International Telecommunication Union

CCITT

ITU-T

50 YEARS 1956 2006

50 YEARS OF EXCELLENCE

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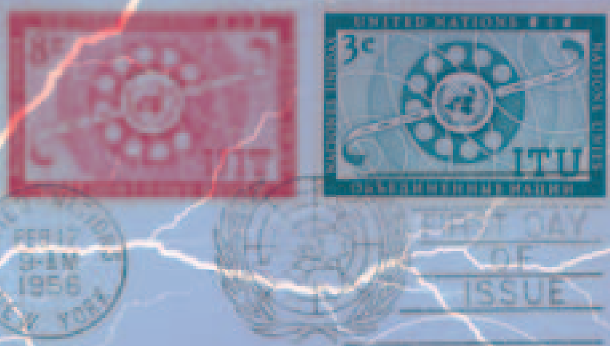


In 2006, ITU-T will celebrate 50 years of making the standards that have played a massive part in shaping the information and communication technologies (ICT) and services of today.

Over the next few pages, we give an insight into the background of telecommunications in general as well as highlight some of ITU's main achievements in terms of standardization.

Telecommunication plays an enormous role in our day-to-day lives and, if it wasn't for ITU-T Recommendations, no form of telecommunication, whether fixed or mobile telephony, cable, DSL or modem-based Internet, would be possible. Don't underestimate what that would mean. Without telecommunication business would grind to a halt, banks would not be able to transfer money, orders could not be placed and air traffic control systems would fail. Telecommunications also has a vital role to play in emergency communications and disaster relief and has been a crucial tool in international diplomacy. Simply put, life without telecommunication is almost unimaginable. And as we have moved from fixed-line telephony into mobile telephony and the Internet, so has ITU's work moved to accommodate and underpin these technologies that are becoming more and more important to the world economy.

20 July 2006
www.itu.int/ITU-T/50/

International Telecommunication Union

Etymology
Telecommunication is the communication of information over a distance and the term is commonly used to refer to communication using some type of signalling or the transmission and reception of electromagnetic energy. The word comes from a combination of the Greek tele, meaning 'far', and the Latin communicationem, meaning to impart, to share – literally: to make common. It is the discipline that studies the principles of transmitting information and the methods by which that information is delivered, such as print, radio or television, etc.

Visual/optical telegraphs

Early forms of telecommunication

Telecommunications predate the telephone. The first forms of telecommunication were optical telegraphs using visual means of transmission, such as smoke signals and beacons, and have existed since ancient times.

A significant telecommunication development took place in the late eighteenth century with the invention of semaphore. The semaphore is an apparatus for conveying information by means of visual signals, with towers equipped with pivoting blades, paddles or shutters, in a matrix. Semaphore can also refer to a system using hand-held flags. In this form, semaphore's use continues to this day in the marine and aviation industries.

While English physicist and chemist Robert Hooke is said to have given the first outline of visual telegraphy in a discourse to the Royal Society in 1684, semaphore was actually the invention of the Frenchman Claude Chappe in 1792. It was used during Napoleon's campaigns and widely imitated in Europe and the United States. The last known commercial mechanical semaphore link ceased operation in Sweden in 1880.

The reports of Chappe's telegraph reached England in the autumn of 1794, and stimulated Lord George Murray to propose a system of visual telegraphy to the British Admiralty. A chain of 15 tower stations was set up for the Admiralty between London and Deal at a cost of nearly GBP 4 000; others followed to Portsmouth, Yarmouth and Plymouth.

In the United States, the first visual telegraph based on the semaphore principle was built in 1800 by Jonathan Grout. It communicated over a distance of 104 km, connecting Martha's Vineyard with Boston, and its purpose was to transmit news about shipping.

In the late 19th century, the British Royal Navy pioneered the use of the Aldis, or signal lamp, which, using a focused lamp, produced pulses of light in Morse code. Invented by A.C.W Aldis, the lamps were used until the end of the 20th century and were usually equipped with some form of optical sight. They were most commonly used on naval vessels and in airport control towers.

The semaphore, invention of Claude Chappe

Electromagnetic and electrical telegraphs

New innovation

The first electrical telegraphs drew from the studies of Alessandro Volta and Luigi Galvani in Italy in the mid-late eighteenth century. The phenomenon of electrolytic decomposition that Volta discovered in his invention of the battery was used to provide the messaging element in an electrochemical telegraph proposed by Francisco Salva of Spain. His idea capitalized on the discovery by Volta that hydrogen bubbles were created as an effect of electrolytic decomposition. The same phenomenon was used by Salva to signal an event between two places. Thus for example, an operator could send a message via Salva's telegraph that would appear as a sequence of bubbles at the receiving end.

In 1809, S.T. von Soemmering demonstrated an electrochemical telegraph to the Munich Academy of Science. Observing the demonstration was Baron Pavel Lvovitch Schilling, a Russian diplomat who created the first electromagnetic telegraph in 1832. Shortly afterwards, in 1833, the first electromagnetic needle telegraph was developed by Professor Carl Friedrich Gauss and Professor Wilhelm Weber, and used at Göttingen for the transmission of scientific information between the physical laboratory of the University and the Astronomical Observatory; it covered a distance of 1 km and remained in use up to 1838.

The first recorded commercial use of the telegraph was in 1839 by the Great Western Railway in the United Kingdom. The telegraph, based on Schilling's studies, was constructed by Sir Charles Wheatstone and Sir William Fothergill Cooke, and ran for a distance of 21 km (13 miles) from Paddington Station (London) to West Drayton. Other railway lines followed, and by 1845 substantial royalties were paid to these two pioneers, who had patented their telegraph in the United Kingdom in 1837. Cooke and Wheatstone continued to improve their telegraph: in 1846 they formed the Electric Telegraph Company and by 1852 it was estimated that there were in England some 6500 km of telegraph lines. Queen Victoria knighted both Cook and Wheatstone for their achievements.


Samuel Morse, inventor of Morse code

An electrical telegraph was independently developed and patented in the United States in 1837 by the other great pioneer, the American artist Samuel Finley Breeze Morse. Morse's innovation was to use an electromagnet as the operative element in an electrical telegraph. The essence of Morse's idea was to use the passage of an electrical current through an electromagnet to deflect a pen or pencil in such a way that they could mark a strip of paper passing underneath them. Also he devised the famous Morse code signalling alphabet with his partner, Alfred Vail, for use with the apparatus. The first Morse telegraph line was opened on 1 January 1845, between Washington and Baltimore. It is said that the first message sent by Morse over a telegraph line was "What hath God wrought". With these very same words, President Kennedy finished the first telephone conversation over a SYNCOM satellite on 23 August 1963. Morse code is still in use today.

As traffic grew, the inherent defects of the Morse system became more and more obvious. First of all, the strip of paper with its dots and dashes could not simply be passed on to the user, but had to be transcribed into plain, uncoded language. This, of course, meant delay and extra staff. The development of telegraphy therefore moved in the direction of printing out the message in readable text. The first step in the direction of plain language telegraphy came in 1855, when David E. Hughens

A need for news drives use

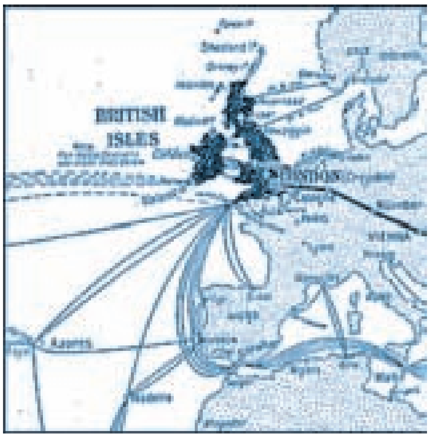
One great contributory factor in the expansion of telegraphic services in United States was the development of telegraphic news service for the New York newspapers, led by the Associated Press. In Europe, newspapers were also among the first and best customers of the telegraph. In 1850, Julius Reuter began his distribution of political, financial and economic news by his Reuter's Telegrams. The collection and distribution of news across Europe had been made easier since the first telegraph line was completed in France in 1845; in Austria, Belgium and Hungary in 1846; in the Italian peninsula in 1847; in Germany in 1849; in Switzerland in 1852; and in Russia in 1853.

A major obstacle: the sea

But there still remained, in 1850, one obstacle, which neither the semaphores of the visual telegraph, nor the new electrical telegraph had yet overcome: the sea. To lay a telegraph cable below the sea meant insulation and, until 1847, when satisfactory machines had been developed by Werner Siemens and others to apply gutta percha (a substance similar to latex) to copper wires for the insulation of underground cables for cities, submarine cables were out of the question. Consequently, many telegraph lines had to terminate at or near to the sea.

The brothers John and Jacob Brett laid, on 28 August 1850, the first submarine cable in the open sea between Cap Gris-Nez in France and Cape Southerland in England. Unfortunately, only a few messages passed because a fisherman took a part of the cable up in his trawl. A second cable, laid the following year, was more successful and remained in operation for many years. Once it had been shown that submarine telegraph cables were possible and economically profitable, there was a veritable rush to install them. In 1860, submarine cables linked many European countries (Wales and Scotland were linked with Ireland, England with Belgium and Denmark, Italy with Corsica and Sardinia, etc.). From 1857, Ceylon (now Sri Lanka) could send telegrams to India over two submarine cables, and in 1859 there was a submarine cable between Tasmania and the Australian mainland. In 1860, a telegraphic cable connection existed between London and the Indian continent.

invented a new telegraph apparatus that would lead many years later to the automatic telegraph printer. Its principle was simple. For sending a message, the operator had a keyboard that relayed electric impulses to the receiving end, that stopping the type-wheel at the right instant of time to give the desired character. A second major improvement came in 1874 from Emile Baudot, who worked for the French Telegraph Service, with the design of telegraph circuits that allowed more than a single message to travel over the same wire at any given time. This was the first example of a time division multiplex system.



Nineteenth century map showing the early telegraph cables that connected Britain with the rest of the world.

The ever increasing demands on telegraph services, in the United States as well as in Europe, led to many important technical improvements of the American telegraph system. One of the most important of these was the sending of more than a single telegraphic message over the same wire in duplex. It was Thomas Alva Edison who, in 1874, advanced this technique. Edison took out patents for duplex circuits and in 1874 he invented the quadruplex circuit. With this technique, it became possible for four messages – two in each direction – to be simultaneously transmitted over a single telegraph wire. This trend of sending more and more messages over the same electrical conductor has continued ever since.

There remained, however, the most important cable yet to be laid, the one to span the Atlantic ocean, a story in which Cyrus W. Field played an important role. Paying out of the cable started on 7 August, 1857, from Valentia on the west coast of Ireland. The project was abandoned many times for various reasons and difficulties. On 5 August 1858, a total of 3240 km had been laid and at 2.45 a.m. of that day the first telegraphic message passed across the Atlantic Ocean. On 14 August, Queen Victoria telegraphed her congratulations to President James Buchanan of the United States. But by one o'clock of 3 September 1858, less than one calendar month after the first message, a fault in the cable brought all communications to a halt. The American Civil War between 1861 and 1865 brought only a temporary halt to Cyrus Field' efforts. New money was raised by the Atlantic Telegraph Company, a three-times heavier cable was spun and the ship the Great Eastern was commissioned to lay 3700 km across the Atlantic. On 23 July 1865, the Great Eastern left again from Valentia. Final success came next year, in 1866, when the Great Eastern succeeded in laying a sound cable grounding in Trinity Bay, Newfoundland. On 27 July of that year, the cable carried its first message.

As in so many other fields in the history of science and technology, electrical telegraphy did not come through the work of a single individual, however great. Nor can a single country claim to have been the sole pioneer of the first of the three great media of telecommunications. The names of pioneers are often forgotten, although their work lives on, and however much telegraphy has been improved, no tribute can be too great to those who showed for the first time that intelligence can be transmitted over the surface of our planet with the maximum possible velocity.

