitating Content Consumption Whatever the Platform

The Internet, mobile communications and broadcasting are converging. But the standardisation 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 both the industry and the consumer.

Broadcasting

Our standardisation of broadcast systems, programme transmission and receiving equipment is dealt with in a Joint Technical Committee which brings us together with the European Broadcasting Union (EBU) and the European Committee for Electrotechnical Standardisation (CENELEC) – JTC Broadcast.

In 2015 JTC Broadcast concentrated on digital broadcasting, focusing on Ultra High Definition TV and related areas. In particular, the committee finalised a new version of the ETSI Technical Specification (TS) on Digital Video Broadcasting (DVB) Audio Video Coding which now also addresses AC-4 audio aspects and DVB 3DTV Phase 3.

The JTC completed its multipart standard on AC-4, an innovative codec for next generation digital audio compression for audio for video and audio-only delivery. AC-4 offers an advanced sound experience to meet modern entertainment requirements including home theatres, online streaming and video games. A new TS was also published on Multi-Dimensional Audio.

The JTC revised the Hybrid Broadcast Broadband TV (HbbTV) standard. HbbTV enables consumers to access a broader range of content to enhance the broadcast programme, and allows broadcasters to include advanced interactive services and Internet applications such as information services, catch-up services, video-on-demand, an electronic programme guide and interactive advertising. The updated version of the specification, which corresponds to HbbTV 2.0, covers new capabilities such as companion device support, HTML5 user experience and advanced video delivery features.

In the radio area, the JTC revised the TS that extends the main Latin-based character set used in digital radio receivers to support the expansion of Digital Audio Broadcasting (DAB) technology into additional countries in Eastern Europe.

The JTC continues to update its popular DVB service specifications, describing the necessary metadata for TV broadcast. The DVB IPTV standards were updated to add support for Internet Protocol version 6 (IPv6), and the JTC completed the DVB-S2 extensions (DVB-S2X) specification, along with corresponding guidelines, to bring more spectral efficiency to professional satellite applications and allow new operational modes such as channel bonding.

The maintenance of TV Anytime specifications continued.

Content Delivery

Protection and rights mechanisms

Our Industry Specification Group (ISG) on the Embedded Common Interface (ECI) for exchangeable Conditional Access (CA)/Digital Rights Management (DRM) solutions is specifying 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 equipment. The core of the concept is the ECI software interface to which CA/DRM clients can be attached after being downloaded to the device. This will improve substantially the interoperability between services and devices, allowing consumers to continue using equipment and content they have previously paid for, after a move or a change of network provider, or to access content from multiple service providers from the same device.
In 2015, we made good progress with the final part of the core specification and two specifications dealing with security and the virtual machine (which will allow multiple clients to run in parallel on the same device).

We also completed an analysis of existing solutions for interoperable multimedia customer premises equipment for CA/DRM.

Compound Content Management

New production techniques including High Dynamic Range (HDR), which can produce darker and brighter, more life-like images, and Wider Colour Gamut (WCG), which extends the colour range displayed, have recently been introduced for the creation of film and broadcast content. HDR and WCG are expected to lead to mass market sales of next generation Ultra HD displays and equipment, but legacy receivers will comprise the majority of the installed receivers for many years to come.

In 2015 we therefore set up an ISG on intelligent Compound Content Management, which began work on a specification for a new Compound Content system for consumer electronic devices. This will allow backwards compatibility with today's television, while also providing full quality for the next generation – without compromising the quality of either.

Spectrum Aspects

Our Electromagnetic Compatibility and Radio Spectrum Matters committee (TC ERM) addresses spectrum aspects of broadcasting, including the needs of Programme Making and Special Events devices (wireless microphones, in-ear monitors, talk-back links, audio links etc.). In 2015 we updated our European Standard (EN) on wireless microphones in the 25 MHz - 3 GHz band.

We began new work on radio and TV broadcast receivers and amplifiers on domestic premises, and on transmitting equipment for Digital Radio Mondiale broadcasting, Terrestrial DAB and the FM and AM sound broadcasting service.

We completed an analysis of co-existence issues stemming from the European Commission's Digital Dividend Decision, including co-existence between cable television and new LTE™ mobile phones operating in the 800 MHz band.

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) involves implementing network functions in software which can run on a range of industry standard server hardware, and which can be moved to, or introduced in, various locations in a network as required, without the need to install new physical equipment. This will simplify the roll-out of network services, reduce deployment and operational costs and encourage innovation.

In 2015 our NFV Industry Specification Group (ISG) made good progress towards publishing its second release of specifications by mid-2016. Release 2 includes normative specifications to facilitate the deployment and operationalisation of Virtual Network Functions and, at the end of the year, the group was working on over 30 different specifications.

We tackled various security and reliability issues in three new Group Specifications (GSs). The first of these begins to catalogue security features in management software relevant to NFV, taking OpenStack™, a widely adopted Cloud operating system, as its first case study. The second specification addresses Lawful Interception capabilities in NFV deployments and the third describes use cases and technical approaches for multi-layer host administration.

Other key reports completed in 2015 focused on scalable architectures for reliability management, acceleration technologies and use cases, and Software-Defined Networking (SDN) usage in an NFV architectural framework.

Work also began to identify preliminary topics for Release 3.

Our NFV Proof of Concept (PoC) framework, published in 2014, has galvanised new development efforts in co-operation with network operators. By validating key concepts, PoCs are helping to accelerate the adoption of NFV for a broader range of applications. By the end of 2015, 39 ISG NFV PoCs had been demonstrated or were in progress.

Cloud

In February 2015, the Cloud Standards Co-ordination (CSC) Phase 2 was launched to address issues left open after CSC Phase 1. The overall objective of the CSC is to draw up a detailed map of the standards needed to support a series of policy objectives defined by the European Commission, in particular in critical areas such as security, interoperability, data portability and reversibility. This will include identifying any standardisation gaps. An ETSI Specialist Task Force was set up to produce Special Reports on four aspects of Cloud standardisation: users' priorities, the maturity of Cloud standards, security conformance and interoperability, and the relationship between standards and Open Source development. The intermediate drafts were discussed within the Cloud computing community during 2015, and a series of public meetings and workshops was organised. By the end of the year, final versions of the reports had been approved by our Network Technologies committee (TC NTECH) and publication was expected early in 2016.

