

SATELLITE AND SPACE COMMUNICATIONS

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**IEEE
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SSC Newsletter

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The Satellite and Space Communications (SSC) Committee is a volunteer group actively involved in advancing satellite and space communication technologies within the IEEE. This committee is approved by the IEEE Communications Society and is governed by the constitution and bylaws of the IEEE as well as the other twenty Technical Committees in the Society.

SATELLITE & SPACE

- JOIN US -

All conference attendees are welcome to join us in the SSC Committee meeting.

Hotel: **Captain Cook,
Anchorage, Alaska**
Room: **Adventure Room**
Date: **Tuesday May 13th**
Time: **7.45 am – 9.00 am**

Future SSC Meetings

December 2003 San Francisco
June 2004 Paris
December 2004 Dallas

GLOBECOM 2003 SSC Committee Activities

Track 9: Broadband Wireless & Satellite Communications

- BW1: WLANS and OFDM, Mon, 12 May 2003 – 8:50-10:30
- BW2: OFDM and Freq. Estimation, Mon, 12 May 2003 – 11:00-12:30
- BW3: OFDM I, Mon, 12 May – 13:30-15:00
- BW4: OFDM II, Mon, 12 May – 15:30-17:00
- BW5: Satellite Communications, Tue, 13 May 2003 – 8:50-10:30
- BW6: Turbo Coding, Tue, 13 May 2003 – 11:00-12:30
- BW7: Wireless System, Tue, 13 May 2003 – 13:30-15:00
- BW8: CDMA, Tue, 13 May 2003 – 15:30-17:00
- BW9: Advances in UWB tech., Wed, 14 May 2003 – 8:50-10:30
- BW10: QoS and Scheduling, Wed, 14 May 2003 – 11:00-12:30
- BW11: Wireless Networks I, Wed, 14 May 2003 – 13:30-15:00
- BW12: Wireless Network II, Wed, 14 May 2003 – 15:30-17:00



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MESSAGE FROM THE CHAIR

Ron P. Smith

The Satellite and Space Communications (SSC) Technical Committee is an international volunteer organization governed by the IEEE Communications Society. SSC has been providing a forum for technical advancement of space borne communications since our founding in 1962. Please help us to continue our contributions to this exciting field by finding your own way to participate in our committee. SSC meets twice per year at ICC and Globecom conferences, and there are numerous ways to be active through the Internet by visiting our web site.

Our last meeting was at Globecom 2002 in Taipei, Taiwan. I would like to thank our Vice Chair, Abbas Jamalipour, for leading our committee in my absence as well as for organizing and presenting our first TC award, the "Distinguished Contributions to Satellite Communications Award," to Professor Romano Fantacci. Please help recognize our deserving colleagues by nominating a candidate for this award, details can be found at our web site.

SSC is actively involved in organizing sessions and workshops for major IEEE ComSoc conferences such as ICC and Globecom. You can help us by volunteering to serve as a technical program representative or as a paper reviewer. If you have suggestions for workshops or tutorials, you can submit your ideas directly to the conferences as well as coming to SSC for support. We are always interested in participating in other events

cosponsored by the IEEE, such as the AIAA International Communications Satellite Systems Conference (www.aiaa-icssc.org), so please contact us if SSC can help with your favorite event.

In recent years there has been increasing convergence of technologies involved in satellite communication. SSC recognizes this as an opportunity to collaborate with our colleagues in other ComSoc TCs such as Communication Theory (CT), Personal Communications (PC) and Communications Systems Integration & Modeling (CSIM) TCs, as well as with other organizations such as the AIAA Technical Committee on Communications Systems and the IEE Satellite Communications Group. We have a number of liaisons with technical committees and publications listed on our web site. Please let us know of other sources of collaboration or volunteer to be one of our liaisons.

Publications are a major instrument in furthering our goals of advancing satcom technology and professional development in our field. The IEEE Communications Magazine is an excellent publication for reaching a wide technical audience and the IEEE Journal on Selected Areas of Communication provides a great opportunity for in depth examination of technical developments. Both of these publications organize featured topics with multiple papers on a subject in a single issue. SSC members help to organize these features by

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submitting recommendations to the editorial boards and serving as guest editors and reviewers.