The telephone

Bringing communication to the masses

Walter S. Gifford, then President of the American Telephone and Telegraph Company, paid tribute to the work of ITU in 1929: "Much of the impressive progress that has been made in international telephone communications on the continent of Europe may be attributed to the activities of the International Consultative Committee on Long-Distance Telephone Communications".

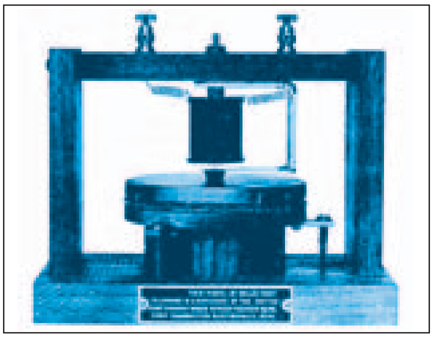
As in the case of the telegraph, communication by the use of the telephone across countries and oceans, would have been impossible without an efficient international organization. In fact, the histories of the telephone and the telegraph have in common another part of history. The English scientist Robert Hooke, who had first outlined ideas for visual telegraphy, is also said to have made the first suggestions of how speech might be transmitted over long distances.

In 1875, when the St Petersburg Conference of the International Telegraph Union drew up its Convention, there were two Americans working on telephonic transmission, independently of and unbeknown to each other. One was Elisha Gray, the other Alexander Graham Bell.

Gray was an inventor and a manufacturer in Chicago. In his telephone he attached a small iron rod to a membrane; the other end of the rod was immersed in a fluid of low electrical conductivity, part of a battery circuit. As sound reached the membrane, it vibrated the rod immersed in the fluid, and a fluctuating current passed down the circuit. On the receiving end, the wires of the circuit passed into the coil of an electromagnet, inside which was another small rod of soft iron, also attached to a membrane. Thus the sound reaching the sending diaphragm was electrically duplicated by the receiving diaphragm.

In 1875 Bell made the discovery that would lead to his invention. One of the iron reeds that Bell was using in his research towards a musical telegraph became stuck to its electromagnet. When Bell told his assistant, Thomas A. Watson, to pluck the sticking reed, Bell found in the adjoining room, that the corresponding reed began to vibrate and produced a sound of the same pitch. From this simple phenomenon, Bell deduced correctly that if a single sound could be transmitted electrically, the same could be done with human speech.

On 14 February, 1876, Gray filed in the United States Patent Office a caveat, a formal notice of his claim to the idea of the new instrument. On the same day, but only a few hours earlier, Bell had applied for a patent for the same type of instrument. In later years there was a great deal of bitter legal dispute about priority,



Model of Bell's first telephone, 1875

but in the end Bell was awarded the patent rights, and he received much credit for his invention. To complicate matters, and despite Bell being widely recognised as the telephone's inventor credit must also be given to Italian, Antonio Meucci. In fact, in June 2002, the United States House of Representatives passed a bill that «expresses the sense of the House of Representatives that the life and achievements of Antonio Meucci should be recognized, and his work in the invention of the telephone should be acknowledged.»

In 1877, the first news dispatch was sent by telephone to the Boston Globe, and this feat inaugurated the public use of the telephone.

In 1880, the first telephone line between Boston and Providence was opened; Boston to New York in 1885; New York to Chicago in 1892; New York to Denver in 1911; and New York to San Francisco in 1915.

The work carried out by Almon B. Strowger from 1889 to 1896 on automatically switched telephone calls is also very important. Strowger's work meant that it was later possible for telecommunication networks to support millions of subscribers. Also, the work of the professor of mathematical physics at Columbia University, Michael Idvorsky Pupin, should be acknowledged for making long-distance telephone cables possible by increasing the transmission efficiency of long telephone circuits.

During the following decades, the network of telephone cables expanded over longer and longer distances, more rapidly in the United States than in Europe. Nevertheless, in 1927, France, for example, had about 1 500 km, Germany 7 400 km, Great Britain 9 600 km and Switzerland about 1 600 km. It was on 7 January 1927 that a public transatlantic telephone service was first opened, using powerful radiotransmissions, with signals originating from Rocky Point, Long Island, and transmitted eastwards to Cupar, Scotland, while signals originating from Rugby, England, were transmitted westwards to Houlton, Maine.

Submarine telephone cables across the Atlantic had to await the design and construction of reliable repeater units, which could be incorporated into the cables to boost the weak telephone signals at regular intervals. To develop these complex electronic amplifiers, and leave them unattended at the bottom of the ocean for 20 years, demanded much research. It is therefore not surprising that the first submarine telephone cable between the United States and Britain was not laid until 1956.

Early wireless communication

Wireless telegraphy: The dawn of radiocommunications

To Faraday, James Clerk Maxwell and Hertz Heinrich, along with other scientists in the early 1800s, it was clear that wireless communication was possible, and many people worked on developing devices and improvements. In 1832, Scotsman James Bowman Lindsay gave a classroom demonstration of wireless telegraphy to his students. By 1854 he was able to demonstrate transmission across the Firth of Tay from Dundee to Woodhaven, a distance of two miles.

The theory of electromagnetic radiation was developed by Maxwell and published in 1865. Electromagnetic radiation does not require a material medium and can travel through a vacuum. Maxwell showed that the speed of propagation of electromagnetic radiation is identical to that of light, about 300 000 km per second. Subsequent experiments by Hertz verified Maxwell's prediction through the discovery of radio waves, also known as hertzian waves. Basically, this term refers to different types of electromagnetic radiation including light and radio waves, and their use as a form of communication without a material medium. This covers many media and modern technologies including radio, telegraphy, television, telephone, data communication and computer networking, although other types of signalling are also included.

Patents for wireless telegraphy devices started appearing in the 1860s but it was not until 1893 that Nikola Tesla made the first public demonstration of such a system. Addressing the Franklin Institute in Philadelphia and the National Electric Light Association, he described and demonstrated in detail the principles of wireless telegraphy. The apparatus that he used contained all the elements that were incorporated into radio systems before the development of the vacuum tube.

A later system, using several patents of Tesla's, and that achieved widespread use, was demonstrated by Guglielmo Marconi in 1896. Marconi and Braun shared the 1909 Nobel Prize in physics for «contributions to the development of wireless telegraphy».

A few decades later, the term radio became more popular. Early radio could not transfer sounds other than Morse code in the tones made by rotary spark gaps. A simple rotary spark gap consists of a pair of fixed electrodes and a pair of «flying» electrodes mounted on a spinning disc. If the disc is turned at a constant angular velocity by a motor, then the electrodes will align periodically. Every time an alignment occurs, the spark gap can fire if there is sufficient voltage to cause breakdown of the air gaps. Canadian-American scientist Reginald Aubrey Fessenden was the first to wirelessly transmit a human voice (his own) in 1900.

After the public demonstrations of radiocommunication that Tesla made in 1893, the principle of radiocommunication – sending signals through space to receivers – was publicized widely. The Tesla apparatus contained all the elements of radio systems used before the development of the vacuum tube.

On 19 August 1894, British physicist Sir Oliver Lodge demonstrated the reception of Morse code signalling using radio waves by means of a detecting device called a coherer, a tube filled with iron filings which had been invented by Temistocle Calzecchi-Onesti at Fermo, Italy, 1884.

The first benefit to come from radio telegraphy was the ability to establish communication between coastal radio stations and ships at sea. Wireless telegraphy using spark gap transmitters quickly became universal on large ships after the sinking of the Titanic in 1912. The International Convention for the Safety of Life at Sea was convened in 1913 and produced a treaty requiring shipboard radio stations to be manned 24 hours a day.

International cooperation Begins

The road to ITU

Once it had proved its success, Chappe's visual telegraph was widely imitated in all developed countries. But whenever a line reached a national frontier, there it ceased. This was as much due to the different systems employed, each having its own code vocabulary, as to the obvious secrecy of all military and political messages that were sent by the telegraph.

Heads of delegation attending the first Conference of the International Telegraph Union in Paris, 1865

Real international collaboration only began when electrical telegraphy became an important instrument of communication. Again, as in the case of the visual telegraph, at first there were only national networks, following closely the established railway lines. But then, railways did not stop at the frontiers, and information about them had to cross them like the passengers. At first, this was not easy.

The first treaty on record designed to link the telegraph systems of two States was signed on 3 October 1849, between Prussia and Austria. It provided for the connection of Berlin to Vienna by an electric telegraph line running along the then existing railway. This treaty was the first action of two independent States, regulating telegraphic communications between them, fixing priorities and settling the rates to be paid. From now on, it was not only up to the scientist and the engineer to improve the electrical means of communications, but also for the civil servant and the administrator to smooth their path from country to country, from continent to continent, and later right round the world.

The agreement between Prussia and Austria was soon followed by other similar agreements and in 1850 in Dresden, four countries – Austria, Bavaria, Prussia and Saxony-created the Austro-German Telegraph Union, which remained in existence until 1872. It worked well, other German states adhered to it and, in 1852, the Netherlands joined. Morse telegraph apparatus was recognized as official for all international lines. Tariff zones were established and the cost of international telegrams calculated according to distance. More than a hundred fifty years later, many agreements of this Union are still in place.

The success of the Austro-German Telegraph Union led to imitation by other countries. Delegates from France, Belgium, Switzerland, Sardinia and Spain met in Paris in 1855 and created their own West European Telegraph Union. However, the flow of telegrams from country to country was impeded by different sets of regulations.

It was the French Imperial Government that sent out invitations to all the major countries in Europe to attend a conference beginning in Paris on 1 March 1865, to negotiate a uniform international telegraph system.

The birth of ITU

A new spirit of cooperation

Following the early development in telecommunication in the 19th century and the continuing rapid expansion of telegraph networks in a growing number of countries, 20 European States met to develop a framework agreement covering international interconnection. At the same time, the group decided on common rules to standardize equipment to facilitate international interconnection, adopted uniform operating instructions which would apply to all countries, and laid down common international tariff and accounting rules.

On 17 May 1865, after two and a half months of arduous negotiation, the first International Telegraph Convention was signed in Paris by 20 founding members, and the International Telegraph Union (ITU) was established to facilitate subsequent amendments to this initial agreement. Today, some 140 years later, and after a scientific evolution which would have dumbfounded delegates to the Paris meeting in 1865, the reasons which led to the establishment of ITU still apply, and the fundamental objectives of the organization remain basically unchanged.

A new industry evolves

At the time of the Paris meeting, the Morse telegraph system was the universally–preferred telegraph platform and this was recognised in the telegraph regulations drawn up by the Conference. They recommended that the Morse instrument adopted for use on international lines. It had become evident that the international telegraph service was of such political and economic importance that each member country would do its utmost to improve its own technical facilities. It was also thought that too strict a control might hinder scientific progress.

The second plenipotentiary conference of the Union took place in Vienna, in 1868. The major achievement of the Vienna Conference, apart from admitting Persia and India, was the setting up of the permanent Bureau, charged with the routine administrative work of the Union. The Bureau acted as a secretariat and had very limited power to exercise any authority. It was located in Berne, Switzerland, until 1948, when it moved to its current home of Geneva.

The third plenipotentiary conference took place in Rome in 1871. There, Great Britain became a Member, having nationalised its telegraph services and thus qualifying for membership. For the first time, Japan sent an observer. The Rome conference also allowed private telegraph companies to be represented at all meetings of the Union, with the right of discussion but without the right to vote.

The major achievement of the St. Petersburg conference of 1875 was the re-drafting of the International Telegraph Convention. It consisted of 21 articles, organized in four major groups: the relations of the contracting parties to the users of international telegraphy, the relations of the Members of the Union to each other, the composition of the Union itself, and the way in which the Convention and the telegraph regulations were to be applied. So successful was the final revision of the Convention at St. Petersburg in 1875 that they did not meet again until 1932, in Madrid.

