

No Strings Attached

-the future of wireless standards

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Table of Contents

Table of contents.....	2
Wireless communications technologies.....	3
The landscape for Wireless Communications Standardization.....	4
Discussion	6
Appendix: A survey of standard-setting organizations for wireless communications technologies	8
<i>The Institute of Electrical and Electronics Engineers Standards Association (IEEE SA)</i>	8
<i>Universal Serial Bus Implementers Forum (USB-IF)</i>	9
<i>The Bluetooth Special Interest Group (SIG)</i>	11
<i>Wi-Fi Alliance</i>	11
<i>WiMAX Forum</i>	11
<i>WiMedia Alliance</i>	11
<i>ZigBee Alliance</i>	12
Telecommunications sector.....	12
<i>The European Telecom Standards Institute (ETSI)</i>	12
<i>The 3rd Generation Partnership Project (3GPP)</i>	13
<i>The 3rd Generation Partnership Project 2 (3GPP2)</i>	13
<i>GSM Association (GSMA)</i>	14
<i>CDMA Development Group (CDG)</i>	14
<i>International Telecommunication Union, Telecommunication Standardization Sector (ITU-T)</i>	14
<i>Open Mobile Alliance (OMA)</i>	14
<i>Telecommunications Industry Association (TIA)</i>	15

Wireless communications technologies

Wireless communications technologies have seen significant development over the last decade. This is true both for mobile, where 3G technologies W-CDMA and cdma2000 has altered the way we are able to use our cell phones, and stationary systems, where Wi-Fi, WiMAX and Bluetooth has enabled device communication over the air instead of cables. Standardization has had a tremendous impact on this progress.

The wireless communications scene can be divided into four main areas; Wireless Personal Area networks (WPAN); Wireless Local Area networks (WLAN); Wireless Metro Area networks (WMAN); and Wireless Wide Area networks (WWAN). As the names hint at, the technologies in each of the four areas are intended for different applications dependent of the proximity of the devices to be connected. WPAN typically is suited for wireless communications of up to 10 meters, WLAN up to 100 meters, WMAN can cover about 10 kilometers and WWAN surpasses that of WMAN by a significant margin. The following Diagram 1 presents an overview of current wireless standards and their attributes.