As you can see, there are numerous ways for you to participate with SSC to help advance our field and the professional careers of our members and yourself.

I have found this to be a rewarding endeavor and invite you to join us.

*Dr Ron P. Smith, Chair
Satellite and Space Communications
Technical Committee*

SCANNING THE WORLD

Abbas Jamalipour

It was just a few years ago that the satellite communications industry has moved its main business direction from providing the backbone of long-distance communications into a more attractive business of personal communications. Many satellite systems at low, medium, and geostationary orbits have been proposed, many got their license, and some even started their commercial service. Whether it was because of general economic downturn in telecommunications industry or because of basic high-cost issues involved in satellite communications, those systems couldn't get much of what they had been expected (in terms of number of customers or revenue), passing several systems into the bankruptcy road and gradual elimination from the market.

It is believed that new applications always can help systems to sustain and evolve into more complex infrastructures. Multimedia applications, for example, revolutionized computer networks and the Internet. Without new and personal services, the Internet would never achieve its current popularity. However, for the satellite, as an old industry, the main sustainability issue lies behind its major advantages compared to other telecommunications systems and new applications could just be included as add-on services. On contrary to the terrestrial systems that are survived through new services, satellite systems are generating new services based on their fundamental characteristics.

So, for the satellite systems one should always remember the main characteristics of wide coverage, large bandwidth, and broadcasting. That is, the applications should impose themselves within the features of satellite and if one adopts a reverse approach (as it is usual in terrestrial system designs), the result will be a blocking among solid parameters surrounding the satellite. Inclusion of everyday personal communications as the main service of the satellite system was one example, which came with unpleasant conclusions.

The new satellite business is thus again going back to its old but effective feature of broadcasting. Although the feature is old, it could be used to generate new applications for both individuals and corporate end users. Those applications are ranging from high-definition radio and TV broadcasting to

more modern high-speed Internet services and so on. The satellite industry consequently has changed its direction of a short-term plan for broadband and Internet services into a longer-term prospect, something that is more realistic. Satellite industry is no more competing with DSL, cable, or personal communications service providers, but complementing those services where they are not readily available, either permanently or temporarily.

So going back is not always a bad thing and the satellite communication is a good example for proving that. The industry has started to grow again. According to April 2003 survey of the Satellite Industry Association (SIA) the commercial satellite industry generated \$86.8 billion in revenue in 2002, 10 percent more than that in 2001, and much higher than \$38 billion in 1996 (114% increase over six years!). Direct-to-home service was a major revenue source for satellite system accounted for about 49% of the entire industry revenue. Transponder leasing revenue had the least share in the total revenue increase, thanks to massive introduction of almost 1000 transponders into service and the subsequent lease price fall.

The satellite manufacturing sector was also very successful in 2002, getting 27% increase compared with 2001 at \$12.1 billion, thanks mainly to two billion-dollar government satellites, the US military's Milstar 5 and the European research satellite Envisat. Governments were the main customers of satellite industry and will be forever. Launching revenue were also increased significantly at 23% from 2001 to 2002, with some declined figures in the US launch revenues.

Overall, the satellite industry has restarted to get its old growing trend and this could be mainly attributed to the fact that the industry reconsidered traditional advantages and features of the satellite communications. Direct-to-home, video, and satellite radio services will be important factors in the growing rate while broadband and Internet services should be planned on a longer-term basis. Increasing the satellite capacity through deployment of Ka-band, which could offer up to seven times more capacity than existing Ku-band systems, would pave the path for those future services. Already many satellite companies have timetabled their Ka-band satellite

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launch in 2003 and 2004, including the SES-Global's new DBS-plus-Internet satellite network which will use a Ka/Ku-band spacecraft AMC-15 carrying twelve 125 MHz Ka-band spot beams, the Hughes' Ka-band system SPACEWAY due to launch in late 2003, the WildBlue Communications, and others. Those systems are targeting roughly 30 million US households and 8 million SOHO businesses that cannot get their hands to DSL or cable. Start of Ka-

band satellite services will reduce the cost and increase the bandwidth offered to users, making the satellite industry back on the track. (The author acknowledges the usage of SatMagazine's statistics in preparation of this article.)