Following the patenting of the telephone in 1876 and the subsequent expansion of telephony the International Telegraph Union began, in 1885, to draw up international legislation governing telephony. With the invention in 1896 of wireless telegraphy — the first type of radiocommunication — and the utilization of this new technique for maritime and other purposes, a decision was made to convene a preliminary radio conference in 1903 to study the question of international regulations for radiotelegraph communications. The first International Radiotelegraph Conference held in 1906 in Berlin signed the first International Radiotelegraph Convention, and the annex to this Convention contained the first regulations governing wireless telegraphy. These regulations, which have since been expanded and revised by numerous radio conferences, are now known as the Radio Regulations.

By 1908 the membership of the Union had risen to 52 countries and 25 private companies. While World War I lasted, international telegraphy was subject to the complete control of each national Government. After the war, there were two further administrative conferences, in Paris in 1925 and in Brussels in 1928. The re-arrangement of national frontiers after 1918 also affected the Union and, as a consequence, its membership grew to 78 by 1932.

In 1927, the International Radio Consultative Committee (CCIR) was established at a conference held in Washington D.C. The International Telephone Consultative Committee (CCIF, set up in 1924), the International Telegraph Consultative Committee (CCIT, set up in 1925), and the CCIR were made responsible for coordinating the technical studies, tests and measurements being carried out in the various fields of telecommunications, as well as for drawing up international standards.

At the 1932 Madrid conference, the Union decided to combine the International Telegraph Convention of 1865 and the International Radiotelegraph Convention of 1906 to form the International Telecommunication Convention. It was also decided to change the name of the Union to International Telecommunication Union. The new name, which came into effect on 1 January 1934, was chosen to properly reflect the full scope of the Union's responsibilities, which by this time covered all forms of wireline and wireless communication.

A Modern Approach
In 1947, after the Second World War, ITU held a conference in Atlantic City with the aim of developing and modernizing the organization. Under an agreement with the newly created United Nations, it became a UN specialized agency on 15 October 1947, and the headquarters of the organization were transferred in 1948 from Bern to Geneva. At the same time, the International Frequency Registration Board (IFRB) was established to coordinate the increasingly complicated task of managing the radio-frequency spectrum; the same year, the Table of Frequency Allocations, introduced in 1912, was declared mandatory.

CCITT/ITU-T Decade by Decade

1956-1965

By the middle of the 20th century, telephone and telegraph services around the world found that, like many other branches of technology, scientific progress brought not only more efficient installations, but also much greater complexity. Two consultative committees were created by the ITU's 1925 Paris conference to deal with the complexities of the international telephone services (CCIF) and long-distance telegraphy (CCIT).

Between 1959 and 1965, the ITU membership increased from 96 to 129.

Highlights 56-65

1956 – CCIF and CCIT merged into CCITT. The ITU Council accepts a proposal from the Canton of Geneva to construct a permanent home for the ITU.

TAT-1 (Transatlantic No. 1) the first submarine transatlantic telephone cable system.

1957 – Launch of Sputnik-1, the Earth's first artificial satellite

1958 – CCITT Plenary Special Assembly: Recommendations relating to telegraph operational and tariff matters, transmission rules, the gentex service, terminal charges in the European system and phototelegraphy, telephone operating and tariff problems, procedures for the international telephone service and rates for automatic calls, for which special services are provided.

1960 – TASI system introduced in TAT-1. First communication achieved between USA, UK and France using the non-geostationary satellite Echo 1.

1960's – The Improved Mobile Telephone System (IMTS), precursor of today's mobile telephony systems is developed with simultaneous transmit and receive, more channels, and greater power.

1960's – AT&T introduced a 2 400-bps modem.

1960 – First example of formal cooperation with an external body: Resolution No. 8: Co-operation with IEC in the standardization of cables, wires and waveguides.

1962 – The new building of ITU head-quarters is officially inaugurated in Geneva, in the presence of the Secretary-General of the UN.

1962 – The communication satellite, Telstar, is launched into orbit.

1963 – The American Standard Code for Information Exchange (ASCII) developed for encoding alpha-numeric and control characters into 7-bit binary strings.

1964 – Approval of Recommendations E.160: Definitions relating to national and international numbering plans and E.171: The international routing plan.

Telephony and telegraphy were by now using the same transmission channels: overhead wires, underground cables, underwater cables and radio circuits. In view of the basic similarity of many of the technical problems faced by the CCIF and CCIT, the decision taken in 1956 to merge them wasn't surprising: they became the single International Telegraph and Telephone Consultative Committee (CCITT, as in the French version).

In the 1958 special Plenary Assembly meeting, many new Recommendations relating to telegraph operational and tariff matters were approved. These referred to: transmission rules, transmission of telegrams in the international service;

the gentex service (gentex describes a network made up of telegraph offices, switching centres and telegraph channels, interconnecting the offices to switching centres and the switching centres to each other); determination of terminal rates in the European system (the cost of routing a telegram in the European system was determined at 11.6 to 15 gold centimes per word); and rules for phototelegraph communication established over circuits normally used for telephone traffic (phototelegraphy is telegraphy by means of light, as by the heliograph or the photophone).

In 1960, the CCITT had its Second Plenary Assembly in New Delhi, India. This was the first Assembly to be held outside of Europe, showing the worldwide increase of interest in telecommunication. During this meeting, the first example of formal cooperation with an external body was approved in Resolution No.8: Cooperation with I.E.C. in the standardization of cables, wires and waveguides. The CCITT recognised that it was important to keep an efficient liaison with the IEC's Technical Committee (T.C. 46) dealing with international recommendations on cables, wires, waveguides and accessories for use in telecommunication equipment and systems using similar techniques.

Between 1960 and 1964, the CCITT embarked on research into all aspects of inter-continental connections by submarine cable and evolved numbering and routing plans with an eye to the advent of worldwide automatic telephony and telex. This led to Recommendations such as E.29, Numbering for international work. International telephone numbering plan defined by ITU-T have governed the country codes, area codes and local numbering ever since.

A telephone numbering plan is a system that allows subscribers to make and receive telephone calls across long distances. The area code is that part of the telephone number that specifies a telephone exchange system. Telephone numbering plans assign area codes to exchanges, so that dialers may contact telephones outside their local system. Occurring at the beginning of the number, area codes usually indicate geographical areas. Together, numbering plans and their component area codes direct telephone calls to particular regions on a public switched telephone network (PSTN), where they are further routed by the local network.

1966-1975

During this period, the work of the CCITT began to gain worldwide applicability, as more nations started to participate in its work and as its studies and Recommendations achieved greater universality.

The then new Varembé ITU Headquarters Building. September 1968.

In 1968, the Fourth CCITT Plenary Assembly took place in Mar del Plata, Argentina. A key conclusion of this meeting was the approval of the final reports regarding the world telephone network, transmission systems and automatic telephone networks. A proposition submitted by the Dutch administration was approved, relating to the use of a single unit of transmission for the interchange of international traffic.

A demonstration to all delegates in Mar del Plata of the transmission of data over a long distance took place for the first time.

Also during this meeting, the first international standards for fax machines were approved. The first users of fax were newspapers transmitting and receiving

Highlights 66-75

1968 – The Defense Advanced Research Projects Agency (DARPA) the United States started developing of the ARPA-NET, a forerunner to the modern Internet.

1968 – The first international standards for fax machines CCITT T-series Recommendations

1968 – CCITT develops the X.21 Interface between data terminal equipment and data circuit-terminating equipment for synchronous operation on public data network published.

1960s – Late in the decade, modems appear with speeds up to 9 600 bps.

1970 – First low-loss optical fibre announced having an attenuation of 20 dB/km.

1975 – Bill Gates and Paul Allen develop a BASIC program for the Altair 8800. They form a company initially called Micro Soft; the company's name is later changed to Microsoft.

photos from around the world. Other early adopters were meteorological services worldwide. This global use of fax would have been impossible without international standards.

Although suitable telephone coupling devices were available from the 1930s, it was not until the 1960s that relatively cheap fax machines were available for connection to the PSTN. These new machines were first known as document facsimile machines and were used for transmitting handwritten, typed or printed text and drawings. A contributory factor to the late development of a simple dial-up facsimile unit was the relatively late stage at which solid state techniques were introduced to the facsimile system.

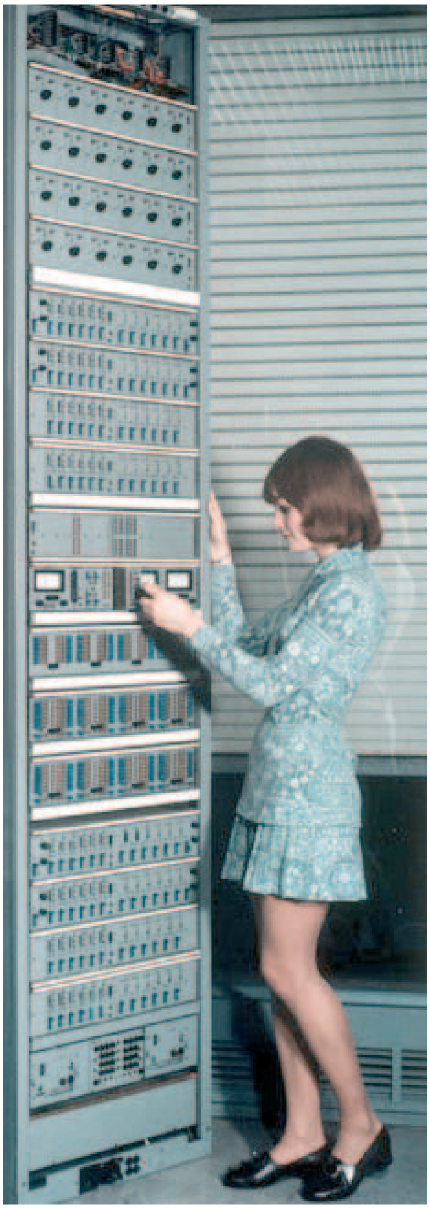
In Europe fax use lagged behind the USA and Japan, but early growth followed agreed standards on machine design. The introduction of ITU's Group I standards in 1968 was a significant step in the development of fax, despite slow and unreliable terminals and lack of full compatibility. It took six minutes to transmit an A4 page, but the machine stimulated interest in the concept of sending text and graphic material by telephone around the world instead of heavily relying on the postal service.

CCITT's Fifth Assembly (Geneva, 4-15 December 1972) adopted, among other Recommendations, those on Group 2 faxes. Group 2 faxes took three minutes to transmit a single page, with a vertical resolution of 100 scan lines per inch.

In 1968, Signalling System No.6 (SS No. 6) specification was completed and introduced on international circuits. In the process of setting-up and clearing of calls, automatic telephone exchanges must necessarily be able to communicate with one another. Basically, the called number must be sent forward to succeeding exchanges, while call status information must go to preceding exchanges and, in the case of international communications, signalling needs to comply to agreed international standards. The CCITT recognised a number of signalling systems as suitable for international use. Signalling had developed along with communications technology, but by the 1960s it was generally recognised that it was necessary to develop the next generation. SS No.6 used a separate telephone channel as a signalling link for the transfer of all information and control signals between exchanges, for up to 2048 speech circuits. The speech circuits connecting these exchanges did not possess individual signalling means and all messages carried via the common signalling link had to contain identification of the speech circuit to which the message pertained.

Also in 1968, a key standard for data in circuit switched networks was approved. Recommendation X.21 is a set of CCITT specifications for an interface between data terminal equipment (DTE) and data communications equipment (DCE) for synchronous operation on public data networks.

A precursor to the mobile telephony systems of today was the Improved Mobile Telephone Service (IMTS). Known by some as 0G (as opposed to 3G), the pre-cellular VHF/UHF radio system linked to the PSTN. IMTS was the radiotelephone equivalent of land dial phone service. It was introduced in 1969 as a replacement to the Mobile Telephone Service or MTS and improved on most MTS systems by offering direct-dial rather than connections through an operator.