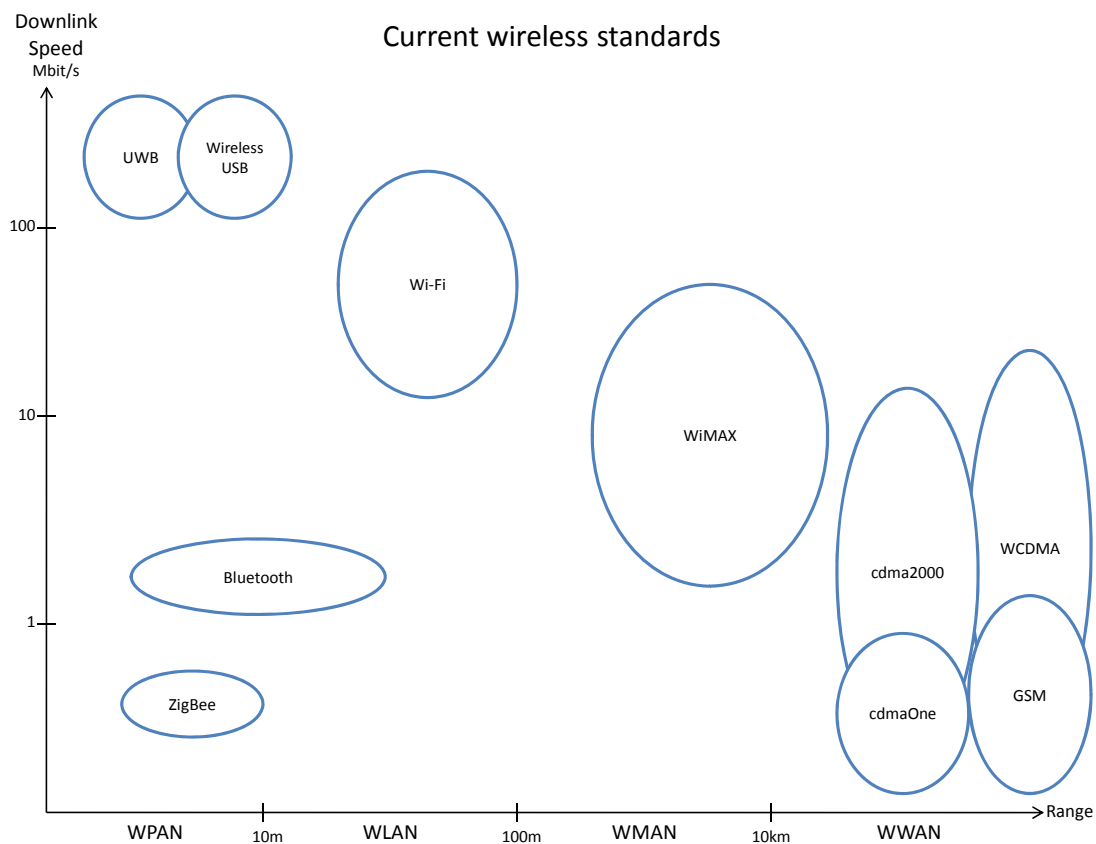


Diagram 1. Overview of current wireless standards and their attributes

Several factors contribute to increasing substitutability between alternatives both from a user and vendor perspective. This intensifies competition both between technologies, standards and standard setting organizations.

Historically, devices have been designed to use only one wireless communication technology. This is now changing. New mobile device, for example the Apple iPhone, can use WPAN, WLAN or WWAN for its operations and selects according to which offers the best connection.

Correspondingly, with a wider deployment of fast local and metro area networks the previous position of mobile networks is now being threatened. As a reaction the telecom industry is developing new standards for long range communications, e.g. Long Term Evolution (LTE), which will rival the speed of WLAN and WMAN and give mobile broadband a new meaning. This development is still some years into the future and we have yet to see how well it plays out.

With the convergence of wireless technologies, making several different connections available to users, it is well worth taking a closer look at the organizations standing behind the different standards of wireless communications.

The landscape for Wireless Communications Standardization

One dominant feature of standardization in wireless technologies is the separation of specification development and standard promotion and certification into different organizations.

While IEEE standards are the basis for essentially all short range communications networks, most if not all wireless communication standards have their own interest groups which take on responsibility for marketing the specifications and provisioning of testing, validation and certification of implementations. These organizations are not affiliates of IEEE, but IEEE does not discourage the formation of such groups since it gives them a greater presence and a larger uptake of produced standards.

The landscape for standardization of wireless communication, as presented in Diagram 2 below, is thus a hybrid of cooperation and rivalry between technologies and standards. This combination of coordination and competition has resulted in some fragmentation, sometimes frustrating to end users, but mostly contributed to valuable differentiation and a fast pace of innovation.

In the telecom sector, intense rivalry has dominated the landscape for over a decade as the organizations GSMA and CDG have been the marketing alternative platforms based on standards developed under the GSM and CDMA respectively. This situation may now change as the next standard for the telecommunications industry will be a joint development project between the two branches rather than a continuation of the two separate lines. While potentially carrying some static benefits, e.g. increased interoperability, it remains to be seen if the rapid rate of innovation can be maintained without head-to-head competition.

Wireless standards can be categorized in two dimensions: application and procedure. In the application-dimension standards can be broadly grouped in five categories; short range wireless communications (PAN and LAN), long range telecommunications (2G and 3G mobile communication) and mobile broadband, which combines the concepts of WMAN, WWAN and 4G mobile technology into one single sector, i.e. high speed wireless communication for mobile devices. New standards are under way in the mobile broadband area; both LTE and IEEE 802.20 will fall in this category.