Network Access

In 2015 our Access, Terminals, Transmission and Multiplexing committee (TC ATTM) made good progress with optical fibre systems for home cabling, publishing three Technical Specifications (TSs). One relates to the use of single mode optical fibre systems for home cabling to enable interoperability among different suppliers. The other two address the application requirements and the physical layer for plastic optical fibre systems.

As part of a revision of our TSs on the general engineering of networks, we completed a new version of the part related to fixed access networks. Good progress was made updating the part on operator sites and data centres and, by the end of 2015, a stable draft of a new TS on digital multiservice cities had been agreed.

In the area of fixed radio systems, we devoted considerable effort to revising our existing Harmonised Standards for point-to-point equipment to take account of the forthcoming Radio Equipment Directive. A new Technical Report (TR) on energy efficiency metrics for point-to-point radio systems was also published, along with a substantial revision of the TR on Multiple-Input Multiple-Output techniques applied to point-to-point radio systems, which takes account of technological developments.

Work continued on a new TR on small cells microwave backhauling.

At the request of the Telecommunications Standardisation sector of the International Telecommunication Union (ITU-T) and the Broadband Forum, ETSI is leading work on the standardisation of reverse power feeding. In 2015 we made good progress with a revision of our TS on the reverse powering of remote access equipment to specify additional requirements and add further detail.

We co-operated with the ITU-T on the enhancement of Very-high-bit-rate Digital Subscriber Line 2 (VDSL2).

Cable

In 2015 our Integrated Broadband Cable Telecommunication Networks committee (TC CABLE) made good progress with a TR describing the evolving electromagnetic environment following the introduction of new mobile radio communication services in the UHF 790 - 862 MHz band. We published a new ETSI Standard (ES) on the Converged Cable Access Platform Operational Support System Interface (CCAP-OSSI) which defines the management interface into key Hybrid Fibre Coaxial access platforms for high speed data services and narrowcast digital video.

Work progressed well on a TS on measurement methods for the network performance of broadband data services, taking into account recent developments in Internet Protocol (IP) technology. When completed, this specification will enable consumers to compare the performance of different service providers.

We also completed a new ES for home routers which defines a core set of features to enable multiple subscriber devices to gain access to high-speed data services using the Data Over Cable Service Interface Specification (DOCSIS).

Numbering, Naming, Addressing and Routeing

TC NTECH completed a TR on the use of the Domain Name System (DNS) protocol in managed networks and how to increase the reliability and scalability of a DNS infrastructure.

Transition to IPv6

The public IPv4 address space was completely depleted by February 2011. Upgrading the Internet with the provision of additional public IP addresses is essential to ensure it can keep growing, especially to cater for the new technologies that will adopt it such as the Internet of Things (IoT), Cloud computing and 5G mobile communications. IPv6 solves the problem of address exhaustion, provides enhanced features and enables new Internet services in need of end-to-end connectivity and security.

Our ISG on IPv6 Integration (ISG IP6) is addressing the transition to IPv6. It held its first meeting in April 2015, attracting the participation of some 30 high-level IPv6 experts. The group's first task (Phase 1) is to define scenarios where IPv6 could have real critical impact: mobile networks and services, critical infrastructure in the safety and emergency networks, and security and privacy. In 2015, we approved an initial list of 18 GSs and began work on 15. These include a set of specifications outlining the motivation for the deployment of IPv6 in different areas – enterprise, telecommunications and Internet service providers, public safety and the emergency sector, academia and education, Cloud computing and governments. Each specification will also include the respective objectives, technology guidelines and an addressing plan, as well as identifying benefits, risks, challenges and milestones.

In addition, a key GS will describe IPv6, the challenges arising from transition from IPv4 to IPv6 and their co-existence, and then identify best current practices and develop guidelines for mitigating any issues identified.

The use of IPv6 in new technologies will also be addressed, in particular, in the IoT and Machine-to-Machine communications, SDN and NFV, 5G mobile Internet, Cloud computing and smart grids. Other issues covered included IPv6 over Time-Slotted Channel Hopping (6TiSCH) technology, privacy and security.

By the end of 2015, we had made good progress and all specifications except the GS on 5G, which needed more investigation, were expected to be completed by the end of 2016.

TC CABLE is also addressing the five different IPv6 transition technologies that have been defined. In 2015 we published conformance test specifications for end-to-end interoperability for each of these transition technologies. We then continued developing Test Descriptions for each of them, which will provide interoperability and test cases that go beyond compliance and protocol conformance testing to enable the deployment of IPv6 transition technology. In September we began defining a strategy for the actual deployment of the transition technologies in operational networks.

Future Networks

To raise confidence in autonomic systems, TC NTECH completed a TS outlining a framework to co-ordinate and promote public PoC demonstrations to illustrate key aspects of autonomic network engineering.

We continued working on the application of the Generic Autonomic Network Architecture reference model onto concrete use cases, beginning work on its application to mobile backhaul and core networks.

Next Generation Protocols

The TCP/IP 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 (such as LTE™-A, G.Fast, DOCSIS 3.1 and 5G) will not deliver their full potential unless, in parallel, the communications and networking protocols evolve holistically. In 2015 we therefore set up a new ISG on Next Generation Protocols (ISG NGP) to examine the future requirements for Internet Protocols.

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.

Users want to 'mix and match' equipment and services, connecting devices from different manufacturers and services from different suppliers. Interoperability increases consumer choice. Interoperability also gives manufacturers a wider potential market. They can produce products in larger quantities for a mass market and benefit from economies of scale, which encourages competition and economic growth. Economies of scale may also be reflected in the price, which can boost sales and benefit the consumer too. 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

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. Many of our standards undergo comprehensive validation through Proofs of Concept (PoCs) and interoperability events. We also 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 in standards validation through our Plugtests™ interoperability events, the development of test specifications and the application of 'best practice' specification approaches.

For many years the CTI has followed a software development approach to the production of test specifications, encouraging feedback from a broad base of users. In 2015 our development platform was upgraded to include Open Source tools. The use of these tools, together with a tighter cycle-time in our technical committees, will allow us to move towards an even more agile testing approach in 2016.