1976-1986

This decade saw a growing collaboration with other international organizations (notably the International Organization for Standardization, ISO) and an increase in the CCITT activities in the field of technical assistance to developing countries.

In 1984, the CCITT Assembly Resolution 7 became the cornerstone of the collaboration with ISO and IEC. Recognizing the convergence of data and its effect on the connection of data and text processing equipment to public telecommunication networks, and aware of the increasing common interests of ISO, IEC and CCITT in these developments, this Resolution provided guidelines to the CCITT on the manner in which it should pursue liaison and collaboration with ISO and IEC.

Also during this period, a veritable technical revolution took place in telecommunications. There was a massive change over to digital techniques and the formerly quite separate domains of computers and communications became inextricably bound together. Long-distance transmission capacity was not only multiplied by high-capacity submarine cables and satellites but was also made much less costly.

This technical revolution had an overwhelming influence on the services provided. A variety of new services were offered to the public and even traditional services were upgraded using new techniques that improved quality. The new techniques also engendered considerable changes in the economics of service provision; the cost of services was no longer as distance dependent as before and this, in turn, led to pressure to bring tariffs more in line with real costs.

Most of these changes could not have been adequately harnessed for practical application and use without the invaluable work of international standardization.

Highlights 76-86

- 1976 – Introduction of X.25, landmark achievement in packet-switched technology
- 1978 – X.25 provides the first international and commercial packet switching network, the International Packet Switched Service (IPSS).
- 1980 – The Seventh CCITT Plenary Assembly took place in Geneva. CCITT completely revamped its study group structure and programme around the Integrated Service Digital Network (ISDN) concept.
- 1981 – Signalling System No. 7 (SS7) paved the way for efficient operation of international networks
- 1984 – Introduction of H.120 codecs for videoconferencing
- 1984 – ASN.1 the widely used notation system
- 1984 – X-series Recommendations on data networks, open systems communications and security jointly-developed with ISO

In the late 70s and the early 80s, in addition to many refinements in traditional services, new non-voice services were standardized. There was also important progress in public switched data networks, new specifications on digital techniques, programming languages and digital networks. One of the most important issues was the move away from the demarcation between the traditional specialized services (telex, telephone, data, etc.) to an integrated services digital network (ISDN). The ISDN was considered the pointer to the future, the advent of which would have a profound effect on telecommunication networks.

ISDN was the international communications standard for allowing voice and data to be transmitted simultaneously across the world, using end-to-end digital connectivity. ISDN supports data-transfer rates of 64 Kbps (64 000 bits per second). Work on this first fully digital, circuit-switched telephone system started in 1984. A family of Recommendations (I-Series) was developed, which provided principles and guidelines on the ISDN concept as well as detailed specifications of the user-network and internetwork interfaces.

A further CCITT standard was agreed in 1980 for Group 3 fax machines, which used digital transmission techniques and took less than one minute per page, with an improved scanning resolution of 200 lines per inch. All were compatible and could communicate with most Group 2 machines, regardless of supplier. By this time, faxes were commonplace in offices of all sizes. They provided an inexpensive, fast, and reliable method for transmitting correspondence, contracts, résumés, handwritten notes, and illustrations.

Recommendation X.25, the highly influential ITU-T standard protocol suite for wide area networks (WAN), was approved during this period. Emerging in the 1980s, it was the first packet-switched network technology and had large coverage throughout the world in the eighties and nineties before being largely supplanted by newer technologies such as frame relay, ISDN, ATM, ADSL, packet over SDH, and the Internet Protocol (IP). The X.25 protocol was developed in the CCITT Study Group VII based on a number of emerging data network projects, such as the research project at the UK's National Physical Laboratory and the

US Government's Defense Advanced Research Projects Agency's (DARPA) research.

X.25 is an ITU-T standard protocol suite for WAN networks using the phone or ISDN system as the networking hardware. It defines standard physical layer, data-link layer and network layers (layers 1 through 3) of the OSI model. The packet-switching network was the common name given to the international collection of X.25 providers, typically the various national telephone companies. Their combined network had large global coverage during the 1980s and into the '90s.

The development of Signalling System 7 (SS7) protocols started around 1975 with the standard approved by ITU-T in 1981 in ITU-T's Q.7XX-series Recommendations. Without SS7, telecom systems worldwide would not interoperate. All telephone switching systems need signalling. It provides the means for monitoring the status of a line to see if it is busy or idle, alerts that indicate

the arrival of a call, and the addressing system that routes calls. Before SS7's implementation, not all nations were parties to standards agreements, which would facilitate the handling of international telephone calls. SS7's implementation paved the way for an efficiently operating international telecommunication networks.

SS7 was designed to replace Signalling Systems 5, 6 and R2, all of which were once in widespread international use. SS7 moved to a system in which the signalling information was out-of-band, carried in a separate signalling channel. This avoided the security problems earlier systems had, as the end user had no connection to these channels. SS7 is also important in linking VoIP traffic to the PSTN network.

SS7 provides a universal structure for telephony network signalling, messaging and interfacing, as well as network maintenance. It deals with establishing calls, exchanging user information, call routing and different billing structures, and supports intelligent network (IN) services.

In order to move some non-time critical functionality out of the main signalling path, and for future flexibility, the concept of a separate 'service plane' was introduced by the IN concept. The initial, and perhaps the most important use of IN technology was for number translation services, e.g. when translating toll free numbers to regular PSTN numbers. But much more complex services have since been built on IN, such as custom local-area signalling services (CLASS) and prepaid telephone calls.

Abstract Syntax Notation One (ASN.1) is an example of the collaboration between ISO, IEC and CCITT.

ASN.1 is a formal language or notation that describes data structures for representing, encoding, transmitting, and decoding data. It provides a set of formal rules for describing the structure of objects that are independent of machine-specific encoding techniques and is a precise, formal notation that removes ambiguities. ASN.1 is an extremely important part of today's networks. ASN.1 is used, for example, in the signalling system (SS7) for most telephone calls, package tracking, credit card verification and digital certificates, as well as in many of the most used software programs.

In telecommunications and computer networking, ASN.1 is a standard and flexible notation that describes data structures for representing, encoding, transmitting, and decoding data. It provides a set of formal rules for describing the structure of objects that are independent of machine-specific encoding techniques and is a precise, formal notation that removes ambiguities.

One may use an ASN compiler that takes as input an ASN.1 specification and generates computer code (for example in the C programming language) for an equivalent representation of the data structures. This computer code, together with supplied run-time libraries, can then convert encoded data structures to and from the computer language representation. Alternatively, one can manually write encoding and decoding routines.

1986-1995

ITU News Vol. 60-III/1993 From Melbourne to Helsinki described the period thus: "The rapid evolution of telecommunication technologies and a dynamic, changing environment characterized by buzz-words like liberalization, privatization, competition, globalization and regionalization (to name just a few) are the forces shaping today's standardization. Only an organization which is flexible and adapts itself continuously to these determining forces will survive."

By the mid-eighties, many carrier backbone networks and telephone exchanges were entirely digital. Experts say this change would have occurred even without data transmission, because digital systems were and are more reliable, flexible and cost-effective than analogue systems.

In 1986, the ITU CCITT Study Group VIII and the ISO/TC97/SC2/WG8 group formed the Joint Photographic Expert Group (JPEG). The most famous product of JPEG was ITU-T Recommen-

Highlights 86-95

1986 – The Joint Photographic Expert Group (JPEG) founded by ITU, ISO and IEC

1988 – Telecommunications management network (TMN)

1988 – E.212 describes a system to identify mobile devices as they move from network to network

1988 – The most used speech coding standards for the PSTN G.711 and the G.72x series developed

1989 – Introduction of SDH key standard for digital information over optical fibre

1990 – Introduction of Recommendation H.261 (p x 64) video coding

1992 – Bell Labs demonstrates 5 Gbit/s transmission of optical solutions over 15 000 km, and 10 Gbit/s over 11 000 km. One-millionth host connected to the internet

1993 – The first DSL standard consented.

1988 – Work began on a set of procedures to allow for common texts between CCITT and ISO/IEC JTC 1.

1980s – Local Area Networks (LANs) emerge as an effective way to transfer data between a group of local computers.

1980s – Telcos around the world start to replace analog with digital multiplexing.

dation T.81 ISO/IEC 10918-1, which specifies a process for digital compression and coding of continuous-tone still images, and is more commonly known by the name of the group, JPEG. This is the most used format for storing and transmitting photographs on the Internet, in digital photography and in many other image compression applications, and it was approved in 1992 first by ITU-T (then CCITT) and later by ISO/IEC.

A key reference for security standards in use today, Recommendation X.509 was published in 1988. It provides electronic authentication over public networks, is a cornerstone for designing applications related to public key infrastructure (PKI), and is widely used in a wide range of applications from securing the connection between a browser and a server on the web to providing digital signatures that enable e-commerce transactions to be conducted with the same confidence as in a traditional system. PKI is an arrangement that provides for third-party vetting of, and vouching for, user identities. It also allows binding of public keys to users. This is usually carried out by software at a central location, together with other coordinated software at distributed locations. Without wide acceptance of X.509, the rise of e-business would have been impossible.

Also in 1988, Recommendation E.212 was developed and describes a system to identify mobile devices as they move from network to network. International mobile subscriber identity (IMSI) is a critical part of the modern mobile telecoms system, allowing a roaming mobile terminal to be identified in another network and the subsequent querying of the home network for subscription and billing information to take place.

1989 saw the beginning of an important collaborative initiative with ISO/IEC with the development of procedures for the recognition of common texts between the organizations. It was in 1992 that the first texts were published under this agreement.

In 1989, CCITT approved and published standards (ITU-T Recommendations G.707, G.708, G.709) for communicating digital information over optical fibre. The standards for Synchronous Digital Hierarchy (SDH) were developed to replace the Plesiochronous Digital Hierarchy (PDH) system for transporting large amounts of telephone and data traffic and to allow for interoperability between equipment from different vendors.

Standards for synchronous data transmission over fibre optic networks are employed in a significant portion of the world's telecommunication backbone. The use of synchronous digital transmission by carriers in their backbone fibre-optic and radio networks put in place the enabling technology for many of the new broadband data services that we take for granted. It not only brought about high-speed gigabit networks but also simplified access, bringing the full benefits of software control in the form of flexibility and introduction of network management.

In Melbourne, Australia, 1989 for the IXth Plenary Assembly of CCITT there was agreement on the latest International Telecommunication Regulations (ITR). ITRs previously known as International Telegraph and International Telex Regulations provide the base rules for the operation of international telecommunication. The purpose ITRs is to promote the development of telecommunication services and their most efficient operation while harmonizing the development of facilities for worldwide telecommunications. They were important in the determination of international accounting rates and defined procedures on how to agree the level of these rates as well as how to settle accounts and in what form to provide this detail. They also discussed among other things the suspension of services, what to do in situations where your network impacted another country's and also the secrecy of communications. For Members of the Union, they represent an international treaty and are Law.

The adoption of Recommendation D.1, published in 1991 was a key factor in the growth of the Internet. D.1 obligated telecommunication operators to provide leased lines and allow their connection to the Internet. This meant that for example it would now be possible for Internet Service Providers to take leased lines from a telecoms operator and route internet traffic from all of their customers via this circuit. Leased lines continue to be central to the development of e-business, e-government and e-health and are needed to build corporate networks and as access circuits for Frame relay, ATM, IP-VPNs and the Internet. Users need physically diverse access circuits with robust service level agreements (SLAs) from multiple carriers to ensure business continuity and Rec. D.1 was key to allowing this situation to develop.

In 1992, the 'additional' Plenipotentiary Conference saw a dramatic remodeling of ITU, giving the Union greater flexibility to adapt to an increasingly complex, interactive and competitive environment. It was at this time that CCITT was renamed ITU-T.