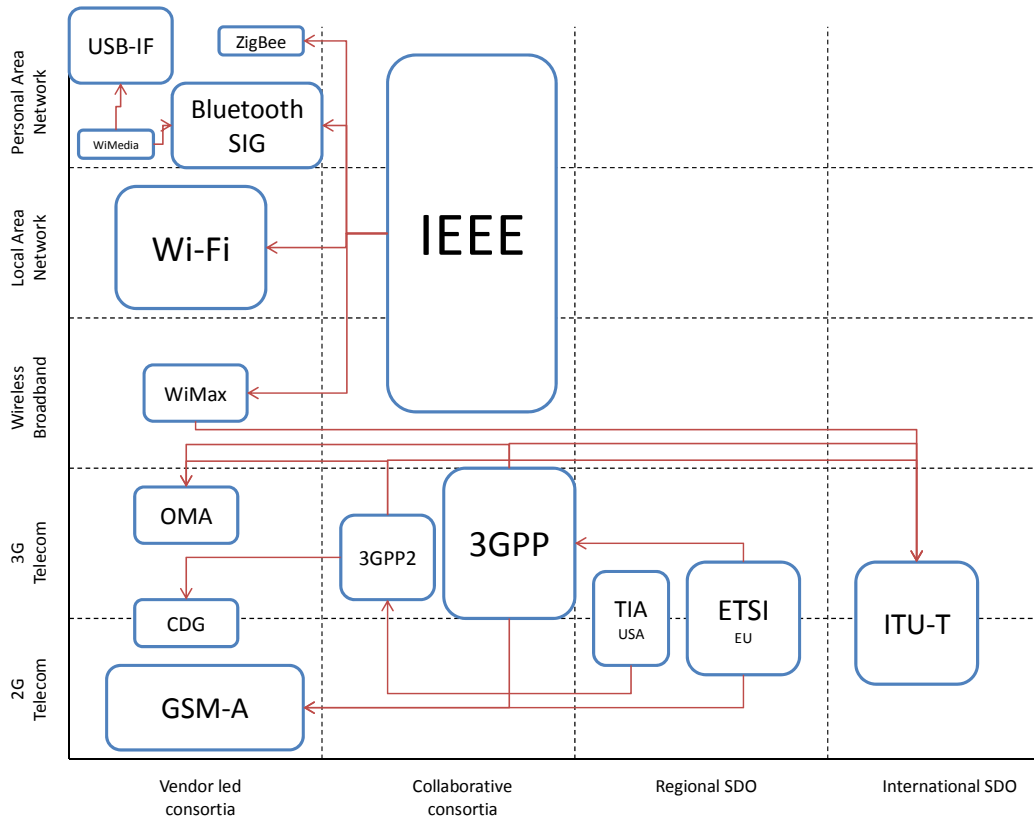


Diagram 2. Overview of the standard setting landscape

The great influence of IEEE is evident from the network map presented above. IEEE has published standards for most of the organizations developing personal, local and metro wireless network systems. As such, IEEE is supposedly the most influential organization in standardizing wireless (as well as wired) communications through its IEEE 802 standards family. The only widely used technology that does not have a connection to IEEE is USB, which have a standalone development and is entirely industry driven.

Among the mobile telecom standards there are currently just two organizations developing standards, 3GPP and 3GPP2. With the coming joint development of LTE among the telecommunication organizations, the number of large standard organizations in the wireless sector is basically reduced to two, IEEE and 3GPP with USB being a smaller but significant independent player focusing on personal area networks.

The standardization of wireless technologies is largely driven by collaborative organizations and by vendor consortia for supplying market oriented activities and uptake.

ITU-T is the ISO equivalent for the telecom sector and it is commonly the final destination for standards with mobile telecom applications. In 2007, WiMAX – essentially developed from technologies used for stationary wireless communication – was accepted as a telecom standard by ITU-T. This highlights the fact that developments within IEEE (stationary wireless) and 3GPP/3GPP2 (mobile wireless) are now converging on mobile broadband communications.

Discussion

One of the most interesting features of wireless technology standards is the fact that the previous barriers between different usage areas are becoming blurred. This happens because of two primary reasons. First off, new standards are being developed, which are able to provide greater speed, better signal ranges and/or higher reliability. This means that IEEE standards, which have traditionally centered around computer applications, are able to compete with telecom standards thanks to development of both greater range (in the case of WiMAX) and deployment (the number of Wi-Fi hot spots in the world have increased significantly, providing greater network coverage).