Building on our interoperability events, in 2015 we experimented with the hackathon concept. For example, in July, in support of the development of the Internet of Things (IoT) infrastructure, we joined with the Internet Engineering Task Force (IETF) to organise a hackathon on Internet Protocol version 6 (IPv6) over Time-Slotted Channel Hopping (6TiSCH) which was collocated with our first 6TiSCH Plugtests event. These two events gave engineers, developers and standardisers the chance to share experiences and to undertake some joint development work around several aspects of the technology.

PoCs facilitate early standardisation activity and feedback. The CTI has developed a generic framework for running PoCs which can be adapted by our individual technical committees to suit their own purposes and technologies. In 2015, this framework was applied very successfully by our Industry Specification Group (ISG) on Network Functions Virtualisation (NFV), which had over 30 PoCs running by the end of the year, several of which were in an advanced stage. Our ISG on Mobile-Edge Computing (MEC) and our Network Technologies committee (TC NTECH) also began their own PoC programmes.

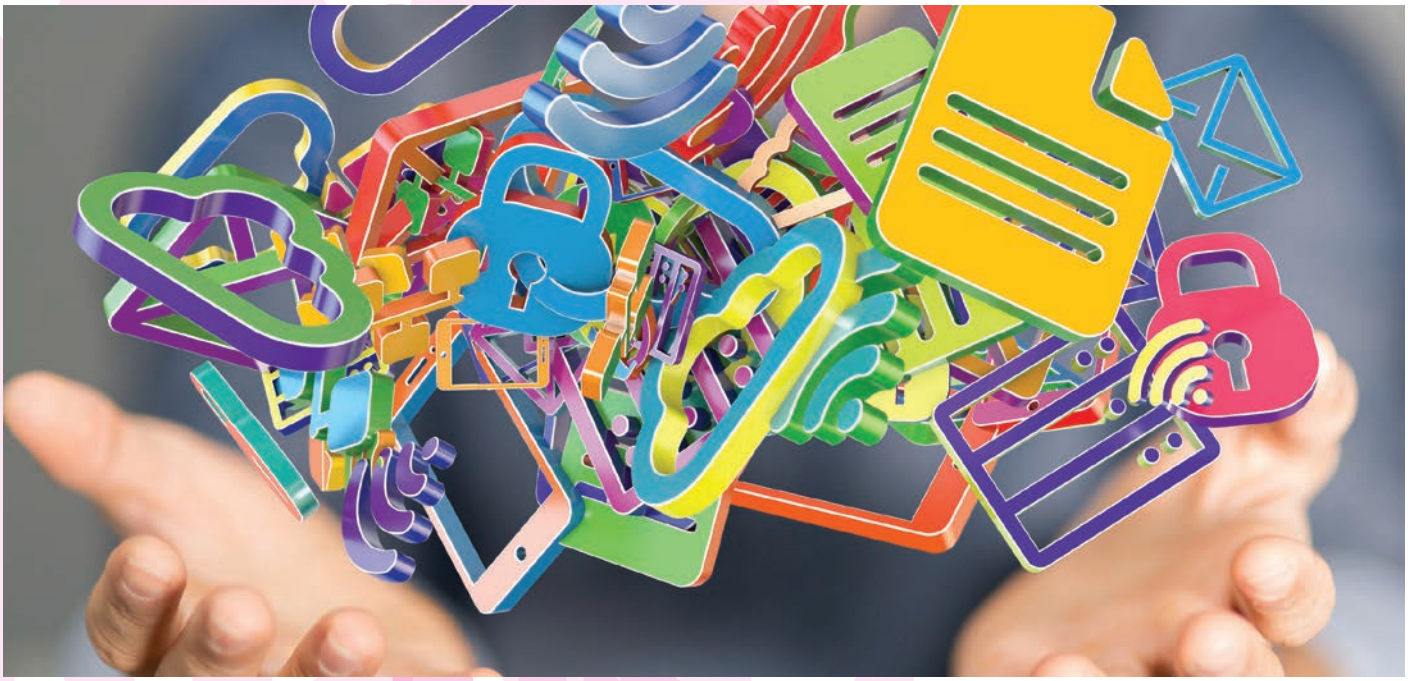
Plugtests Events

In our Plugtests events companies can interconnect prototype or production implementations of standards to test for interoperability and, where needed, conformance to requirements. These events provide a highly cost effective and practical way of identifying inconsistencies in either an implementation or the standard itself.

In 2015 we organised 12 Plugtests events, with varying formats to meet the specific needs of our members and the industries we serve. Our Plugtests events are often supported by the European Commission (EC).

Supporting the Internet of Things

Key events in 2015 included several to support the IoT. For example, the oneM2M Plugtests event in September provided an opportunity to verify the interoperability of implementations defined in oneM2M standards and to check end-to-end functionality on oneM2M interfaces. This was followed in December by a oneM2M Showcase, run in parallel with the ETSI M2M workshop, which included multi-party demonstrations showing oneM2M standards in use in applications related to smart cities and smart living.



Also in December, the first ETSI Vehicle-to-Grid (V2G) Plugtests event was hosted by the EC's Joint Research Centre with the support of the COTEVOS project (Concepts, capacities and Methods for Testing Electric Vehicle Systems and their Interoperability within the Smart Grids). This event focused on assessing the interoperability of systems, apparatus and protocols for interfaces that can be used to integrate electric vehicles within the electricity grid. The testing campaign conducted was based on the interoperability test plan developed by the COTEVOS partners.

In the continuous effort to support the rapid deployment of Intelligent Transport Systems (ITS) and to validate our first Release of ITS standards, we held our fourth ITS Plugtests event in March 2015. This event focussed on Co-operative Mobile Systems standards developed by our ITS committee (TC ITS) as well as the European Committee for Standardisation (CEN) and the International Organization for Standardization (ISO). The event tested the interoperability of ITS equipment from all key vendors.

More remote events

To minimise travel costs for those involved and to encourage new activities and participation (as well as being more environmentally-friendly), in 2015 we finalised the Virtual Private Network infrastructure and platform support (called HIVE - Hub for Integration and Validation at ETSI) to enable more remote events. We also updated our comprehensive set of online tools to allow the scheduling of remote test sessions and to facilitate participants' enrolment, interaction and reporting.

