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An Overview of the Satellite and Space Communications Committee

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The Satellite and Space Communications (SSC) Committee has provided a forum for technical interchange among those working in this field for nearly 40 years. It began in the early 1960s soon after it was recognized that the rocket capabilities demonstrated by the Soviet Union and United States in the late 1950s could readily be used to launch communications satellites.

From that time, the development and impact of satellite communications has been revolutionary. In the early days, the major activity was associated with business, political and technical issues associated with the development and introduction of the first communications satellites. The technical community was occupied with the tradeoff studies associated with satellite orbits, frequency bands, and link design. However, the first communications satellites came along quickly with low earth orbit launches of Telstar and Relay in 1962, the first synchronous orbit satellite, Syncom, in 1963, and the launch of INTELSAT 1 and MOLNIYA 1 in 1965. Since that time, the field of satellite communications has continued to grow rapidly. Satellites have become dramatically larger, capable of increased capacity and employing rapidly developing light weight electronics technology, spacecraft control, and power generation and storage devices. Significant development went into sophisticated space-borne regional and spot-beam dual polarized antennas at both C- and Ku-band to increase payload capacity through frequency reuse techniques. Next, Very Small Aperture Terminal (VSAT) networks and applications, and direct broadcast satellite systems and technologies, were introduced. Quickly, the exploitation of the Ka-band frequencies for future growth became an important topic within the satellite communications community. During the 1970s and 1980s, major engineering efforts were devoted to the development of higher power amplifiers, lighter weight, improved performance microwave filters and circuit switches, and electric power generation and storage devices, which contributed to larger communications satellite payloads that fit the launch constraints of available launch vehicles. Eventually, systems that provide communications services to mobile terminals (e.g., ships, land vehicles, and aircraft) were developed. These systems exploited one of the major attributes of communications satellites, i.e., the capability to offer wireless services over a large service area.

Today, communications satellites carry about one-third of voice and essentially all international television traffic. Significant advances in video compression and data protocol enhancement technology have made new and many previously very expensive satellite communications services such as digital direct broadcast satellite (DBS), digital direct-to-home (DTH), and Internet access available at lower cost. At the same time, we are entering a new and potentially revolutionary era in satellite communications. A large number of commercial systems are being planned and introduced to provide a wide array of voice, data, and video services that promise to radically change global telecommunications. These include narrow band systems such as Ellipso, Globalstar, ICO, Iridium, and ECCO, which intend to provide cellular telephone-like services in L/S-band. There are also a host of wideband systems being planned for Ka-band, such as Astrolink, Spaceway, and Teledesic, which intend to provide multimedia services to desktop computer-size terminals starting around 2000. Both the narrowband and wideband systems appear attractive because they offer much higher capacity and relatively low user costs compared to traditional systems. In the latter part of 1997, several companies announced proposals to build satellite systems in the Q and V bands to supplement the Ka-band wideband systems now in various stages of development.

The importance and excitement of these new satellite initiatives was featured in two recent magazine articles. An article in the March 1998 issue of *IEEE Spectrum*, "Satellites Free the Mobile Phone," by Barry Miller, describes the emerging L/S band personal communications satellite systems. In an April 1998 *Scientific American* article, "New Satellites for Personal Communications," John V. Evans profiled all the new voice- and data-oriented personal communications systems, as well as the systems planned for use of the frequencies beyond Ka-band.

The committee has had the opportunity to experience rapid and revolutionary developments that have occurred in the field of satellite and space communications over the years, and today it continues to provide a forum to facilitate technical interchange among those working in the field. Current emphases are on the evolution of new satellite- and space-based systems and on applications of emerging technologies to satellite and space communications. Because of the broad range of the technologies involved, and the necessity of integrating and interfacing satellite communications with other networks, the committee has attempted to develop liaisons with other committees such as Multimedia Communications, Personal Communications (PC), and Communication System Integration and Modeling (CSIM). In addition, the committee maintains a keen interest in the development and mainte-

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Catalonia Experiments with LMDS Technology

By Joan Garcia-Haro, Spain

Europe is becoming an attractive market for the deployment of wireless broadband communications, especially those systems based on Local Multipoint Distribution System (LMDS) or its European counterpart known as Multipoint Video Distribution System (MVDS). LMDS is a wireless millimeter-wave technology operating in the 28 GHz band. The bandwidth ranges up to 1 GHz and provides capacity to support two-way voice, data, and video services. The system can deliver 49 analog TV channels, more than 150 digital TV channels, and more than 10,000 conventional telephone lines or a combination of different services. They are FM modulated and transmitted from a base station covering a radius up to 7 Km for an emission power of 60 W.