At the same time telecom standards have begun to allow for greater transmission speeds, which have enabled such things as streamed media, seamless web connection and video calls, functions that were previously not available through mobile devices and in which the wireless spectrum was only provided by Wi-Fi network connections.

Second, the emergence of new devices which comply with several wireless specifications reduces switching costs and increases substitutability.

Telecom standards development has historically been a battle between competing technologies. New developments might however change this picture. The camps behind 3GPP and 3GPP2 have decided to develop a uniform standard for 4G telecommunications, i.e. the Long Term Evolution standard. This might put an end to a standards war that has been ongoing for two decades. However, this might also signal the start of a new battle, that between mobile broadband standards from IEEE and those originating from the telecom industry.

The concept of mobile broadband is rapidly changing the way consumers use wireless technology. With devices now being able to connect to the internet anywhere at any time, new standards will have to be developed which take this functionality further and since there are several solutions available or soon to be available (Wi-Fi, WiMAX, 3G telecommunications standards and LTE for example) the ability of these different standards to attract widespread use might shape the outcome of which standards will be dominant in the future.

Greater network coverage for Wi-Fi and WiMAX could potentially threaten the telecommunication hegemony for CDMA and GSM technology. Up until now, the latter have had the competitive advantage of being the only ones with wide enough networks to allow wireless communication regardless of location.

WiMAX has an important lead time and is already being deployed whereas LTE is still some years into the future. While LTE receives broad support in the mobile industry, any delays of the standard might put WiMAX in such a favorable position that LTE will find it hard to catch up.

It is quite possible that the future of the mobile broadband will be determined by governments rather than by the market. At least two important factors point in this direction: the significant economies of scope and public involvement in the telecom sector and the need for radio spectrum ultimately controlled and allocated by governments.

On the other hand, increasing competition between standards both in the WPAN area (USB and Bluetooth) and for mobile broadband (LTE and WiMAX) suggests that markets still have an important role to play in determining what technologies that are preferred by users.

Appendix: A survey of standard-setting organizations for wireless communications technologies

The wireless communication standards are to a large extent developed in a symbiotic fashion between standards developing organizations and promoter groups. Among the more common standards only wireless USB diverges from this set-up. Vendors and operators thereby gain a large influence over the standardization process with a strong standing in the development organizations and especially the promoter organizations. This is more pronounced among the telecom standards which have rather closed development organizations compared to IEEE. The openness of the standardization within wireless communications is thereby dependent on how IEEE will fare in the increasingly competitive wireless standards domain. This might in turn also impact on the extent to which governments and third party interests can have an influential role in the standardization process.

The three organizations discussed in further depth in this report are all concerned with development of wireless standards. USB-IF is the most dissimilar of these three since it is a pure industry organization, developing its own set of standards and combining the development with support activities of testing, validation and certification. USB-IF covers the whole spectra of the standardization ecosystem while ETSI and IEEE are primarily concerned with the development of new standards within wireless communication. While IEEE produces their own standards ETSI however partakes in 3GPP and uses this platform for development of new telecom standards. The three organizations as such utilize different approaches to standardization, all of which have so far been successful.

Both IEEE and ETSI have been active in wireless communications for an extended period whereas USB-IF is a recent actor in the area. The wireless USB specification was finalized as late as 2005, with the first devices shipped in 2007. The role of wireless USB is therefore not clear-cut as of yet but given the wide success of traditional USB there is no reason to suspect that wireless USB will be much less successful, especially since there are currently no comparable PAN standards in terms of speed.