*Prof. Abbas Jamalipour, Vice Chair
Satellite and Space Communications
Technical Committee*

FORTHCOMING GLOBECOM AND ICC CONFERENCES

COSPONSORING / RELATED CONFERENCES AND WORKSHOPS

Globecom 2003

Dec. 1-5, 2003,

San Francisco, CA, USA

GLOBECOM 2003 will be composed of six major Symposia (including wireless communications symposium), the traditional GLOBECOM General Conference addressing a set of current communication topics, and R&D Tutorials and Workshops.

ICC 2004

June 20 - 24, 2004,

Paris, France

The technical program will feature a unique set of technical symposia disseminating the latest research and development results in communications and networking, and business applications sessions and panels, where industry leaders will address the hottest topics in telecommunications and the future evolutions of this field. In addition, the program will include tutorials and workshops by internationally recognized experts, where engineers can learn about new technologies of their choice. ICC 2004 will thus feature a technical program equally attracting researchers from academia and engineers from industry, network operators, and service providers.

Globecom 2004

Nov. 26 – Dec. 3, 2004,

Dallas, Texas, USA

Milcom 2003

Oct. 13 - 16, 2003,

Boston, MA, USA

MILCOM 2003 has accepted both unclassified and classified papers on military communications including the following subjects: Architectures, Modeling, Simulation, and Emulation, Mobile Networks, Application of Commercial Technology, Cellular, PCS, broadband, optical Network aware applications, Application of Advanced Technology, Waveforms, signal processing, antennas, adaptive techniques, UWB, laser communication, Military Satellite Systems, Future Terrestrial & Airborne Systems/Networks, Secure and Robust Network, Network Operations.

The conference theme for 2003 is "Transformation: Power to the Edge".

Milcom 2004

Oct. 31 – Nov. 3, 2004,

Monterey, CA, USA

VTC 2003 Fall

Oct. 4-9, 2003,

Orlando, Florida, USA

The IEEE Semiannual Vehicular Technology Conference aims to capture and present the current state of the innovative and highly active mobile wireless industry, presenting the changing face of wireless technology and a glimpse in the future of this exciting field. Highly qualified technical papers and posters will be presented, along with tutorials, business application/panel sessions and exhibits.

CONFERENCE CALENDAR

CONFERENCE	LOCATION	INFORMATION
PIMRC 2003 Personal, Indoor and Mobile Radio Communications	September 7 - 10, 2003, Beijing, China	http://www.pimrc2003.org/
VTC 2003 Fall The 58th IEEE Semiannual Vehicular Technology Conference	Oct 4-9, 2003 Orlando, Florida, USA	http://www.vtc2003.org/
MILCOM 2003 IEEE/AFCEA Military Communications Conference	Oct 13 - 16, 2003, Boston, MA, USA	http://www.milcom.org/2003/
GLOBECOM 2003 IEEE Global Communications Conference	Dec 1 - 5, 2003, San Francisco, CA, USA	http://www.globecom2003.com/
INFOCOM 2004 23rd IEEE International Conference on Computer Communications	March 7-11, 2004 Honk Hong	http://www.ieee-infocom.org/2004/
WCNC 2004 IEEE Wireless Communications and Networking Conference	March 21-25, 2004 Atlanta, Georgia, USA	http://www.comsoc.org/confs/wcnc/2004/index.html
NOMS 2004 IEEE / IFIP 2004 Network Operations and Management Symposium	April 19-23, 2004 Seoul, Korea	http://www.noms2004.org/
ICSSC 2004 AIAA 22 nd International Communication Satellite Systems Conference	May, 9-12, 2004 Monterey, CA, USA	http://www.aiaa-icssc.org/
VTC 2004 Spring The 59 th IEEE Semiannual Vehicular Technology Conference	May, 10-14, 2004 Genoa, Italy	http://www.vtc2004spring.com/
ICC 2004 International Conference on Communications	June 20 - 24, 2004, Paris, France	http://www.icc2004.org/
MILCOM 2004 IEEE/AFCEA Military Communications Conference	Oct 31 – Nov. 3, 2004, Monterey, CA, USA	e-mail: MILCOM2004x@comsoc.org
VTC 2004 Fall The 60th IEEE Semiannual Vehicular Technology Conference	September 26-29, 2004 Los Angeles, CA, USA	http://www.aero.org/conferences/vtc2004fall/

To all SSC members: If your postal or e-mail addresses, telephone or fax numbers have changed, please update them with the committee secretary. You can review our current records on our web page at www.comsoc.org/socstr/techcom/ssc

Satellite Communications: a technical perspective

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Introduction

The deep transformations that are characterizing the global communication world are dominated by the recurring word "integration". Residential, moving, traveling user are asking for the ability to use the same services on various and heterogeneous conditions of their life.