The year 1993 saw the first standardization of digital subscriber line (DSL) technology. ADSL, as defined in ITU-T G.992-Series of Recommendations, used something called the discrete multitone technique (DMT) to allow a greater variety of services to be provided over traditional copper-based telephony networks.

DSL meant that copper cable owned by many incumbent telcos around the world was given an extended lease of life, bringing higher bandwidth to small businesses and residential customers. DSL is still the number-one choice for broadband technology. The distinguishing characteristic of ADSL, the first flavour of DSL, is that the volume of data flow is greater in one direction than the other, i.e., it is asymmetric.

The year 1996 saw the adoption of the first international standard for universal international freephone numbers (UIFN). A UIFN means that a marketer can use the same number throughout the world, allowing customers to make free calls, while the called party picks-up the bill. There are currently over 29 000 UIFNs in service.

The Telecommunication Standardization Bureau of the ITU acts as Registrar for UIFNs, in accordance with ITU-T (new) Recommendation E.169 and (revised) Recommendation E.152, International Freephone Service.

A UIFN is composed of a three-digit country code (ITU-T Recommendation E.164 on country codes) for a global service application, 800 and an eight-digit Global Subscriber Number (GSN), resulting in an 11-digit fixed format.

The nineties also saw the emergence of the first ITU-T Recommendations on ATM. Short for Asynchronous Transfer Mode, ATM is a network transport technology based on transferring data in cells (fixed size packets) and applicable from low to high data rate (sub-2Mbs to 640 Mbps) capability. It is a key broadband enabler, and has widespread deployment. Many ADSL implementations use ATM as a layer technology, particularly in the traffic aggregation network. It is a technology that offers flexible high bandwidths (hundreds Mbps), and performance measurement and Quality of Service (QoS) features, useful for point to point and multipoint applications.

Highlights 96-06

1996 – Adoption of UIFN (universal international freephone numbers)

1996 – H.323 Key facilitator for videoconferencing, VoIP

1999 – J.117 Key CableTV standard

1990s – V.90 56-Kbp/s modems speed-up Internet connections

1997 – New international telephone numbering plan – E.164.

1998 – Harmonization of interconnection rates

2000 – Introduction of bearer independent call control

2002 – ITU-T Recommendation H.264 revolutionises videocoding

2003 – Introduction of Recommendation H.350.

2004 – NGN Focus Group formed to smooth transition from PSTN to packet-based networks

2006 – VDSL 2 further extends the use of legacy copper cabling

2006 – Work begins on RFID, IPTV Focus Group formed

1996-2006

Characterising the period, the ITU 1999-2003 Strategic Plan states: "The global market for telecommunications is expanding rapidly. It is not a question of "demand pull" or "supply push". Both are happening. The interaction of these two forces has made telecommunications one of the leading growth sectors in the world economy. It has also made telecommunications one of the most important components of social, cultural and political activity.

On the demand side, growth is pulled by an increasing reliance on telecommunications and information technology in every area of human life: in government, in the provision of public services, and in the management of public infrastructures; in the pursuit of knowledge and the expression of culture; in the control of the environment; and in response to emergencies, whether natural or man-made.

On the supply side, growth is pushed by rapid technological developments which continuously improve the efficiency of existing products, systems and services, and provide the foundation for a continuing stream of innovations in each of these areas. Particularly noteworthy is the convergence of telecommunication, information, broadcasting and publishing technologies, which has greatly enriched the communication choices available to consumers."

The 2004-2007 mission plan notes that the telecommunication environment' can be specifically characterized in the telecommunication Standardization Sector by the ongoing transformation of telecommunication activities from being regulatory-driven, into a service and demand-driven sphere, and thus into a globally competitive business; growth in the fixed-line network which continues at a steady rate while mobile networks grow at a faster rate; continued growth of electronic commerce; voice communications over IP-based networks."

In 1996, the second World Telecommunication Standardization Conference (WTSC-96) that convened in Geneva took some important decisions and set new directions for the future work of ITU's Standardization Sector (ITU-T). The eight-day conference (9 18 October 1996) was chaired by Mr Hans Karl Pfyffer, Senior Counsellor to the Director General of Swiss Telecom PTT.

A press release following the event said: "As markets globalize and the use of multimedia services becomes more widespread, the importance of agreed common standards can only become more vital to all telecommunication operators, manufacturers and users. One momentous decision has been the creation, by the Conference, of the new Study Group 16 to deal with multimedia services and systems. This is clear indication that the distinction between three currently separate industries – telecommunications, computing and audiovisual entertainment, is rapidly blurring. The growing convergence of these industries, which will usher in the information age, is bringing with it not just challenges but opportunities as well."

Cybersecurity

In this period, cybersecurity became a real cause for concern and standardization was recognized as providing a solid way of coordinating resources to fight cybersecurity threats. ITU-T provides an international platform for the development of the protocols that will protect current and next- generation networks. All 13 ITU-T study groups developed security-related questions, and regular security workshops were held that led to better coordination between other standards-development organizations. There are over 70 ITU-T Recommendations focusing on security. ITU-T's work on security covers a wide area, including studies into: security from network attacks, theft or denial of service, theft of identity, eavesdropping, telebiometrics for authentication, security for emergency telecommunications and telecommunication networks security requirements.

In addition to a workshop on cybersecurity organized on the eve of 2004's World Telecommunication Standardization Assembly (WTSA), a Resolution was adopted on the subject. The Resolution tasks ITU-T to evaluate its Recommendations, especially in the area of signalling and communication protocols, in order to ensure their robustness and prevent exploitation by malicious parties. It also asks that ITU-T continue to raise awareness of the need to defend information and communication systems against the threat of cyber attack, and continue to promote cooperation among appropriate entities in order to enhance the exchange of technical information in the field of information and communication network security.

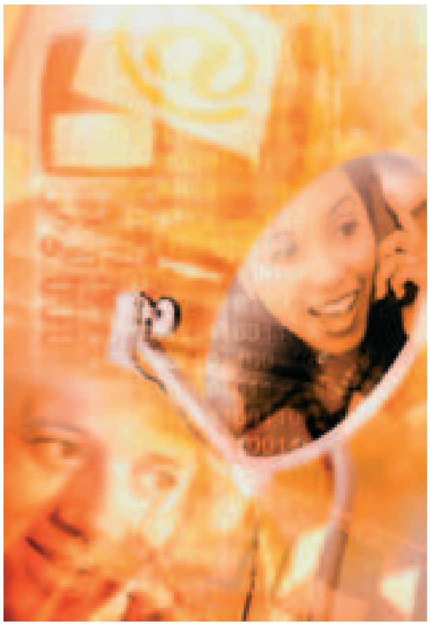
Modern working methods

One of ITU T's most important priorities of the last decade has been to modernize its working methods. This involved huge investments in electronic facilities and electronic working methods, which allowed a response to a significant current-day market need: to speed-up the standards approval process. In today's fast-moving world, speed to market is key to success. ITU T has acknowledged this with an initiative to by-pass much of the bureaucracy previously involved in the development of standards. The Alternative Approval Process (AAP) was developed by ITU T, in response to members' demands, as a fast-track approval procedure for technical standards. The introduction of AAP also formalizes the private sector's role in the approval process by providing them with opportunities equal to those of Member States to influence the approval of technical standards.

AAP is designed to make sure that standards reach Recommendation-stage as quickly as possible, while maintaining the highest degree of transparency. However, AAP is not just about saving ITU T study group members' time. With these standards in place, network operators will have the confidence to roll out next-generation services quickly and efficiently.

Besides redefining many of the procedures involved in the approval process, the key to the success of AAP is the automation of much of the approval process. Under the new process, once a meeting considers that a draft Recommendation is ready for approval, it is posted on the ITU T website. In the majority of cases, the rest of the process can then be completed electronically with no further physical meetings.

This dramatic overhaul of standard-making by streamlining approval procedures was implemented in 2001 and is estimated to have cut the time involved in this critical aspect of the standardization process by 80 to 90 per cent. This means that an average standard – which took around four years to approve and publish until the mid-



nineties, and two years until 1997 – can now be approved in an average of two months, or as little as five weeks. At present, more than 3 100 ITU-T Recommendations are in force and around 210 new and updated Recommendations are produced each year, that is, nearly one for every working day.

Workshops

Following the success of an initiative in 2001, workshops have become an important part of ITU-T activity. These events are aimed at increasing the awareness of ITU T activities worldwide and are coordinated with the ITU regional offices. Meetings held outside Geneva also provide an opportunity for local experts to get to know ITU-T and allow ITU T experts to benefit from regional feedback. These events serve as an introduction to new standardization issues and to coordinate the work between sectors of ITU and other interested bodies. Attendance at these events is free and is normally open to both members and non-members, and the presentations made are freely available on the ITU T website. The workshops have already covered a wide spectrum of topics, including ENUM, IPv6, Multimedia Convergence, NGN and cyber-security.

Bridging the standardization gap

At the ITU 2002 Plenipotentiary Conference, held in Marrakesh, Morocco, ITU-T was asked to help address the standardization gap between developing and developed countries (Resolution COM 5/8). It was the first time that a stand-alone Resolution addressed this issue. This is an area of great importance: developing nations form a key part of the membership of ITU, and ITU-T has already devoted much energy to addressing the needs of developing nations. Important to this strategy is increasing the regional presence of ITU in developing areas (Resolution 25). ITU-T aims to cooperate with the other ITU Sectors in the organization of information meetings, seminars and workshops, and in the development of case studies, guidelines and handbooks that will aid in bridging the international digital divide. These tools are aimed at safeguarding the integrity and interoperability of networks, and the dissemination of information and know-how that will give developing countries the ability to respond to the challenges of privatization, co mpetition, globalization and technological change.

At the 2004 WTSA, ITU-T was again mandated in Resolution 44 to help bridge the gap between developing and developed countries.

Standardization of technologies has a crucial role in helping to bridge the digital divide. Standardization can help keep infrastructure costs down by ensuring that competition exists between equipment vendors. Interworking between network elements is crucial. If a service provider can opt for an end-to-end solution that complies with an internationally recognized standard, rather than a proprietary solution, it means that vendors of those network elements are more likely to offer competitive pricing. Standardization also makes it easier for service providers to make an informed choice about the equipment that they buy. It means that, rather than having to rely solely on the sales spiel of a manufacturer, they can quote compliance to standards in their calls for tender.

Cooperation

Standardization has proven value to industry. But industry does not have limitless funds for any one given activity and, in recent years, we have seen a growing demand for more efficiency across the standard-making world. ITU-T has done much to sharpen procedures at the organization level, and has also tried to facilitate cooperation between the various forums and standard-developing organisations (SDOs). This collaboration is necessary to avoid duplication of work and the consequent risk of conflicting standards in the market place.

There are formal procedures for establishing communication between ITU-T, forums and SDOs laid out in Recommendations A4-A6, which have been in place for the best part of a decade. But the complexity and diversity of the ICT market today means that the demand is greater.

In recent years, we have witnessed ever greater cooperation with forums and other SDOs, and ITU-T has taken a lead role in coordination throughout the standards world. As an international standards body, ITU-T is able to provide global applicability for standards by taking on the responsibility of referencing the work taking place across all of the different bodies. An increased spirit of cooperation has allowed standards to develop at the pace that industry requires.

In December 2001 and then July 2003, senior figures from the world's premier ICT standards groups joined together for two events that helped to foster this new age of cooperation. Organized by the ITU and held in Geneva and San Francisco, respectively, the Informal Forum Summits marked a new stage in standards development – one where cooperation, rather than competition and duplication, would dominate standards activity. Both events were very successful, with the San Francisco event attended by 69 chiefs from 34 standard-development organizations active in the fields of internet, mobile, software tools, broadband and optical networking.

Since the Informal Forum Summits, ITU-T's cooperation with other standard-makers has increased and this new era of collaboration can only be positive for the industry that we all serve. Regular workshops covering all manner of topics in which ITU is working include contributions from forums and SDOs, and often close with an agreement on increased collaboration. A powerful tool, workshops not only offer valuable coordination, but are also a means to diffuse the ever growing technological knowledge between the haves and have-nots. Many of ITU-T's workshops have been held in developing regions.