The Institute of Electrical and Electronics Engineers Standards Association (IEEE SA)

Website: <http://standards.ieee.org/>

IEEE Standards Association (IEEE-SA) is the standards developing organization which creates industry standards for IEEE. IEEE is a professional association with more than 375 000 members from over 160 countries. The acronym stands for Institute of Electrical and Electronics Engineers but the organization has grown to such an extent that the original name is no longer fitting. The members of the association are active in a wide range of fields, such as aerospace systems, computers, telecommunications, biomedical engineering, electric power and consumer electronics. Membership in IEEE-SA is open for anyone, both individuals and organizations. In 1999 the organization IEEE-ISTO (Industry Standards and Technology Organization) was formed in cooperation with IEEE and IEEE-SA. This organization is dedicated to facilitate industrial cooperation for development of IEEE standards

and also to facilitate the worldwide adoption and implementation of IEEE standards and best practices.

The development of an IEEE standard is a complex process which starts when anyone with a proposition is able to get one of the subgroups within IEEE to sponsor the proposition. The New Standards Committee within IEEE-SA then makes a decision on whether to approve the proposition as an authorized project. If approved, a working group which anyone is allowed to participate in is appointed and given the task to produce a draft. Once a draft is produced a ballot is held. In this ballot, anyone is allowed to vote provided the payment of a minor ballot fee. Each year, approximately 200 such ballots are held. Approval requires at least 75 percent positive votes and the participation of at least 75 percent of the members who paid the ballot fee. If approved, the draft is sent to the Standards Review Committee, which conducts a review of the draft before sending a recommendation to the IEEE-SA Standards Board, which takes the final decision on whether or not to approve the draft as a new IEEE standard.

Once published, a standard shall be maintained and supported by the subgroup which initially sponsored the proposition. That group is also required to conduct a review of the standard at least once every fifth year. If needed, the sponsor shall revise the standard, following the same procedure as the development of a new standard.

The IPR to all standards and specifications is owned by IEEE by way of a binding contract. Published standards are made available for purchase in a document shop. However, many standards are available for free courtesy of the sponsor to the IEEE standard. Issues related to third party IPR are handled by a specific Standards Patent Committee within the IEEE-SA. In situations where the IPR to essential technologies is held by a third party, IEEE requires an assurance from the patent holder that licenses will be available under Fair, Reasonable and Non-Discriminatory (FRAND) terms.

The total number of supported IEEE standards and standards under development by IEEE-SA is approximately 1 300 and the IEEE-SA also strategically cooperate with many other standards development organizations such as ANSI, IEC, ISO and ITU. One of the best known standards developed by IEEE-SA is probably the IEEE 802 standard for networks, which is a family of many different standards for fiber optics, wired and wireless networks and other applications.

IEEE largely competes with other international standardization bodies which has a broad ICT focus, for example ETSI, CEN, ISO, ANSI and ITU. However, the cooperation agreements with ISO and IEC were extended during 2008 to not only include a road for adoption of IEEE standards by ISO/IEC, but to also include joint development of standards. IEEE also competes with many organizations with a more narrow focus. For example, the USB standards are competing with various IEEE standards such as IEEE 1394, Bluetooth and Wi-Fi. Recently, IEEE has also started development of standards within the eHealth domain, where numerous other organizations are active.

Universal Serial Bus Implementers Forum (USB-IF)

Website: www.usb.org

USB-IF is a combined Standard Setting Organization, certifications body and marketing platform for USB technology, a leading specification for short range data transfer between devices. The forum is a not-for-profit organization founded in 1995 by the group of companies which developed the

specification for USB and function as a forum for the promotion and further development of the USB technology.

Membership in the organization grants the right to participate in the three main activities of the organization: developer conferences, testing of products and working groups for the development of new specifications. In total more than 800 companies are members of the USB-IF and the membership fee is USD 4 000 per year. Membership exists in two levels; to become a Promoter Member the company has to be active within the research and development of USB specifications and have demonstrated leadership and dedication in accordance with the ambitions of the USB-IF. Whether a company fulfills these requirements is decided by the current Promoter Members.

The development of completely reworked versions of the USB specification, so called primary specifications, is done outside of the USB-IF. USB 3.0, the latest version, was developed by the USB 3.0 Promoter Group, consisting of Intel, HP, Microsoft, NEC, NXP Semiconductors and Texas Instruments. Once they had produced the first draft for the proposed specification other members of the USB-IF was invited to contribute to the final version. After finalizing the specification, management was transferred to the USB-IF.