The new Internet users demand is the access to multimedia services with a guaranteed level of quality, at high rate, even while they are in motion. Terrestrial networks will satisfy these requirements only with the support of satellite systems. The added value is the realization of a single global communication network providing to the end users multimedia high bit-rate services with different profiles, irrespective of location, motion, distance from the content provider and with a seamless access to the space or terrestrial segments.

Satellite Systems

Several aspects contributed over the past years to a radical change of the global business perspective for satellite systems. Recent failures of LEO companies consolidated the satellite services in the traditional broadcasting area. Nevertheless the impulse of the Internet related technologies, as well as their integration with third and fourth generation of personal communications, increased the interest for satellites in their role of one-to-many delivery of multimedia streams. An exponential growth of the number of subscribers characterized the 2nd generation of mobile cellular systems; the current Universal Mobile Telecommunications (UMTS) instead is designed to provide services with variable bitrate to satisfy the requirements of high speed customers. The satellite component of UMTS (S-UMTS) will play, among the others, the fundamental role of delivering multicast video services to UMTS subscribers without loading the critical terrestrial wireless segments. With this key can be analyzed the recent FCC decision of granting the use of the terrestrial spectrum for mobile satellite services for the 2 GHz bands (Big LEO, L bands). The terrestrial component is allowed only when a sufficient satellite signal is not present (e.g. for urban or indoor coverage). The above considerations also explain the search for a sophisticated design of the space platforms aimed at increasing their lifetime considerably. As an example the W3A GEO satellite from Eutelsat, scheduled for launch in this year, is expected to be operational for over 12 years. The coverage is another key issue. Wide area coverage contrasts with high capacity, especially if the earth terminal antenna has to be small and with limited transmission power. This is solved reducing the footprint size. One example of this trend is the iPSTAR satellite system which provides a wide area cellular-like coverage for two-way satellite access up to 4 Mbps in the uplink.

Services

If in the deployment area we are experiencing the effects of the loss of confidence for some satellite systems, the service segment is certainly more active. The leading application for newborn system is the Direct-to-home Internet access with or without satellite return. Several operators are entering this business with various technologies. The common characteristics of this service are summarized in: asymmetric traffic, multiplexed downlink stream on DVB or DVB-like TDM format, shared uplink channel based on TDMA. The main technological effort [1] is devoted to the integration of digital broadcast services, like DVB and DAB with a packet oriented two-way communication with the end user. This will enable a new form of interaction between the consumer and the Content Provider, enabling services like Personal TV, on-demand download of files and movies and many other interactive services.

The request for Internet connectivity of traveling people also created new sectors where satellites have a fundamental role: Internet access on intercontinental flights and trans-oceanic cruises are two examples. The general trend about the provision of connection services on moving vehicles is the integration with positioning services provided by the well known GPS system and the future European GALILEO. The knowledge of the geographical position of the user terminal allows a remarkable increase in the channel capacity and provides an added value to the contents. The positional information can be used for a customization of the services. Among these new services are worth noting the real-time interactive maps, detailed traffic information, real-time weather forecast and remote monitoring and surveillance of sensible buildings.