The system design is scalable by nature since its architecture is cellular and the LMDS channels can be reused many times from cell to cell. LMDS uses frequency interleaving in diagonally proximate cells and spatial separation. The receiver part consists of a set-top-box where the signal is down converted and decoded. A small (12 x 12 cm) high-gain narrow-beam antenna, that can be mounted indoors, has to be included. The system retains good quality signal reception in varied weather conditions. LMDS allows interactive and pay-per-view services, as well as the accommodation of local channels adapting the TV programming and publicity to the specific needs of a particular population.

Economics play always a significant role in the deployment of these technologies. Central and eastern European countries are without any doubt some of the prime potential markets due to their lack of updated telecommunication infrastructures and the real need to optimize costs that can be unaffordable using cable technologies. But in general, Europe presents urban regions with a high density of population and uniform distribution of buildings' heights, reducing radio shadow areas and easing the deployment of such networks. In addition, the majority of European companies are small- and medium-sized, and therefore unable to invest in optical fiber infrastructures in order to acquire the bandwidth they require. Finally, the main European telecom operators are not lowering prices as fast as will be desirable within the new framework of deregulation. Consequently, new LMDS operators using aggressive and competitive tariffs could attract an important number of customers and obtain a considerable benefit.

In this context, the Autonomous Region of Catalonia, Spain, is performing LMDS technical trials from the telecommunications tower of Collserola in Barcelona. This cellular fixed radio technology is considered a complementary approach to accelerate the coverage provided by new cable operators in urban areas (except Barcelona city), as well as an extension of broadband services to rural areas and scattered populations where wiring is not economically rewarding. The Autonomous Government is paying particular attention to this last aspect, trying to improve their citizens' quality of life and stop the economic and demographic recession in rural areas, especially those located at the Pyrenees Mountains. Due to the high bandwidth that LMDS provides, it is possible to offer advanced services such as digital TV, voice and data transmission, Internet access, and interactive and multimedia services (videoconference, teleworking, educational, and health care services, etc.). Furthermore, part of the existing infrastructure for conventional radio and TV can be reused. Therefore, deployment can be very fast, ranging from several months to one year at an acceptable low cost in comparison to the cable networks, ranging from four to seven years and much more expensive.

A Report from the Novosibirsk Chapter

By Wjacheslav Shuvalov, Russia

Originally, a joint Chapter of the IEEE Microwave Theory and Techniques Society and the IEEE Electron Device Society was organized in May 1996. In June 1997 the IEEE Component Packaging and Manufacturing Technology Society also extended its support and in November 1997 the IEEE Communications Society was added to the Chapter. The four above-mentioned societies have actively supported the joint Chapter's activities by providing:

- regular approval of the Chapter's requests for subsidies
- assistance in arranging advertisements of Calls for Papers within IEEE periodicals
- financial support for Chapter representatives to attend the Society's current meetings

IEEE's support has allowed the development of a program which has resulted in an increase to more than 50 IEEE members. Among them there are 12 ComSoc members.

The main directions of scientific research carried out by the Chapter's ComSoc members are:

- Compression, security of Communication and Information, cryptography and security protocols.
- Soft-Decision Decoding.
- Optimizing of Telecommunication Networks, including mobile Networks.
- Microwave/RF devices and Systems for Communication.

The development of these directions includes not only employees of universities and academies of sciences, but representatives of regional telecommunication industry as well.

One of the Chapters initiative was to support the local engineering community in organizing international professional meetings with IEEE cooperation. The first such meeting Modern Information Technology (MIT-98) International Conference was held 16–18 June 1998 in Novosibirsk under Comsoc technical cosponsorship support. Over 90 speakers both from Russia and abroad participated in it. The International Conference on Actual Problems of Electronic Instrument Engineering (APEIE '98) was held 23–26 September 1998. The *APEIE Proceedings '98* consists of 16 volumes. Comsoc atendance was high.