The development of complementing specifications designed to support the primary specifications, such as how a specific type of product is to use USB, is done in working groups within the USB-IF. The USB-IF is headed by a board consisting of the promoter members. In the structure below the board there is a Document Review Board and a number of working groups and subgroups. The groups develop specifications in different areas, such as mass storage, audio, video and battery charging. In most of the groups, participation is open to all members, but it often requires that the member first sign specific IPR agreements. Some groups are however restricted to specific members, such as the companies which contributed to the development of the USB 3.0 specification. The Document Review Board, which includes the chairs of each working group, is tasked with reviewing the working procedures of all groups and to review all proposed specifications. After the review of a proposal, a recommendation is handed to the board which makes the final decision on whether to publish a new specification.

All specifications and similar documents are made publicly available online for free. Most of the tools and procedures created for testing and product development are however not free, but sold in the USB-IF eStore. Useful information is also available in an online forum.

The USB-IF is dedicated to eliminate all problems with interoperability when implementing USB specifications. To validate that products actually follow the specifications, the USB-IF has got a number of independent test labs situated throughout the world. Membership in the USB-IF also grants the right to participate in regular workshops, where testing of conformity with the USB specification is done. These workshops are also intended to prevent problems proactively by facilitating communication between the various vendors. Once a product has passed the tests, it is allowed to use the USB-IF logotypes and is also listed on the USB-IF Webpage as a certified product. There are currently several thousands of products which have gone through the testing procedures.

USB-IF competes with several other standards and their parent organizations. USB wired standards compete with IEEE 1394 (FireWire) and with the introduction of a wireless USB standard in 2007, competition is also increasing with other IEEE standards such as Wi-Fi and Bluetooth. This considered

it is obvious that IEEE and organizations dedicated to IEEE standards such as the Wi-Fi Alliance are the closest competitors of USB-IF.

The Bluetooth Special Interest Group (SIG)

Website: www.bluetooth.org

The Bluetooth Special Interest Group is a privately held, not-for-profit trade association founded in 1998, currently with 12 000 member companies. The SIG publishes Bluetooth specifications, administers the certification process, protects the Bluetooth trademark and advocates Bluetooth wireless technology. To use the Bluetooth technology, manufacturers must be members of Bluetooth SIG. The Bluetooth technology is based on the IEEE 802.15.1 standard. Bluetooth is used for WPAN and primarily exists in mobile devices. Certification of Bluetooth implementations is common, SIG has certified close to 10 000 devices.

Wi-Fi Alliance

Website: www.wi-fi.org

Wi-Fi Alliance was formed in 1999 as a not-for-profit organization with the aim to drive the adoption of the IEEE 802.11 standard for high-speed WLAN. The Wi-Fi Alliance currently has more than 300 members from 20 countries and owns the trademark to Wi-Fi. The Alliance tests and certifies the compatibility of wireless devices that implement the IEEE 802.11 specification to ensure interoperability and has issued over 5 000 Wi-Fi certifications. Wi-Fi is the preferred technology for stationary WLAN solutions and certification of products is close to mandatory.

WiMAX Forum

Website: www.wimaxforum.org

WiMAX Forum was established in 2001 as an industry-led, not-for-profit organization which currently consists of 500 members. WiMAX Forum promotes the global adoption of the wireless IEEE 802.16 standard (WiMAX). In order to achieve its goals the WiMAX Forum publishes complimentary specifications, certifies interoperability of WiMAX products and functions as a marketing and knowledge platform for the technology. WiMAX is an intermediate wireless technology which is situated in-between short range communications like Wi-Fi, USB and Bluetooth and long range telecommunications like GSM, W-CDMA and cdma2000 and is established as a Metro Area network. WiMAX was in 2007 recognized by ITU as the 6th IMT-2000 air interface, giving it an official status as a 3G standard.