One real challenge was the first fully remote Small Cell LTE™ interoperability event held in April 2015 in co-operation with the Small Cell Forum. This technically demanding event focused on features that included Closed Subscriber Group, Voice over LTE (VoLTE), Emergency Alerts (CMAS) and mobility. All the participants connected their different equipment (HeNB, pico-Cell, micro-cell, HeNB-GW or ePC) to the remote test infrastructure provided by the HIVE and successfully ran the test sessions from their own laboratories in different parts of Europe, Asia and North America.

Test Specifications and Frameworks

In 2015 we continued to develop conformance test specifications, including for our Smart Machine-to-Machine communications committee (TC SmartM2M), oneM2M and ITS.

In support of the Third Generation Partnership Project (3GPP™), we focused on conformance test specifications for LTE-Advanced features in 3GPP Releases 11 and 12, in particular carrier aggregation enhancements, low-cost machine type communications, the BeiDou Navigation Satellite System, the Internet Protocol (IP) Multimedia Subsystem (IMS), especially Video over LTE (ViLTE), and reverse Single Radio Voice Call Continuity, as well as several Universal Mobile Telecommunications System (UMTS™)/High Speed Packet Access (HSPA) features in Release 11 and 12 such as High Speed Downlink Packet Access (HSDPA) Multiflow and Dedicated Transport Channel enhancements.

Interoperability is particularly important to the provision of good Quality of Service and Quality of Experience in complex end-to-end systems such as the IMS running over LTE. 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 2015 we began work on a new ETSI Guide which will examine different approaches for testing 'adaptive networks' such as virtualisation, self-organisation, self-configuration, self-optimisation, self-healing and self-learning. This guide will address the challenge of testing new dynamic technologies such as NFV, Self-Organising Networks, MEC

and Autonomic Network Infrastructure, which all react to changing traffic conditions, applications, service demands and changes in the environment.

Other work in 2015 included continued maintenance of our enormously successful testing language, Testing and Test Control Notation version 3 (TTCN-3), dealing with numerous Change Requests to align with recent developments and producing further conformance test suites for TTCN-3 tools.

We also continued to address security testing and in March we published a Technical Report on security testing terminology. A guide to risk-based security testing methodologies was also completed and good progress was made on a second guide, on the security assurance lifecycle.

TDL – a New Testing Language

In 2015, we launched a new testing language, Test Description Language (TDL). Developed by our Methods for Testing and Specification committee (TC MTS), TDL represents the next generation of testing languages. It fills the methodology gap in existing test specification languages, such as TTCN-3, between the simple expression of what needs to be tested, i.e. the test purposes described in prose or Test Purpose Language, and the complex coding of the executable tests in 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 will improve and accelerate test development without sacrificing quality. TDL will be used primarily for functional testing, but could also be used for other types of testing.

To accelerate the adoption of this new language, we commissioned an Open Source reference implementation of a TDL editor, viewer and UML profile implementation to lower the barrier to entry for both industry users and tool vendors in getting started with TDL. TDL was launched in October 2015 at the annual ETSI International User Conference on Advanced Automated Testing (UCAAT) when first prototypes were presented and demonstrated. The final products will be made publicly available in the first half of 2016.

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

Organised by ETSI, with the support of TC MTS and the CTI, UCAAT was held in ETSI for the first time in 2015 and attracted hundreds of delegates from all over the world. As well as guest speakers from ETSI, the industry and academia, the conference included a tutorial and live demonstrations of the practical use of TDL.

Mission-critical Communications to Rely on

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

TETRA

The future vision for Terrestrial Trunked Radio (TETRA) is an evolution towards a fully integrated and seamless Information and Communications Technologies solution, providing narrowband/wideband/broadband wireless communications for mission-critical and business-critical Professional Mobile Radio (PMR) applications. Broadband will be a crucial factor in this, to supply the high data speeds required for various key applications including, for example, streaming video from the scene of an incident.

In 2015, our TETRA and Critical Communications Evolution committee (TC TCCE) therefore continued to address the standardisation of a broadband extension to the TETRA standard, looking at methods of integrating TETRA into broadband solutions and enabling migration from (future) TETRA to broadband.

To minimise the work required and to optimise the standardisation process, the plan is to enhance existing standards for technologies, such as LTE™ and 5G, by the development of interfaces and applications, to make them suitable for mission-critical applications. We are therefore developing an architecture encompassing a range of application layer interfaces to LTE. In 2015 we published the first in a set of Technical Specifications (TSs) defining the mobile to network interface architecture of a critical communications application operating over a broadband Internet Protocol interface. Ongoing work includes the specification of a mobile to infrastructure interface and we have begun to look at extending our work to interfaces to 5G.

We revised our existing standards in response to feedback from manufacturers and users, particularly in relation to interworking at the inter-system interface between two TETRA systems. This will simplify the future integration of TETRA into LTE.

We published a new Technical Report (TR) which describes the user requirements of mission-critical communications applications providing PMR services.

We made good progress with the addition of voice services to the TETRA Enhanced Data Service (TEDS) channels to improve spectral efficiency and we began work to enhance the functionality of TETRA Release 1 and TEDS with the addition of group addressed data.

We continued to address security, as well as the need for additional spectrum to support broadband TETRA.

Emergency Calling and Alerting

Our Emergency Telecommunications committee (SC EMTEL) began work on a new TR on Advanced Mobile Location, a system whereby an emergency caller's location is transmitted to the public safety answering point (PSAP) during the call.

Work started on an implementation guide for Total Conversation, which enables a three-way emergency video call to be established between a caller with special needs, a PSAP and a sign language interpreter.

We made good progress defining alerting libraries to enable alerting messages to be encoded from keywords, or even generated automatically, and then decoded in the receiver into the user's preferred language. We began a new study into the best means of presenting alerting messages to users with special needs such as the elderly, the very young or those with disabilities.

We continue to work on enhancements to the TS for EU-Alert, the European public warning system which uses the Cell Broadcast Service.

In response to European Commission Mandate M/493 on the Location Enhanced Emergency Call service, work progressed with the development of protocol specifications for the interfaces of the functional architecture. The service is intended to cover a situation where different service providers and network operators need to co-operate to determine the location of an emergency caller.