A good example, though certainly not the only one, of how cooperation is characterizing a new era of standardization is in work on next-generation networks (NGN). On many levels, NGN represents an unprecedented example of unification, bringing together some very important constituents of the global economy. From an ITU perspective, we have seen experts from across the 13 study groups pooling efforts, adjusting to new work programmes and schedules. Ongoing involvement of other SDOs and regional standards organisations in NGN planning and standard-development activities is essential. In short, the industry has risen to meet the enormous challenge that NGN presents. We believe that we are well on track to ensure that the roll out of this new approach to information and communication provision will be underpinned by a solid standards foundation.

NGN work was accelerated with the formation of a Focus Group, another ITU-T mechanism to provide greater efficiency in the publication of standards. The recently formed Focus Group on IPTV (FG IPTV) has seen great industry support already.

ITU T is a dynamic member-driven organization that strives to meet market requirements with flexible and efficient procedures. ITU T also recognizes that valuable work is also being done in other institutions and is in a privileged position to cooperate with relevant partners. We welcome any initiative that supports the goal of global interoperability and the extension of the benefits of these technologies to all of the world's inhabitants.

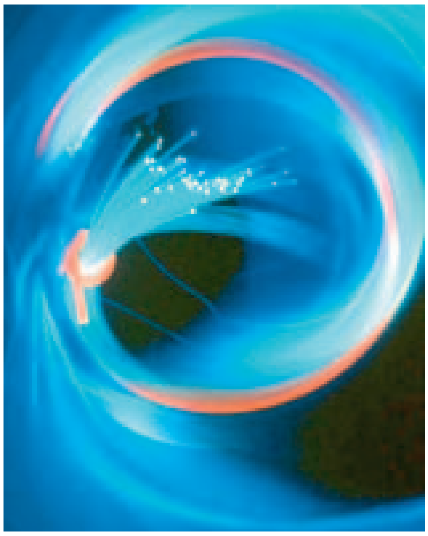
Technical Highlights

Passive Optical Networks

Passive optical network (PON) technologies were standardized in ITU-T Recommendations (G.983.1, G.984.1/2) during this period. PONs are an effective way of implementing fibre to the home/building and a crucial step towards all-optical networks. PON technology is used in the local loop to connect residential and SME end-users premises in an all-fibre network. By eliminating the dependence on expensive active network elements, the use of PON enables carriers to make significant savings.

A (PON) is a point-to-multipoint fibre to the premises network architecture in which unpowered optical splitters are used to enable a single optical fibre to serve multiple premises. A PON consists of an Optical Line Termination (OLT) at the service provider's central office and a number of Optical Network Units (ONUs) near end users. A PON configuration reduces the amount of fibre required, compared with point-to-point architectures.

The most recent standard, ITU-T G.984 (GPON), represents a significant boost in both the total bandwidth and bandwidth efficiency through the use of larger, variable-length packets. A GPON network delivers up to 2 488 megabits per second (Mbp/s) of downstream bandwidth, and 1 244 Mbp/s of upstream bandwidth. GPON Encapsulation Method (GEM) allows very efficient packaging of user traffic, with frame segmentation to allow for higher Quality of Service (QoS) for delay-sensitive traffic such as voice and video communications.



Cable

Late in the 90s, cable modems that exploit cable television connectivity begin to mature. If you have a cable modem, chances are that it will be built according to specifications from ITU-T. Cable is an increasingly popular means of accessing broadband services, and a key competitor to DSL.

The J.112 standard for interactive cable television services was approved in 1998. It fixes modulation protocols for high-speed, bi-directional data transmissions, allowing the transfer of IP traffic over all-coaxial or hybrid fibre/coaxial networks. Recommendation J.117, approved in 1999, covers the connection of cable television feeds into digital television sets. This can be used in high-definition television (HDTV) and conventional sets, anywhere in the world, as well as for terrestrial and satellite television feeds. It allows for the passage of large amounts of data at 200 million bit/s, which is important for digital video and data services.

VoIP

VoIP was given a boost in 2000 with Recommendation G.799.1 which specified functions and characteristics of VoIP gateways and made it easier for VoIP carriers to determine whether new gateways fully meet new requirement specifications.

BICC

Bearer Independent Call Control (BICC) was another key technology standardized by ITU-T in the period. BICC signalling protocols are used to support legacy PSTN/N-ISDN services over packet-based (IP or broadband) backbone networks without interfering with interfaces to the existing networks and end-to-end services. BICC protocols were a historic step toward packet-based and broadband multimedia networks, enabling the seamless migration of circuit-switched TDM networks to packet-based high-capacity broadband multimedia networks.

Videocoding

ITU's 2002 video coding standard, H.264/ AVC, is the first truly scalable video codec, delivering excellent quality across the entire bandwidth spectrum - from high definition television to videoconferencing and 3G mobile multimedia.

The video compression standard (full name ITU-T Rec. H.264 or MPEG-4 pt.10/ AVC) jointly developed by ITU-T SG16 and the ISO/IEC Moving Picture Experts Group (MPEG) is now being deployed in products from companies including Apple, Sony, BT, France Telecom, Intel, Motorola, Nokia, Polycom, Samsung, Tandberg and Toshiba and in services such as over-the-air broadcast television, the new HD DVD and Blu Ray disc formats, and a large number of deployments of direct-broadcast satellite-based television services.. It is an excellent example of cooperation between ITU-T, ISO and IEC.

Digital video is being used in an increasing array of applications that have been fuelled by the development of video coding standards. The new standard follows in the footsteps of earlier mould-breaking video coding advances, such as H.262|MPEG2-Video (the product of an earlier collaboration between ITU and ISO/IEC) and H.263, but surpasses earlier video standards in terms of video quality, compression efficiency and resilience to packet and data loss, the type of network impairments found on the Internet.

In addition to the potential of better image quality, improved data compression offers advantages in terms of bandwidth usage (more channels over existing systems) or greater media storage (more video files onto media such as DVDs.) The many application areas likely to benefit include videoconferencing, video broadcast, streaming and video on mobile devices, tele-medicine and distance learning.

Gary Sullivan, chairman of the JVT and the ITU-T Video Coding Experts Group VCEG was quoted in the ITU press release for H.264: «We have achieved a key milestone in making this important new standard available to the industry at large. It's a credit to the entire team that the technical design was completed in record time and it paves the way for the adoption of this exciting technology in 2003».

Next-generation networks

In 2004, work on next-generation network (NGN) standards found a home at ITU following intense industry debate. ITU-T created a Focus Group that went on to produce global standards for NGN.

The fundamental difference between NGN and today's network is the switch from current 'circuit-switched' networks to 'packet-based' systems such as those using Internet Protocol (IP). The need for global standards is critical, as most operators expect to move to an IP infrastructure. One area to be addressed is the concept dubbed 'nomadicity', which will give fixed-line and mobile users completely seamless communication. Simply put, this means the underlying technology will be invisible to the user regardless of a multi-service, multi-protocol, multi-vendor environment.

«Industry sought a quick solution on NGN and we responded,» said Houlin Zhao, Director of the ITU Telecommunication Standardization Bureau in the ITU press release making the announcement. «In this case, the Focus Group concept has given us the means to act with the level of immediacy required. There is no faster and more efficient place for the development of this work.»

Security

ITU-T Recommendation X.805 will give telecommunication service providers and enterprises the ability to provide an end-to-end architecture description from a security perspective. The Recommendation will allow operators to pinpoint all vulnerable points in a network and address them. Incorporating X.805 into a risk-management policy will give the network owners the confidence to be able to say that it has addressed security issues to the best of their ability.

Recommendation H.235, introduced in 2003, provides the protocols necessary for IP media such as voice over Internet Protocol (VoIP) or videoconferencing calls to be authorized and routed.

With the help of H.235, users communicating through IP media are authenticated and authorized, so that their communications are protected against various security threats. Real-time multimedia encryption adds a further layer of security, protecting against call interception. The security countermeasures are designed to thwart service fraud, avoid service misuse and detect malicious message-tampering. H.235 also provides a framework to improve security levels using PKI certificates.

Other key Recommendations on security include E.408 which specifies security requirements for telecommunication networks and E.409 which gives guidelines for Incident organization and security incident handling for telecommunication organizations.

DSL

In May 2005 Study Group 15 finalized work on new technical specifications that will allow telecom operators around the world to offer a 'super' triple play of video, internet and voice services at speeds up to ten times faster than standard ADSL.

The ITU-T Recommendation for very-high bit-rate digital subscriber line 2 (VDSL2) will allow operators to compete with cable and satellite providers by offering services such as high definition TV (HDTV), video-on-demand, videoconferencing, high speed internet access and advanced voice services, like VoIP, over a standard copper telephone cable.

The new VDSL2 standard delivers up to 100 Mbp/s both up and downstream, a ten-fold increase over «plain vanilla» ADSL. By doing so, it provides for so-called 'fibre-extension', bringing fibre-like bandwidth to premises not directly connected to the fibre optic segment of a telecoms company's network.

As well as addressing fast-growing consumer demand for high-speed multimedia services, VDSL2 offers carriers a solution which is interoperable with the DSL equipment many already have in place, expediting migration of customers to new VDSL2-based products. In addition, VDSL2 will work both legacy ATM networks and next generation IP-based networks.

Yoichi Maeda, chairman of the ITU Telecommunications Standardization Sector (ITU-T) study group responsible for the work, said in a press release issued at the time: «We have leveraged the strengths of ADSL, ADSL2+, and VDSL to achieve the very high performance levels you will see with VDSL2. This new standard is set to become an extremely important feature of the telecommunication landscape, and is a landmark achievement for our members, many of whom are relying on this Recommendation to take their businesses to the next level.»

VDSL2 is seen by many operators as the ideal accompaniment to a fibre-to-the-premises (FTTP) roll out, where fibre optic lines are used to link large premises like office or apartment blocks to the PSTN, and ordinary copper cables used within the building to connect tenants or residents to high-speed services.

Ready for immediate deployment, the new VDSL2 Recommendation (ITU-T G.993.2) will continue to foster competitive global markets for high-speed equipment, assuring a level playing field for developers and vendors.

H.323

Recommendation H.323, adopted in 1996, facilitates the delivery of voice, video and data over computer networks like the internet and remains the most used standard for this job. The H.323 family of standards has been crucial in fostering the development of new voice-over IP services, winning widespread support from equipment vendors because of the interoperability that it enables. It is estimated that systems using H.323 carry billions of voice minutes each month. H.323 is also widely used in videoconferencing systems.

Interconnection rate harmonization

Recommendation D.140 published in 1998 was a key enabler for international telephony. Interconnection rates are the costs between telecommunication service providers when linking networks for the exchange of traffic. This work was becoming increasingly complex with the more widespread use of VoIP, and the move to IP based or next generation networks (NGN). In order to cope with this paradigm shift, principles were developed to negotiate accounting rates and measures to facilitate developing countries to allow «soft landing» to the reality of the new market (Recommendation D.140). It also introduced the new concept of international remuneration which is the shift from accounting rate system to the termination rate system (Recommendation D.150).