WiMedia Alliance

WiMedia Alliance was established in 2002 to develop and promote the Ultra-WideBand (UWB) technology, initially developed by IEEE and later standardized by Ecma International. WiMedia UWB enables multimedia data transfers in the wireless personal area network (WPAN); it is targeted at the individual consumer's need and is present in such devices as personal computers, consumer electronics and mobile devices. In March 2009 WiMedia Alliance announced the transfer of all specifications and development of the UWB technology to Bluetooth SIG, Wireless USB Promoter Group and USB-IF. Following the completed transfer WiMedia Alliance ceased its operations.

ZigBee Alliance

Website: www.zigbee.org

ZigBee Alliance is an industry-based, non-profit organization consisting of over 300 members. The organization is mainly focused on certification of ZigBee products for interoperability and promoting the standard but also takes a role in managing the development of the standard. ZigBee technology is a simple and low cost wireless technology aimed at monitoring and control functions, primarily within industry and government. Specific utilization areas include building automation, industrial, medical and home automation and energy management applications. While ZigBee does not focus on high transfer rates, as most other wireless technologies do, it still fills an important role for simple and reliable wireless management applications.

Telecommunications sector

The European Telecom Standards Institute (ETSI)

Website: www.etsi.org

ETSI was founded in 1988 as it was considered that a European standards setting organization was needed specifically for the telecommunications field. ETSI is a not-for-profit organization which develops global standards for information and communications technology (ICT) within a wide range of areas, for example mobile, radio, internet, broadcasting and medical systems. ETSI is officially recognized by the European Commission (EC) as a European Standards Organization, which implies that ETSI standards are adopted by the EU member states.

In contrast to the other standard organizations recognized by the EC, ETSI offers membership to any organization from any country. Among the approximately 700 members from over 60 countries are not only the national standard bodies of the EU member states, but also a number of companies and other organizations. ETSI membership exists in three different tiers: full-, associate- and observer membership. Full membership is only open for members from the geographical area of CEPT (The European Conference of Postal and Telecommunications Administrations), whereas associate membership is available for others. Observer status is available for anyone who does not wish to fully participate in the work conducted by ETSI. ETSI is composed of a General Assembly, a Board, a Secretariat and a number of Technical Bodies.

The development of standards is done by technical bodies, where all full and associate members have the right to participate. The technical bodies are in most cases technical committees which are semi-permanent groups, each responsible for standards within a number of specified technical areas. There are also temporary groups, ETSI Projects, which are based around a specific market rather than a technology, and ETSI Partner Projects which are collaborations with other standards development organizations. A technical committee delegates the task to develop standards, specifications and other papers to small working groups of experts. Once such a working group is done drafting a standard, the committee has a ballot on whether to approve it or not. Approval requires at least 71 percent of the votes, where votes are weighted in accordance with the membership fee. Members of the committee may appeal the ruling of a vote to the ETSI Board.

Since a technical committee is semi-permanent, it continues to support approved standards with regular reviews, tests and validations. If a committee is dissolved it needs to provide

recommendations on how the future supports of its standards are to be conducted since ETSI is committed to support approved standards until removal.

The working documents and meeting minutes in ETSI are only made available for ETSI members while all approved standards and specifications are made publicly available. The IPR of all contributions made by members is owned by ETSI and ETSI grants the right to freely use and copy the standard documents.

Any contributor in a technical committee is requested to disclose any related patents they are aware of to make sure that work is not conducted in areas where patent claims could prohibit the introduction of a new standard. Holders of such patents have to offer irrevocable licenses on FRAND terms before such technologies may be included in a standard.

ETSI is widely recognized as the standards development organization which developed the GSM standard for mobile communications and ETSI has also been involved in the cooperation 3GPP which develops standards for third generation mobile systems. ETSI has developed a large number of standards within the ITC field and since it is recognized by the EC, ETSI obviously holds a notable influence.

ETSI to a large extent overlap the scope of the International Telecom Union and can be considered to be a regional competitor. Considering the leading role of ETSI in 3GPP it also competes with the 3GPP2 project, responsible for the development of the cdma2000 standard which is a direct competitor of 3GPP's WCDMA. Being engaged in the standardization of wireless communication ETSI also competes with other standards like Wi-Fi and WiMAX and their parent organization IEEE. Several of the other technologies with which ETSI works also overlap with the work of other standard setting organizations. However, ETSI is very focused on cooperation with other organizations. Together with the other European organizations CEN and CENELEC, ETSI participate in the Information Communications Technologies Standards Board. ETSI also cooperate with the international organizations ISO, IEC and ITU, and with industry organizations such as EMTel, MESA, ICANN and GSC. Further, memorandums of understandings have been signed with numerous organizations, such as OASIS and ERCIM.