In April, the European Parliament made it mandatory from March 2018 onwards for all new models of cars to be equipped with eCall, the in-vehicle emergency call service which automatically relays data about an accident from a vehicle to the emergency services. We developed the standards which describe the transmission of eCall data in co-operation with the Third Generation Partnership Project (3GPP™). In 2015, we turned our attention to conformance and interoperability test specifications for eCall.

Satellite Communications for Emergency Situations

Our Satellite Earth Stations and Systems committee completed a new TS which provides a framework for the deployment of a satellite-based emergency telecommunication network for use by first responders in mass casualty incidents. It addresses the different requirements for road or rail incidents respectively in the countryside (where satellites can provide a communications hub to supplement minimal existing infrastructures), and incidents caused by a major earthquake in an urban environment (where satellite communications can replace disabled infrastructures).

In a global alert network, satellite links provide robust communication channels with broadcast capabilities. In 2015 we completed work on Multiple Alert Message Encapsulation over Satellite (MAMES) which provides a flexible encapsulation scheme for alert messages and mechanisms to be issued from or distributed to many technologies including SMS and cell broadcast, audio message, facsimile, pagers, slow scan TV and telex.

Other Public Safety Activities

We are also creating standards for maritime safety equipment and working on various mechanisms for road safety through the use of Intelligent Transport Systems.

Working in Partnership

Working with Europe

We value our partnership with the European Commission (EC) and the European Free Trade Association (EFTA) highly. As a European Standards Organisation (ESO), ETSI provides world class standards and specifications to support European Union (EU) legislation and public policies. In 2015 we continued to strengthen our relationships with relevant EC services.

In 2015 we worked on a number of existing EC mandates and accepted two standardisation requests: M/530 (privacy by design) and M/536 (Harmonised Standards in support of the Radio Equipment Directive (RED)). We also commented on draft standardisation requests that were under preparation and on the draft Annual Union Work Programme for European Standardisation which is to be used as a planning tool to prepare for possible future standardisation requests and actions.

We worked with the EC in the development of procedures for the preparation of mandates (the 'Vademecum') to ensure that the standardisation process remains responsive to the rapid technological changes in Information and Communications Technologies (ICT). This work contributed to the final adoption and release of the new Vademecum in October 2015.

We completed our first release of standards for Co-operative Intelligent Transport Systems (ITS) in response to Mandate M/453, which was welcomed by the EC. We remained heavily committed in mandated areas such as electronic signatures (M/460), space standardisation (M/496) and enhanced emergency calls (M/493). In many of these areas, we co-operated with the European Committee for Standardisation (CEN) and the European Committee for Electrotechnical Standardisation (CENELEC).

We participated in all of the meetings of the EC's Committee on Standards that took place in 2015 and all four meetings of the ICT Multi-Stakeholder Platform. We regularly took part in meetings of the Task Force on the Rolling Plan for ICT Standardisation and contributed to the final outcome. We also participated in working groups set up to evaluate specifications submitted by public authorities/the EC for consideration as Common Technical Specifications for ICT public procurement. We continued to attend as an observer at various Member State committees and their working groups, including the Telecommunication Conformity Assessment and Market Surveillance Committee (TCAM) Expert Group, the Communications Committee (COCOM) and the Radio Spectrum Committee. We also participated in the Radio Spectrum Policy Group and assisted in the development of radio spectrum policy in the EU.

Throughout 2015 we continued to develop and maintain Harmonised European Standards (ENs) in support of the Radio and Telecommunications Terminal Equipment (R&TTE) and Electromagnetic Compatibility (EMC) Directives. Considerable effort was invested in drawing up our work programme for Harmonised Standards to cover the RED's extended scope. With over 180 standards to develop, this is a major undertaking for our radio community but, by the end of 2015, we had made good progress.

Collaboration between the ESOs

Co-operation and collaboration with CEN and CENELEC continued throughout 2015. ETSI participates in the CEN and CENELEC Technical Boards and attends their General Assemblies. The Joint Presidents' Group ensures management level co-ordination, and there are direct links between our technical committees. By working together on appropriate topics, especially those which are the subject of EC standardisation requests, we ensure that industry benefits from a more integrated European standardisation system.

In 2015 the ESOs continued to work closely together in areas such as ITS, smart energy, smart metering and electronic signatures to ensure that together we develop a coherent set of standards and avoid overlapping work. Other significant areas in 2015 included EMC, wireless industrial automation applications operating in the 2,45 GHz Industrial, Scientific & Medical band, energy efficiency, green data centres and accessibility.

Working with NSOs

We are assisted in our role and responsibility as an ESO by our network of National Standards Organisations (NSOs). About half of the NSOs are also members of ETSI, but all perform the important task of organising 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 may even accompany local Small and Medium-sized Enterprises (SMEs) in their first steps in standardisation. 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 our sister ESOs, especially in fields where ICT is an enabling technology for other industries.

For all these reasons we have worked to improve our understanding of the needs of NSOs. In 2015 we continued to meet with the NSOs before every meeting of our General Assembly to exchange information, and we work with individual NSOs on particular projects. For example, in June the BSI hosted a workshop in the UK, which triggered the creation of our Industry Specification Group on Next Generation Protocols.

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. Working in partnership also helps reduce fragmentation in standardisation, particularly in a world of converging technologies, and is an important means by which we ensure our activities keep up to date with market needs. Establishing partnership agreements with fora, consortia and international and regional Standards Development Organisations around the world is one of the key mechanisms we have adopted in working with others.

By the end of 2015, our partnership agreements portfolio numbered over 90 active partnerships. During 2015, we entered into new Memoranda of Understanding with the Comité International Radio-

Maritime, the Global ICT Standardization Forum for India, the Optical Internetworking Forum, SAFE-Bio-Pharma and the Trusted Computing Group.

The Letter of Intent (LoI) with the Telecommunications Standards Development Society, India (TSDSI) was upgraded to a full Co-operation Agreement. Other Co-operation Agreements were signed with the Car Connectivity Consortium, the Society of Cable Telecommunications Engineers and the Small Cell Forum. In addition, we signed LoIs with EMVCo and the Open Platform for Network Functions Virtualisation.