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ASSEMBLIES, DIRECTORS AND STUDY GROUP CHAIRMEN SINCE 1956

Assemblies

Event	Date	Location	Chairman
Ist Plenary Assembly of the CCITT	10-20 December 1956	Geneva, Switzerland	Mr. G. Gneme (Italy)
Special Assembly	22-27 September 1958	Geneva, Switzerland	Mr. F. Nicotera (Italy)
IInd Plenary Assembly of the CCITT	8-16 December 1960	New Delhi, India	Mr.R.C. Vaish (India)
IIIrd Plenary Assembly of the CCITT	15-26 June 1964	Geneva, Switzerland	Mr. A. Langenberger (Switzerland)
IVth Plenary Assembly of the CCITT	14-25 October 1968	Mar del Plata, Argentina	Lt. Cnel. R.R. Albariño (Argentina)
Vth Plenary Assembly of the CCITT	4-15 December 1972	Geneva, Switzerland	Mr. A. Baczko (Poland)
VIth Plenary Assembly of the CCITT	27 September – 8 October 1976	Geneva, Switzerland	Mr. F. Lockher (Switzerland)
VIIth Plenary Assembly of the CCITT	10-21 November 1980	Geneva, Switzerland	Mr. D. Gagliardi (Italy)
VIIIth Plenary Assembly of the CCITT	8-19 October 1984	Málaga-Torremolinos, Spain	Mr. G. Entrena Cuesta (Spain)
IXth Plenary Assembly of CCITT	14-25 November 1988	Melbourne, Australia	Mr. M. K. Ward (Australia)
First World Telecommunication Standardization Conference - WTSC-93	1-12 March 1993	Helsinki, Finland	Mr. S.J. Halme (Finland)
WTSC-96	9-18 October 1996	Geneva, Switzerland	Mr. H.K. Pfyffer (Switzerland)
WTSA-2000	27 September – 6 October 2000	Montréal, Canada	Mr. M. Israel (Canada)
WTSA-04	5-14 October 2004	Florianópolis, Brazil	Mr Savio Pinheiro (Brazil)

Directors

Name	Period
Mr. Jean Rouvière (France)	1956 to 1972
Mr. Raymond Croze (France)	1972 to 1976
Mr. Léon C. Burtz (France)	1976 to 1984
Mr. Theodor Irmer (Germany)	1984 to 1998
Mr. Houlin Zhao (China)	1999 to 2006

STUDY GROUP CHAIRMEN

Study period 1957 – 1960

Study Group	Name	Chairman
Study Group 1	Coordination of studies of line transmission and general transmission problems	Mr. G.H. Bast (Netherlands)
Study Group 2	General coordination for operation and tariffs	Mr. A. Langenberger (Switzerland)
Study Group 3	Introduction of radio relay links into the general line telecommunication network. Linking-up of radio circuits to the general network	Mr. V. Gori (Italy)
Study Group 4	Maintenance of the general telecommunication network	Mr. J. Valloton (Switzerland)
Study Group 5	Protection against dangers and disturbances of electromagnetic origin	Mr. L.J. Collet (France)
Study Group 6	Protection and specifications of cable sheaths and poles	Mr. H.L. Halstrom (Denmark)
Study Group 7	Definitions, Vocabulary, Symbols	Mr. G. Gella (Spain)
Study Group 8	Telegraph apparatus and local connecting lines. Facsimile and phototelegraphy	Mr. P. Pellé (France)
MP	Joint Study Group CCIR-CCITT for phototelegraphy	Mr. P. Pellé (France)
Study Group 9	Quality of telegraph transmission, specification of channel equipments and directives for maintenance of telegraph channels	Mr. H.L. van Lommel (Netherlands)
Study Group 10	Telegraph and Telex switching	Mr. E.H. Jolley (United Kingdom)
Study Group 11	Telephone signalling and switching	Mr. D.A. Barron (United Kingdom)
Study Group 12	Telephone transmission quality and local telephone networks	Mr. G. Swedenborg (Sweden)
PLAN	General plan for the development of the international network	Mr. Antinori (Italy)

Study period 1961 – 1964

Study Group	Name	Chairman
Study Group I	Telegraph operation and tariffs (telex service included)	Mr. T. Perry (Netherlands)
Study Group II	Telephone operation and tariffs	Mr. G. Terras (France)
Study Group III	General tariff principles. Lease of telecommunication circuits	Mr. A. Langenberger (Switzerland)
Study Group IV	Maintenance of the general telecommunication network	Mr. J. Valloton (Switzerland)
Study Group V	Protection against dangers and disturbances of electromagnetic origin	Mr. H. Riedel (F.R. of Germany)
Study Group VI	Protection and specifications of cable sheaths and poles	Mr. H.L. Halstrom (Denmark)
Study Group VII	Definitions and Symbols	Mr. G. Gella (Spain)
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Study Group XVI	Telephone circuits	Mr. R.H. Franklin (United Kingdom)
Study Group Special A	Data transmission	Mr. J. Rhodes (United Kingdom)
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CMTT	Television transmission (Joint CCITT/CCIR Study Group under the administration of CCIR)	Mr. Y. Angel (France)
RIT	Inter-American telecommunication network (Temporary Study Group; Joint CCITT/CCIR Study Group under the administration of CCITT)	Mr. C. Núñez (Mexico)
Plan	General plan for the development of the international network (Joint CCITT/CCIR Committee under the administration of CCITT)	Mr. Antinori (Italy)

Study period 1965 – 1968

Study Group	Name	Chairman
Study Group I	Telegraph operation and tariffs (including telex)	Mr. R. Vargues (France)
Study Group II	Telephone operation and tariffs	Mr. R. Rütschi (Switzerland)
Study Group III	General tariff principles; lease of telecommunication circuits	Mr. P.F. Eriksen (Denmark)
Study Group IV	Maintenance of lines, circuits and chains of circuits	Mr. J. Valloton (Switzerland)
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EUROPE	Plan Committee for Europe and the Mediterranean Basin (Joint CCITT/CCIR Study Group to be managed by CCITT)	Mr. T. Noat (France)

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GAS 2	Local networks	Mr. Sundin (Sweden)
GAS 3	Economic and technical comparison of transmission systems	Mr. M. Ben Abdellah (Morocco)
GAS 4	Primary power sources	(Canada)
GAS 5	Economic conditions and telecommunication development	Mr. Garbe (F.R. of Germany)

Study period 1969 - 1972

Study Group	Name	Chairman
Study Group I	Telegraph operation and tariffs (including telex)	Mr. A. Gomes (United States)
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Study Group III	General tariff principles; lease of telecommunication circuits	Mr. L. Burtz (France)
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Study Group V	Protection against dangers and disturbances of electromagnetic origin	Mr. H. Riedel (F.R. of Germany)
Study Group VI	Protection and specifications of cable sheaths and posts	Mr. Walters (United Kingdom)
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Study Group X	Telegraph switching	Mr. A. Jansen (Netherlands)
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GAS 4	Primary power sources	Mr. F. Bentley (Canada)
GAS 5	Economic conditions and telecommunication development	Mr. H. Longequeue (France)

Study period 1973 – 1976

Study Group	Name	Chairman
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Plan Committee for Europe and the Mediterranean Basin	Telecommunication plan for Europe and the Mediterranean Basin	Mr. M. Toutan (France)

Special autonomous groups

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GAS 5	Economic conditions and telecommunication development	Mr. H. Longequeue (France)

Study period 1977 – 1980

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Study Group III	General tariff principles	Mr. M. Kojima (Japan)
Study Group IV	Transmission maintenance of international lines, circuits and chains of circuits; maintenance of automatic and semi-automatic networks	Mr. J. Kiil (Denmark)
Study Group V	Protection against dangers and disturbances of electromagnetic origin	Mr. G. Gratta (Italy)
Study Group VI	Protection and specifications of cable sheaths and poles	Mr. J. Pritchett (United Kingdom)
Study Group VII	New networks for data transmission	Mr. V.C. MacDonald (Canada)
Study Group VIII	Telegraph and terminal equipment, local connecting lines	Mr. W. Staudinger (Germany, Fed. Rep. of)
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CMTT	Television and sound transmission (Joint CCIR/CCITT Study Group)	Mr. Y. Angel (France)
CMV	Definitions and symbols (Joint CCIR/CCITT Study Group)	Mr. R. Villeneuve (France)

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Plan Committee for Latin America	Telecommunication plan for Latin America	Mr. C. Núñez-A. (Mexico)
Plan Committee for Asia and Oceania	Telecommunication plan for Asia and Oceania	Mr. A. Zaidan (Saudi Arabia)
Plan Committee for Europe and the Mediterranean Basin	Telecommunication plan for Europe and the Mediterranean Basin	Mr. L. Terol Miller (Spain)

Special autonomous groups

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GAS 5	Economic conditions and telecommunication development	Mr. H. Longequeue (France)
GAS 6	Economic and technical aspects of the choice of switching systems	Mr. L. Ackzell (Sweden)

Study period 1981 – 1984

Study Group	Name	Chairman
Study Group I	Definition and operational aspects of telegraph and telematic services (facsimile, Teletex, Videotex, etc.)	Mr. K. Freiburghaus (Switzerland)
Study Group II	Telephone operation and quality of service	Mr. J. Biot (Belgium)
Study Group III	General tariff principles	Mr. M. Kojima (Japan)
Study Group IV	Transmission maintenance of international lines, circuits and chains of circuits; maintenance of automatic and semi-automatic networks	Mr. J. Kiil (Denmark)
Study Group V	Protection against dangers and disturbances of electromagnetic origin	Mr. G. Gratta (Italy)
Study Group VI	Protection and specifications of cable sheaths and poles	Mr. K. Nikolski (USSR)
Study Group VII	Data Communication networks	Mr. V.C. MacDonald (Canada)
Study Group VIII	Terminal equipment for telematic services (facsimile, Teletex, Videotex, etc.)	Mr. W. Staudinger (Germany, Fed. Rep. of)
Study Group IX	Telegraph networks and terminal equipment	Mr. E.E. Daniels (United Kingdom)
Study Group XI	Telephone switching and signalling	Mr. J.S. Ryan (United States)
Study Group XII	Telephone transmission performance and local telephone networks	Mr. P. Lorand (France)
Study Group XV	Transmission systems	Mr. D. Gagliardi (Italy)
Study Group XVI	Telephone circuits	Mr. S. Munday (United Kingdom)
Study Group XVII	Data communication over the telephone network	Mr. V.N. Vaughan (United States)
Study Group XVIII	Digital networks	Mr. Th. Irmer (Germany, Fed. Rep. of)
CMBD	Circuit noise and availability (Joint CCITT/CCIR Study Group)	Mr. A.P. Bolle (Netherlands)
CMTT	Television and sound transmission (Joint CCIR/CCITT Study Group)	Mr. Y. Angel (France)
CMV	Definitions and symbols (Joint CCIR/CCITT Study Group)	Mr. M. Thué (France)

Plan committees
(CCITT/CCIR joint committees administered by CCITT)

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Plan Committee for Africa	General Plan for the development of the Regional Telecommunication Network in Africa	Mr. L. Dia (Senegal)
Plan Committee for Latin America	General Plan for the development of the Regional Telecommunication Network in Latin America	Mr. R.J.P. Severini (Argentina)
Plan Committee for Asia and Oceania	General Plan for the development of the Regional Telecommunication Network in Asia and Oceania	Mr. A.M. Al-Sabej (Kuwait)
Plan Committee for Europe and the Mediterranean Basin	General Plan for the development of the Regional Telecommunication Network in Europe and the Mediterranean Basin	Mr. L. Terol Miller (Spain)

Special autonomous groups

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GAS 4	Primary sources of energy	Mr. H. Krakowski (Germany, Fed. Rep. of)
GAS 5	Economic and social problems relating to telecommunication development	Mr. M. Benedetti (Italy)
GAS 7	Rural telecommunications	Mr. C. Rudilosso (Italy)
GAS 8	Economic and technical impact of implementing a regional satellite network	Mr. G. Malleus (France)
GAS 9	Economic and technical aspects of transition from an analogue to a digital telecommunication network	Mr. L. Ackzell (Sweden)