The 3rd Generation Partnership Project (3GPP)

Website: www.3gpp.org

3GPP is a cooperative organization, founded in 1998, uniting telecommunications standard bodies from Europe, Asia and America. 3GPP was established to produce and maintain technical specifications for the 3G mobile system based on the Global System for Mobile communication (GSM). More specifically, 3GPP produces standards for the Wideband Code Division Multiple Access (WCDMA) 3G technology, recognized by ITU IMT-2000 as a 3G wireless technology. The standardization includes radio, core network, and service architecture and is transformed into global standards by the organizational partners.

The 3rd Generation Partnership Project 2 (3GPP2)

Website: www.3GPP2.org

3GPP2 is a collaboration between telecommunications companies through regional telecom standard organizations from Asia and America and was founded in 1998. The aim of 3GPP2 is to develop the

cdma2000 3G technology, based on the 2G cdmaOne standard, and to create a global telecommunications standard in accordance to ITU IMT-2000 requirements.

GSM Association (GSMA)

Website: www.gsmworld.com

GSMA is an organization of 750 mobile network operators and 200 companies of the mobile ecosystem, for example handset makers, software companies and media organizations. GSMA supports the deployment of networks based on the GSM family of technologies in order to create economies of scale and global interoperability. Being the foremost promoter of the highly successful GSM standards family GSMA is instrumental to the success of the GSM/WCDMA standards.

CDMA Development Group (CDG)

Website: www.cdg.org

CDG was established in 1993 and has close to 150 members, mainly network operators and vendors. The mission of CDG is to promote rapid development and deployment of CDMA-based systems. This includes managing the CDMA development through requirements definitions, outreach activities to increase CDMA awareness and participation, enabling of interoperability and roaming for CDMA systems and to create opportunities for economies of scale in CDMA technology. CDG essentially fills the same role for the CDMA technology as GSMA fills for the GSM technology.

International Telecommunication Union, Telecommunication Standardization Sector (ITU-T)

Website: www.itu.int/ITU-T/index.html

ITU-T coordinates standards for telecommunication on behalf of the International Telecommunication Union, ITU. Together with ISO and IEC, ITU is one of the formal global standard organizations. ITU has 191 member states and more than 700 sector members and associates. The majority of the members are from the private sector. The ITU-T recommendations define how telecommunication networks function and interoperate. Prioritized areas include accessibility; adopting international standards that promote interconnection of a wide range of communication systems; emergency communication; and to build confidence and security in the use of ICT. The ITU IMT 2000 and ITU Advanced initiatives define the requirements for 3G and 4G telecommunications.

Open Mobile Alliance (OMA)

Website: www.openmobilealliance.org

OMA was formed in 2002 by over 200 companies active in wireless communications technology. OMA brought together the interests of several fragmented organizations and forums active in the mobile services sector. The aim of OMA is to develop specifications for mobile services and OMA functions as a bridge between the telecommunication and web standard spheres. OMA is the central organization for standardizing and testing the services enabled by wireless telecommunications. The OMA specifications are set on top of existing technologies like GSM, UMTS and cdma2000 and enables interoperable services across the different technology platforms.

Telecommunications Industry Association (TIA)

Website: www.tiaonline.org

TIA is an ANSI accredited developer of telecom standards with over 600 company members and can to a large part be seen as the American alternative to ETSI, with standardization focused on telecommunications. TIA however has a more narrow scope than ETSI. TIA is a driving factor behind the 3GPP2 project and was instrumental in the development of the cdmaOne standard for mobile 2G communication. Due to its lesser scope and the lesser success of cdmaOne compared to GSM, TIA enjoys a somewhat lesser influence than ETSI on the global standards scene.