We renewed our partnership with the European Railways Agency, to facilitate direct collaboration. Partnerships were also renewed with ERTICO-ITS Europe, the European Patent Organisation (EPO), the Traveller Information Services Association, the Organization for the Advancement of Structured Information Standards and the Institute of Electrical and Electronics Engineers.

Seconded Experts in Emerging Markets

As every technological development makes the world a smaller place, we continue to place special emphasis on bridging the gap with new players in emerging markets and regions. In partnership with CEN and CENELEC, the EC and EFTA, we have therefore appointed 'Seconded Experts' to raise the profile of European standardisation and to intensify co-operation on standardisation issues in key emerging regions.

India

In 2015, our Seconded European Standardisation Expert in India (SESEI) was involved in events and workshops on various strategic topics such as smart cities, cyber security and device certification. Our second 'Indo-European dialogue on ICT standards and Emerging Technologies' was held in November in New Delhi, organised back-to-back with the EU-India Co-operation on ICT Standards Project workshop. These two events provided a platform for us to present our latest work and for the local ICT community to share their needs.

Collaboration with the TSDSI was cemented in April with the signing of a Co-operation Agreement. Such collaboration enables us to support Indian policies such as 'Make in India' and 'Digital India' with our standards, particularly in areas such as Machine-to-Machine communications and the Internet of Things, energy efficiency and mobile terminal safety.

With the completion of the current SESEI's three-year term in early 2016, the project partners unanimously confirmed their support for its continuation for another (third) phase.

China

Our Seconded European Standardisation Expert for China (SESEC) gave special attention in 2015 to analysing China's Standardisation Reform, which is expected to impact on EU-China co-operation on standardisation issues.

A new SESEC website was launched, providing information about the Chinese and European standardisation systems. This was expected to prove useful to European companies seeking to do business in China (and vice versa).

Forapolis™ Support Services

Drawing on over two decades of ETSI experience, in 2015 Forapolis provided customised support services to four third party organisations in which ETSI members are involved. These services are provided on a cost-recovery basis.

Intellectual Property Rights

Our Intellectual Property Rights (IPR) Policy is highly regarded around the world. We work constantly to improve it, consulting widely with our members, the EPO, the EC, the United States Government and relevant partner organisations, to meet the needs of our members, public authorities and the ICT industry in general.

In 2015 our IPR Special Committee focused on ways to increase the transparency of patent declarations and the information we provide to members and the public, as well as improving our support to SMEs. Throughout the year, we contributed the views and represented the interests of the standardisation community on patents, standards and the interplay between them at conferences and workshops worldwide.

Recognising the risks inherent in the telecommunications industry, we provided training for our staff on IPR and competition law. In June we organised a workshop on Alternative Dispute Resolutions in partnership with the WIPO Arbitration and Mediation Centre.

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. In this way, STFs are able to 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.

Altogether, 43 STFs and other funded projects were active in 2015, involving 150 experts for an equivalent of about 25 man-years.

The financial investment was about 2,6 M€. In addition, a voluntary contribution equivalent to 480 k€ was provided by experts working free of charge.

In 2015, we allocated an additional 150 k€ of the ETSI contribution to the STF budget to support the preparation and revision of the Harmonised Standards required to comply with the new Radio Equipment Directive. As a result, we made rapid progress in this task.

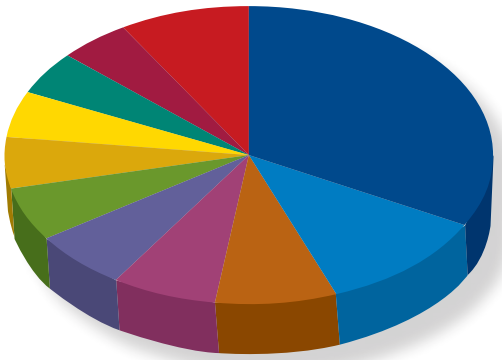
EC/EFTA Funding

We continued to collaborate with the EC and EFTA during 2015. We saw the finalisation of the long awaited Commission Decision on Lump Sum Financing in early July, and we signed an amendment to our Framework Partnership Agreement with the EC and EFTA, enabling us to submit proposals and negotiate action grants for the financing of standardisation actions. The number of action grants agreed in 2015 continued to be affected but proposals were submitted in the latter part of the year to be considered for grants in early 2016. However, we were able to agree our Operating Grant for 2015.

The EC continued to reduce its budget for standardisation for 2015 compared with 2013 and 2014, which resulted in a further decrease in the amount available for Operating Grants for the European Standards Organisations. In our case, our Operating Grant went down from 2,6 M€ in 2014 to 2,44 M€ in 2015. However, we were able to achieve the finalisation and full payment of the 2014 Operating Grant. Following discussions with the EC, the 2016 Operating Grant was expected to be agreed for the same amount, i.e. with no further reduction.

We continued to manage and invoice the action grants received from the EC/EFTA efficiently, and we finalised and closed actions started in 2011-2012 onwards. The actions signed in 2015 covered activities related to the Internet of Things, the Seconded European Standardisation Expert in India (SESEI), training materials for Information and Communications Technologies standardisation plus the organisation of Plugtests™ interoperability events.

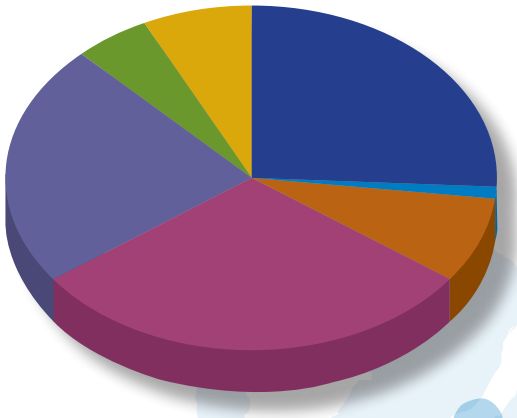
Technical areas in which funded resources were invested in 2015



Technical area	Spent (k€)	%
3GPP	869	33
Satellite Earth Stations & Systems (SES)	305	11
Core Network and Interoperability Testing (INT)	211	8
Methods for Testing & Specification (MTS)	185	7
Electronic Signatures & Infrastructures (ESI)	167	6
Emergency Telecommunications (EMTEL)	153	6
Cloud (Network Technologies)	150	6
Intelligent Transport Systems (ITS)	128	5
EMC and Radio Spectrum Matters (ERM)	127	5
Human Factors (HF)	124	5
Others	226	8

Figures are rounded to the nearest k€.