Technologies

New technical challenges in designing and implementing the satellite based Internet are necessary. Two main elements dominate most of the technological efforts in this area: a large population of users sharing a limited radio resource for high speed content delivery, the need of a proper classification of the Internet traffic for various purposes ranging from the preservation of the quality to pricing issues. In this direction prioritized schemes for the medium access control (MAC) are deeply analyzed in the literature. A possible way to implement QoS at MAC level is to include dynamic demand-based resource assignment. Schemes like PRMA [3] and free resource pre-assignment as in DVB-RCS belong to this DAMA class. In PRMA the assignment of time slots to terminals is not fixed, but is dynamically handled on the basis of the presently active terminals. PRMA provides a high efficiency in managing voice and data traffic and is quite insensitive to the variations of round trip delay in LEO systems. Another key issue is related to the network layer. The efficiency for the LEO systems strictly depends on the exploitation of global routing policies made available by Inter-Satellite Links (ISL) [2]. ISL for LEOs are an attractive feature since they allow complex routing schemes with reduced latencies. The main challenging aspect concerning ISL is the management of the complex dynamical routing structure composed by the moving constellation of satellites. Routing/splitting approaches and algorithms known from terrestrial networks have to be tailored to dynamic satellite constellation taking into account the constraints of time-variance of the LEO ISL scenario. A new concept for connection-oriented ATM-based routing for periodically time-variant ISL networks has been developed, called *Discrete-Time Dynamic Virtual Topology Routing (DT-DVTR)* [4]. Besides the consolidated radio technologies, wireless optical ISL (laser) are gaining a considerable interest today. The European Space Agency has recently conducted successful tests of large images transmission from the Artemis satellite to SPOT4 using laser ISL technology. Given the power limitation, especially in the up-link, the solution to reduce the shadowing effects is the *satellite diversity*. Satellite diversity is the general case where at least two satellites cover a given location on earth. It results in an overlap of the satellite footprints delimiting the area where the satellites are seen above a specified elevation angle. A common feature of all non-GEO constellations is to provide continuous coverage of the service area. Selection diversity (the strongest signal are selected) and spatial diversity (a combination of the received signals is performed) are the most promising techniques. Satellite antennas can be configured either to cover the service area with fixed beams or with beams dynamically varying in shape and size using active antenna arrays. In satellite diversity a user can exploit different satellites inside its field of view in order to reduce the probability to have bad propagation conditions. The challenging aspect here is the control of the inter-satellite and inter-beam handoff procedure. In the literature efficient schemes providing diversity for CDMA based systems are present. CDMA access is chosen accordingly to recent 3GPP specifications. Another fundamental technical issue is related to the choice of the transport protocols: the Internet is based on IP, a fully compatible IP architecture has been defined by 3GPP for the terrestrial component of UMTS, therefore a high level of IP compatibility is required also for satellite networks. Nevertheless, on satellites, errors during transmissions and long round-trip delays limit the performance of the TCP/IP-based applications. The session establishment latency is quite large because the whole message needs to be retransmitted even if only a part of message is lost due to the highly unreliable condition of the satellite channel. IP, native or encapsulated over ATM or DVB, is considered the most agreed evolution. The main advantage is the natural integration with existing terrestrial networks, mainly IP based. Terrestrial IP implementations are moving towards a complete QoS provision with support for scalable multicast streams. It is advisable that also on the satellite IP segments the same features will be addressed. The provision of these services, along with the solution to the limited TCP performance caused by long RTTs make the protocol design and optimization problem a fundamental research aspect in the development of next generation satellite systems.

References

- [1] E. Del Re, L. Pierucci, L. S. Ronga, "Trends in Satellite Communications", ICC 2002, Apr 28th 2002, New York, US.
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- [4] M. Werner, "A Dynamic Routing Concept for ATM-Based Satellite Personal Communication Networks" IEEE JSAC , vol.15,n.8,oct.1997, pp1636-48

SSC COMMITTEE MEMBERSHIP APPLICATION

You can participate in the SSC Committee as a member by attending the SSC Committee meeting which is held twice a year during ICC and GLOBECOM conferences or you can participate as an associate member by filling in and mailing the application form below (preferably send an e-mail with the same information). Please note there is no difference between a member and an associate member except that an associate member has never attended an SSC Committee meeting.

The members and associate members can receive various information through the SSC newsletter and on our web page at <http://www.comsoc.org/socstr/org/operation/techcom/ssc/>, and also may propose hot topics, workshops and tutorials as well as provide paper reviews for conferences and publications. The members and associate members may provide regional conference / workshop information to the Editor which may appear in the SSC newsletter and on our web page if it is applicable to the committee's charter.

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Stamp
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Paper topics you would like to review (optional) _____

Please Note: Your contact information will appear on our web page unless requested otherwise.