In 1999, with ComSoc's participation, we plan to organize the development of the following:

- Sibconvers '99, Tomsk City, Russia, May 1999
- Information and Telecommunication Problems (ITP '99) National Conference, Novosibirsk, Russia, 21–23 April 1999
- IEEE High Power Microwave Electronic Conference (MIA- ME '99), 23–25 Sept., 1999, Novosibirsk, Russia

The Chapter also plans to involve neighboring Novosibirsk Scientific and Industrial Centers in IEEE activities. Novosibirsk is located near several large cities with populations ranging from 0.5 to 1.5 million. The region has tremendous scientific and industrial potential in the areas of IEEE profes-

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Information Society Technology Programme

By Paulo de Sousa, Belgium

The Information Society Technology (IST) Programme is part of the Fifth Framework Programme, the European Union setting of research, technology development, and demonstration activities for the period 1998–2002. IST brings together and extends the current ACTS, Esprit, and Telematics Applications programs to provide a single and integrated program that reflects the convergence of information processing, communications, and media. The IST Programme is managed by DG XIII of the European Commission. The budget proposed for 1998-2002 is EUR 3.6 billion.

The work program for 1999 and the definitive timetable for calls for proposals in 1999 will be available soon in the Web (http://www.cordis.lu/ist). A call for experts (i.e., reviewers and evaluators) is now open; this covers the entire Fifth Framework Programme, including the IST Programme.

The overall objective of IST is to create a user-friendly information society or, more specifically, to bring about the benefits of the information society for Europe both by accelerating its emergence and by ensuring that the needs of individuals and enterprises are met. The program has four interrelated specific objectives, each one translated into a Research Area or Key Action:

I. Systems and services for the citizen – For the private individual the objective is to meet the needs and expectations of European citizens for high-quality, affordable general-interest services.

II. New methods of work and electronic commerce – Addressing the requirements and concerns of European enterprises, workers and consumers the objective is to enable both individuals and organizations to innovate and be more effective and efficient in their work and business, whilst at the same time improving the quality of the individual's working life.

III. Multimedia content and tools – Multimedia content is central to the information society; the objective here is to confirm Europe as a leading force in this field and enable it to fulfill the potential of its creativity and culture.

IV. Essential technologies and infrastructures – For the essential technologies and infrastructures that form the building blocks of the information society the objective is to drive their development, enhance their applicability and accelerate their take up in Europe.

Two extra activities are also included:

- Research and Technological Development Activities of a Generic Nature (future and emerging technologies: the open domain; proactive initiatives)
- Support for Research Infrastructures (Research networking: Broadband interconnection of national research and education networks; Advanced European experimental testbeds)

The context, rationale, and objectives of the IST Programme necessitate a single and integrated program which reflects the convergence of technologies and media and of industries and markets, together with the increasing significance of content, and responds to the need to integrate research and development and take-up actions. To this effect, the program consists of this set of four key actions centred on the four specific objectives and a specific activity on longer-term or higher-risk research on future and emerging technologies. These activities complement each other and are derived by grouping together the technologies, systems, applications and services and the research and development and take-up actions with the greatest affinity or interdependence. Each activity has its own specific focus and priorities, however, the key issues of usability, interoperability, dependability, and affordability will be addressed ubiquitously throughout the program.

Key Action IV, Essential Technologies and Infrastructures, is the largest of the activities, with almost 36 percent of the total funding, and probably the one that most interests the ComSoc readership.

The aim of Key Action IV is to promote excellence in the technologies which are crucial to the information society, to accelerate their take-up and broaden their fields of application. The work will address the convergence of information processing, communications and networking technologies and infrastructures. The focus will be on technologies and infrastructures common to several applications, while those specific to one application only would be addressed in the context of that application in other parts of the Framework Programme. It comprises six technological domains:

- Technologies for and the management of information processing, communications and networks, including broadband, together with their implementation, interoperability and application. The work will focus on the development and convergence of information processing, telecommunications and broadcast network and system technologies.
- Technologies and engineering for software, systems and services, including high-quality statistics. Work will centre around the development, deployment, operation and evolution of software-intensive systems embedded in goods and services as well as facilitating production and enterprise processes, including technologies and tools for testing and validation at all stages.
- Real-time and large-scale simulation and visualisation technologies. Work will address the development and integration of advanced simulation and visualisation technologies and environments in all applications. Work will include distributed simulations and shared virtual environments.
- Mobile and personal communications and systems, including satellite-related systems and services. Work will target the move to an integrated seamless network that ensures global personal connectivity and enables access to wireless multimedia communications and services by anyone, from anywhere, at any time, with capabilities, quality and performance comparable to those of fixed network services.
- Peripherals, sub-systems and microsystems. Work will address the need for advanced intelligent (computing and communications) network peripherals which can have multiple functionality yet remain user-friendly. Work on subsystems will cover the building blocks of information processing and communications systems and networks.
- Microelectronics. Work will address materials, equipment, processes, design and test methodologies and tools which enable the development of electronic components, their packaging, interconnection and application. The approach will be system-oriented and application-driven, and will aim at reinforcing strengths and exploiting technological opportunities drawing on appropriate microelectronic technology solutions best filling generic application requirements.

The views expressed in this article are those of the author and do not necessarily reflect the views of the European Commission.

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sional interest. These cities are Krasnojarsk, Omsk, Tomsk, Irkutsk, Yekaterinburg, Chelyabinsk, Chita, Ulan-Ude, Chabarovsk, and others. The total estimated number of new IEEE members which might be recruited in this area is 100–200 individuals (among them about 40–50 new Comsoc members).

Our joint Chapter is located at the Siberian State University of Telecommunication and Information Sciences (SibSUTIS), an important research and education center that trains highly qualified specialists in the field of Telecommunication and Information Sciences for Siberia and the Far East, as well many countries in Europe, Asia, Africa, and the Americas.

For 1999 we have prepared application forms for recruiting 10 new IEEE ComSoc members. Upcoming steps in the Chapter's activities include:

- membership development among M.Sc. and Ph.D. students;
- support for student research grants;
- assistance for students in preparing and publishing research results in IEEE periodicals and participating in IEEE conferences

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SATELLITE COMMUNICATIONS/*(Continued from page 1)*

nance of standards for communication and is particularly concerned with those that affect satellite and space communications. Specific technologies of current interest include:

- Satellite-based personal and mobile communications systems
- ISDN and B-ISDN satellite applications and networks
- Advanced modulation/demodulation and on-board signal processing
- Direct broadcast and high definition television
- Very small aperture and handheld satellite systems and networks
- Ka/Q/V-band satellite communications systems

The committee has also encouraged the publication of papers that present progress in the *Transactions on Communications* and *The Journal on Selected Areas In Communications* (*J-SAC*). In fact, the inaugural issue of *J-SAC* (January 1983) was devoted to Digital Satellite Communications and this has been followed by five other special issues on communications satellite areas.

The committee continues to meet semi-annually at the ICC and GLOBECOM conferences and to sponsor technical sessions on satellite communications systems and technology. The committee also publishes the *SSC Newsletter* semi-annually. In recent years, the committee has been striving to provide information about the new systems and developments via workshops. At recent GLOBECOM conferences, the committee has held workshops on "Future Satellite Communications Systems." These workshops reviewed several mobile and fixed satellite communication systems being developed for use in the year 2000 and beyond, and focused on concepts, architectures, multiple access, operation, performance, and network management for the new satellite communication systems. A workshop on "Audio and Video Compression Technology for Satellite Communications" was also organized for a recent ICC conference and focused on the revolutionary advances in data compression algorithms and technology associated with audio and video signal processing, and their impact on satellite direct broadcast TV, distance learning, video conferencing, news gathering, tele-medicine, and digital audio broadcasting.

The committee is currently collaborating with the CSIM committee in organizing a workshop on "Satellite Communications Architectures and Networks" for ICC '99 in Vancouver. The objective of this workshop is to examine the architectures, applications, and technologies of satellite networks in their role in the current information services infrastructure as well as in their future role when new commercial narrowband and wideband satellite communications systems become ubiquitous. It will address important themes and topics such as TCP/IP, Internet, ATM, and multicasting over satellite; Digital Video Broadcasting; integration of satellite and terrestrial networks; new developments in access technology and protocols; and emerging low earth orbit SATCOM.

Clearly, the field of satellite communications continues to grow rapidly and remains interesting and exciting. We encourage all who are interested in this field to join our committee. Visit our Web site (http://www.comsoc.org/socstr/techcom/ssc) where you can get information on events and upcoming meetings, and interact with committee officers and members.