Funding sources in 2015



ETSI funding	26%
ETSI members	1%
ETSI voluntary contribution	8%
EC/EFTA Mandates/ICT	30%
3GPP Partners funding	23%
3GPP members	5%
3GPP voluntary contribution	7%

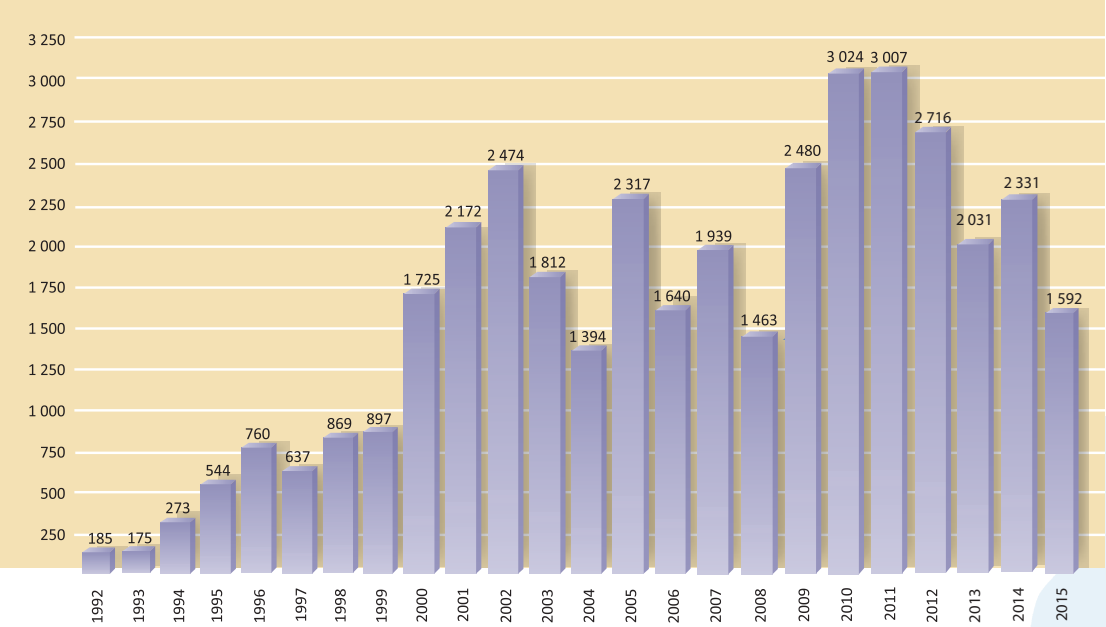
Standards Production

In 2015 we published nearly 1 600 standards, specifications, reports and guides, bringing the total published since our establishment in 1988 to over 38 500. Although the number of documents published in 2015 is significantly less than in 2014 due to the freeze-point of 3GPP Release 13 (December 2015), that freezing will result in the production of more than 1 000 deliverables. A bumper crop of standards is therefore forecast for 2016.

We are widely regarded as producing world class standards but in 2015 considerable effort went into raising quality levels still further. We increased the number of documents for pre-processing by the Secretariat before submission to the technical body for approval and final processing. We also revised the ETSI drafting rules and upgraded the skeleton for standards production.

In response to a request from the European Commission to reduce the development time of European Standards (ENs) by 50% by 2020, we streamlined processing in the Secretariat and, with the support of the National Standards Organisations, we reduced the length of time which an EN spends in the EN Approval Procedure from 120 to 90 days.

The number of deliverables published, for each of the years 1992 - 2015



Distribution by type of published document

	in 2015	Total since 1988
Technical Specification (TS) [1]	1 389	29 508
Technical Report (TR) [2]	72	3 148
ETSI Standard (ES)	29	756
European Standard (telecommunications series) (EN) [3]	73	4 678
ETSI Guide (EG)	4	246
Special Report (SR)	3	87
Group Specification (GS)	22	101
TOTAL	1 592	38 524

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)

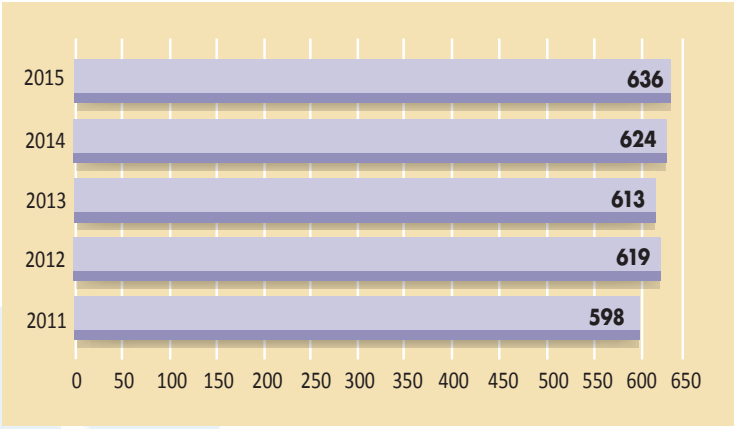
Membership

Overall ETSI membership (all categories) increased again in 2015. At the end of the year, we had a total of 784 members, drawn from 63 different countries and provinces, from across five continents. This was made up of 636 full members drawn from 42 European countries, 129 associate members drawn from 18 non-European countries and 19 observers. 118 of our members are Small and Medium-sized Enterprises (SMEs), of which 77 are micro-enterprises.

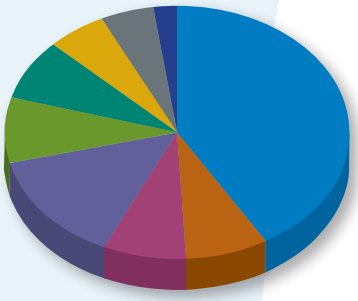
The European Commission and the European Free Trade Association Secretariat, which hold special roles as Counsellors, attend the General Assembly and the ETSI Board and continue to play an active part in our work.