Study period 1985 – 1988

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Study Group II	Operation of telephone network and ISDN	Mr. G. Gosztony (Hungary)
Study Group III	General tariff principles including accounting	Mr. B. Rouxeville (France)
Study Group IV	Transmission maintenance of international lines, circuits and chains of circuits; maintenance of automatic and semi-automatic networks	Mr. H.L. Marchese (United States)
Study Group V	Protection against dangers and disturbances of electromagnetic origin	Mr. G. Gratta (Italy)
Study Group VI	Outside plant	Mr. K. Nikolski (USSR)
Study Group VII	Data Communication networks	Mr. J.O. Wedlake (United Kingdom)
Study Group VIII	Terminal equipment for telematic services (facsimile, Teletex, Videotex, etc.)	Mr. W. Staudinger (Germany, Fed. Rep. of)
Study Group IX	Telegraph networks and terminal equipment	Mr. M. Matsubara (Japan)
Study Group X	Languages and methods for telecommunications applications	Mr. C. Carelli (Italy)
Study Group XI	ISDN and telephone network switching and signalling	Mr. J.S. Ryan (United States)
Study Group XII	Transmission performance of telephone networks and terminals	Mr. P. Lorand (France)
Study Group XV	Transmission systems	Mr. A.M. Nouri (Saudi Arabia)
Study Group XVII	Data transmission over the telephone network	Mr. K. Kern (Germany, Fed. Rep of))
Study Group XVIII	Digital networks including ISDN	Mr. H.K. Pfyffer (Switzerland)
Special Study Group “S”	CCITT Study Groups structure	Mr. W.G. Simpson (United Kingdom)
PC/WATTC-88	Preparatory Committee WATTC-88	Mr. F. Molina Negro (Spain)
CMTT	Television and sound transmission (Joint CCIR/CCITT Study Group)	Mr. Y. Angel (France)
CMV	Definitions and symbols (Joint CCIR/CCITT Study Group)	Mr. M. Thué (France)

Plan committees
(CCITT/CCIR joint committees administered by CCITT)

World Plan Committee	General Plan for the development of the International Telecommunication Network	Mr. C. Crump (United States)
Plan Committee for Africa	General Plan for the development of the Regional Telecommunication Network in Africa	Mr. E. Kamdem Kamga (Cameroon)
Plan Committee for Latin America	General Plan for the development of the Regional Telecommunication Network in Latin America	Mr. C. Romero Sanjines (Peru)
Plan Committee for Asia and Oceania	General Plan for the development of the Regional Telecommunication Network in Asia and Oceania	Mr. A.M. Al-Sabej (Kuwait)
Plan Committee for Europe and the Mediterranean Basin	General Plan for the development of the Regional Telecommunication Network in Europe and the Mediterranean Basin	Mr. L. Terol Miller (Spain)

Special autonomous groups

GAS 3	Economic and technical aspects of the choice of transmission systems	Mr. J.Z. Jacoby (United States)
GAS 7	Rural telecommunications	Mr. C. Rudilosso (Italy)
GAS 9	Economic and technical aspects of transition from an analogue to a digital telecommunication network	Mr. M. Ghazal (Lebanon)
GAS 10	Planning data and forecasting methods	Mr. A. Zolfaghari (Isl. Rep. of Iran)
GAS 11	Strategy for public data networks	Mr. J.B. Pécresse (France)

Study period 1989 – 1992

Study Group	Name	Chairman
Study Group I	Services	Mr. M. Israel (Canada)
Study Group II	Network operation	Mr. G. Gosztony (Hungary)
Study Group III	Tariff and accounting principles	Mr. B. Rouxeville (France)
Study Group IV	Maintenance	Mr. J. Shrimpton (United States)
Study Group V	Protection against electromagnetic effects	Mr. H. Lorke (German Democratic Rep.)
Study Group VI	Outside plant	Mr. K. Nikolski (USSR)
Study Group VII	Data Communication networks	Mr. J.O. Wedlake (United Kingdom)
Study Group VIII	Terminals for telematic services	Mr. W. Staudinger (Germany, Fed. Rep. of)
Study Group IX	Telegraph networks and telegraph terminal equipment	Mr. M. Matsubara (Japan)
Study Group X	Languages for telecommunication applications	Mr. C. Carelli (Italy)
Study Group XI	Switching and signalling	Mr. J.S. Ryan (United States)
Study Group XII	Transmission performance of telephone networks and terminals	Mr. P. Lorand (France)
Study Group XV	Transmission systems and equipments	Mr. A.M. Nouri (Saudi Arabia)
Study Group XVII	Data transmission over the telephone network	Mr. K. Kern (Germany, Fed. Rep. of)
Study Group XVIII	ISDN	Mr. H.K. Pfyffer (Switzerland)
CMTT	Television and sound transmission (Joint CCIR/CCITT Study Group)	Mr. W.G. Simpson (United Kingdom)

Plan committees
(CCITT/CCIR joint committees administered by CCITT)

World Plan Committee	General Plan for the development of the International Telecommunication Network	Mr. C. Crump (United States) Mr. L. Terol Miller (Spain) Chairman designate
Plan Committee for Africa	General Plan for the development of the Regional Telecommunication Network in Africa	Mr. E. Kamdem Kamga (Cameroon)
Plan Committee for Latin America	General Plan for the development of the Regional Telecommunication Network in Latin America	Mr. A.F. Garcia (Argentina)
Plan Committee for Asia and Oceania	General Plan for the development of the Regional Telecommunication Network in Asia and Oceania	Mr. J.L. Parapak (Indonesia)
Plan Committee for Europe and the Mediterranean Basin	General Plan for the development of the Regional Telecommunication Network in Europe and the Mediterranean Basin	Mr. L. Terol Miller (Spain)

Special autonomous groups

GAS 7	Rural telecommunications	Mr. C. Rudilosso (Italy)
GAS 9	Economic and technical aspects of transition from an analogue to a digital network	Mr. M. Ghazal (Lebanon)
GAS 12	Strategy for the introduction of new non-voice telecommunication services	Mr. J.B. Pécresse (France)

Study period 1993 – 1996

Study Group	Name	Chairman
Study Group 1	Service definition	Mr. M. Israel (Canada)
Study Group 2	Network operation	Mr. G. Gosztony (Hungary)
Study Group 3	Tariff and accounting principles	Mr. B. Rouxeville (France)
Study Group 4	Network maintenance	Mr. J. Shrimpton (United States)
Study Group 5	Protection against electromagnetic environment effects	Mr. G. Meineri (Italy)
Study Group 6:	Outside plant	Mr. K. Nikolski (Russan Federation)
Study Group 7	Data networks and open system communications	Mr. H. Bertine (United States)
Study Group 8	Terminals for telematic services	Mr. W. Staudinger (Germany, Fed. Rep. of)
Study Group 9	Television and sound transmission (former CMTT)	Mr. J.L. Tejerina (Spain)
Study Group 10	Languages for telecommunication applications	Mr. O.F. Faergemand (Denmark)
Study Group 11	Switching and signalling	Mr. S. Kano (Japan)
Study Group 12	End-to-end transmission performance of networks and terminals	Mr. P. Lorand (France)
Study Group 13	General network aspects	Mr. B.W. Moore (United Kingdom)
Study Group 14	Modems and transmission techniques for data, telegraph and telematic services	Mr. K. Kern (Germany)
Study Group 15	Transmission systems and equipments	Mr. P.A. Probst (Switzerland)
TSAG	Telecommunication Standardization Advisory Group	Mr. B. Horton (Australia)

Study period 1997 – 2000

Study Group	Name	Chairman
Study Group 2	Network and service operation	Mr. G. Gosztony (Hungary)
Study Group 3	Tariff and accounting principles including related telecommunications economic and policy issues	Mr. T. Matsudaira (Japan)
Study Group 4	TMN and network maintenance	Mr. D. Sidor (United States)
Study Group 5	Protection against electromagnetic environment effects	Mr. G. Meineri (Italy)
Study Group 6:	Outside plant	97-99 - Mr. L. Molleda (Spain) 2000 - Mr. J. R. Osterfield (United Kingdom)
Study Group 7	Data networks and open system communications	Mr. H. Bertine (United States)
Study Group 8	Characteristics of telematic systems	Mr. W. Staudinger (Germany)
Study Group 9	Television and sound transmission	Mr. J.L. Tejerina (Spain)
Study Group 10	Languages and general software aspects for telecommunication systems	Mr. A. Sarma (Germany)
Study Group 11	Signalling requirements and protocols	Mr. S. Kano (Japan)
Study Group 12	End-to-end transmission performance of networks and terminals	97-99 - Mr. M. Cao (China) 2000 – Mr. C.A Dvorak (USA) Acting Chairman
Study Group 13	General network aspects	Mr. B.W. Moore (United Kingdom)
Study Group 15	Transport networks, systems and equipment	Mr. P. Wery (Canada)
Study Group 16	Multimedia services and systems	Mr. P.A. Probst (Switzerland)
TSAG	Telecommunication Standardization Advisory Group	Mr. G. Fishman (United States)

Study period 2001 – 2004

Study Group	Name	Chairman
Study Group 2	Operational aspects of service provision, networks and performance	Mr. R. Blane (2001-2002) (United Kingdom) Mr. Ph. Distler (2003-2004) (France)
Study Group 3	Tariff and accounting principles including related telecommunication economic and policy issues	Mr. R. Thwaites (Australia)
Study Group 4	Telecommunication management, including TMN	Mr. D.J. Sidor (United States)
Study Group 5	Protection against electromagnetic environment effects	Mr. R. Pomponi (Italy)
Study Group 6	Outside plant	Mr. F. Montalti (Italy)
Study Group 7 (until 16/9/2001)	Data networks and open system communications	Mr. H. Bertine (United States)
Study Group 8	Characteristics of telematic systems	Mr. W. Staudinger (Germany)
Study Group 9	Integrated broadband cable networks and television and sound transmission	Mr. R. Green (United States)
Study Group 10 (until 16/9/2001)	Languages and general software aspects for telecommunication systems	Mr. A. Sarma (Germany)
Study Group 11	Signalling requirements and protocols	Mr. Y. Hiramatsu (Japan)
Study Group 12	End-to-end transmission performance of networks and terminals	Mr. J-Y. Monfort (France)
Study Group 13	Multi-protocol and IP-based networks and their internetworking	Mr. B.W. Moore (United Kingdom)
Study Group 15	Optical and other transport networks	Mr. P. Wery (Canada)
Study Group 16	Multimedia services, systems and terminals	Mr. P.-A. Probst (Switzerland)
Study Group 17 (as from 17/9/2001)	Data networks and telecommunication software (Merger of Study Group 7 and Study Group 10)	Mr. H. Bertine (United States) Mr. A. Samra (Germany) (Co-Chairmen)
Special Study Group	IMT-2000 and beyond	Mr. J. Visser (Canada)
TSAG	Telecommunication Standardization Advisory Group	Mr. G. Fishman (United States)

Study period 2005 – 2008

Study Group	Name	Chairman
Study Group 2	Operational aspects of service provision, networks and performance	Mrs. M.-Th. Alajouanine (France)
Study Group 3	Tariff and accounting principles including related telecommunication economic and policy issues	Mr. K.S. Park (Korea, Rep. of)
Study Group 4	Telecommunication management	Mr. D. Sidor (United States)
Study Group 5	Protection against electromagnetic environment effects	Mr. R. Pomponi (Italy)
Study Group 6	Outside plant and related indoor installations	Mr. F. Montalti (Italy)
Study Group 9	Integrated broadband cable networks and television and sound transmission	Mr. R. Green (United States)
Study Group 11	Signalling requirements and protocols	Mr. Y. Hiramatsu (Japan)
Study Group 12	Performance and quality of service	Mr. J-Y. Monfort (France)
Study Group 13	Next generation networks	Mr. B.W. Moore (United Kingdom)
Study Group 15	Optical and other transport network infrastructures	Mr. Y. Maeda (Japan)
Study Group 16	Multimedia terminals, systems and applications	Mr. P.-A. Probst (Switzerland)
Study Group 17	Security, languages and telecommunication software	Mr. H. Bertine (United States)
Study Group 19	Mobile telecommunication networks	Mr. J. Visser (Canada)
TSAG	Telecommunication Standardization Advisory Group	Mr. G. Fishman (United States)