Our membership team worked hard in 2015 to build and maintain close relationships with our members to ensure we meet their needs.

Evolution of ETSI Full Membership



Full and Associate Membership by category



Manufacturers	318	(42%)
Network operators	60	(8%)
Administrations	59	(8%)
Research bodies/universities	108	(14%)
Service providers	63	(8%)
Consultancies	61	(8%)
Users	42	(5%)
Others	37	(5%)
Other Government bodies	17	(2%)

Membership by type

	1-1-2015	31-12-2015
Full Members	624	636
Associate Members	120	129
Observers	23	19
Total	767	784

Overall membership by country/province

Albania	2
Andorra	1
Australia	5
Austria	14
Belgium	32
Bosnia Herzegovina	2
Botswana	1
Bulgaria	2
Canada	12
China	10
– Taiwan (Province of China)	12
Croatia	2
Cyprus	1
Czech Republic	5
Denmark	17
Egypt	1
Estonia	3
Finland	14
Former Yugoslav Republic of Macedonia	1
France	103
Georgia	1
Germany	116
Greece	6
Hungary	4
Iceland	1
India	6
Indonesia	1
Ireland	14
Israel	7
Italy	26
Japan	10
Jordan	1
Korea	4
Latvia	1
Lebanon	1
Lesotho	1
Lithuania	1
Luxembourg	10
Malaysia	1
Malta	2
Moldova	1
Montenegro	1
Netherlands	31
Norway	16
Poland	9
Portugal	4
Qatar	2
Romania	2
Russian Federation	9
Serbia	1
Singapore	1
Slovakia	2
Slovenia	3
South Africa	3
Spain	23
Sweden	25
Switzerland	21
Turkey	6
Ukraine	1
United Arab Emirates	4
United Kingdom	112
United States of America	52
Uzbekistan	1
63 COUNTRIES OR PROVINCES IN TOTAL	**784**

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 Patrick Aumeras, whose auditor's mandate was renewed by the 55th General Assembly, has audited the 2015 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 2014, income decreased by 3,8%, or roughly 931 k€, while expenditure was down by 4,2% or 1 019 k€. After having made provision of roughly 5 k€ for Income Tax to be paid, the net result of the year is 117 k€. This compares with a net result of 28 k€ in 2014.

The key points of the budget management are the following:

Expenditure – Secretariat costs were 3,6% above budget and lower by 4,2% compared with 2014. In addition to the close monitoring of the expenditure budget along with delays in implementing some planned projects that also contributed to the budget underspend, in 2015 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 until 2031. Partners' services are delivered on a cost recovery model. 3,6 M€ were spent on experts' costs for Specialist Task Forces and other standardisation-related technical experts.

Income – Members' contributions (15,3 M€) increased by 4,8% compared with 2014 and funded roughly 65% of the budget. European Commission (EC)/European Free Trade Association (EFTA) payments amounted to 4,3 M€ to cover expenses related to the operation of the European standardisation platform and standardisation projects. With some partners significantly reducing or terminating their service contracts, income generated by support services supplied to fora and consortia (Forapolis™) amounted to 0,3 M€, which represents a 40% decrease compared with 2014. The decreasing trend will continue until the end of 2017, when these activities were planned to be terminated.

2015 Budget statements

INCOME	(k€)	EXPENDITURE	(k€)
Members' contributions and Observer fees net of credit notes	15 301	Secretariat staff costs	12 458
EC/EFTA contracts	4 293	Other Secretariat costs	5 940
3GPP™ Partners	1 778	Special projects	324
Voluntary contributions	177	European Friends of 3GPP	438
Forapolis	299	Provision and losses	506
European Friends of 3GPP	534	Experts' costs	3 587
Sales	262		
Plugtests™	33		
Financial income	90		
Other income	601		
TOTAL INCOME	**23 369**	**TOTAL EXPENDITURE**	**23 252**

In 2015, there was a net result of 117 k€.

Financial Statements for the Year 2015

The final accounts and the balance sheet are summarised below. The fiscal accounting period is 1 January 2015 - 31 December 2015.

Statement of Income and Expenditure Year 2015

	Income (€)	Expenditure (€)
Income	23 316 501	
Purchases		8 902 256
Expenses		14 195 418
Financial income and expenses	93 987	4 387
Extraordinary income & expenses	545	187 685
Income Tax		4 683
TOTAL	**23 411 033**	**23 294 429**

There was a net result of 116 604 € in 2015.

Summary of the Balance Sheet

Assets

Net amounts at:	31 Dec 2014 (€)	31 Dec 2015 (€)
Fixed assets	7 925 695	6 875 318
Debtors	16 805 507	16 793 229
Securities/cash	6 314 362	6 683 684
Prepaid expenses	168 047	138 469
TOTAL ASSETS	**31 213 611**	**30 490 700**

Liabilities

Net amounts at:	31 Dec 2014 (€)	31 Dec 2015 (€)
Equity	8 278 661	8 278 661
Provisions	579 160	396 771
Balance carried forward	264 074	292 128
Result of the year	28 054	116 604
Creditors	5 899 317	5 081 594
Deferred revenue	16 164 345	16 324 942
TOTAL LIABILITIES	**31 213 611**	**30 490 700**

Figures are rounded to the nearest €.

World Class Standards

- 2G, 3G, 4G, 5G Mobile Communications
- Air Traffic Management
- Automotive Radar
- Autonomic Systems
- Body Area Networks
- Broadband Wireless Access
- Broadcasting
- Cable Networks
- Cloud Technology
- Cognitive Radio
- Content Delivery
- 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
- IMS Network Testing
- Intelligent Transport
- Internet of Things
- Interoperability
- Lawful Interception
- Low Power Radio
- Machine-to-Machine Communications
- Maritime Communications
- Media Content Distribution
- Millimetre Wave Transmission
- Mobile-Edge Computing
- Network Functions Virtualisation
- 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
- Railway Communications
- Safety
- Satellite Communications
- Security Algorithms
- Short-range Radio
- Smart Appliances
- Smart Cards
- Software Defined Radio
- Telemedicine
- Testing
- Terrestrial Trunked Radio (TETRA)
- Wireless Medical Devices

To find out about our plans for the future, see our Work Programme 2016-17.

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