

# SATELLITE AND SPACE COMMUNICATIONS

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**IEEE  
COMMUNICATIONS  
SOCIETY**



**SSC**

**SSC Newsletter**

**Vol. 12, No. 2, November 2002**

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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: Grand Hyatt Taipei**  
**Room: Swan**  
**Date: Tuesday Nov. 19<sup>th</sup>**  
**Time: 12:30 pm - 2:00 am**

### Future SSC Meetings

May 2003	Anchorage
December 2003	San Francisco
June 2004	Paris

### GLOBECOM 2002 SSC Committee Activities

Tutorial T-08, Broadband Wireless IP –  
Architectures and Protocols  
Sunday 17 Nov. - Afternoon, 14:00 – 17:30  
Prof. Abbas Jamalipour

Satellite Communications Symposium,  
SAT-01 Transmission Techniques and Resource Allocation,  
Monday 18 Nov. – 9:30-12:20, Rm 202, TICC  
SAT -02 CDMA Systems  
Monday 18 Nov. – 14:15-16:37, Rm 202, TICC  
SAT -03 Routing  
Monday 18 Nov. – 16:37-17:45, Rm 202, TICC  
SAT -04 Satellite Communications  
Tuesday 19 Nov. – 9:00-10:30, Rm 202, TICC  
SAT -05 TCP over Satellite  
Tuesday 19 Nov. – 11:00-12:30, Rm 202, TICC

Tuesday, 19 November, 12:30 - 2:00, Lunch  
SSC Technical Committee Meeting



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## SSC COMMITTEE OFFICERS

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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. In this, our 40th Anniversary year, please renew your commitment to this exciting field and find 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.

At our last meeting we had a change of officers. I would like to thank Iwao Sasase for his leadership as Chair for the past two years. Abbas Jamalipour has taken the roles of Vice Chair and Awards Subcommittee Chair, and I greatly appreciate his efforts recently in administrating the first presentation of our committee's "Distinguished Contributions to Satellite Communications Award." The award will be presented at our committee meeting at Globecom 2002. I also want to extend a welcome and thank you to Mario Marchese who is now our Secretary, Webmaster and the Editor of this Newsletter.

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](http://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

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multiple papers on a subject in a single issue. SSC members help to organize these features by 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*

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## SCANNING THE WORLD

*Abbas Jamalipour*

In this issue of SSC Newsletter, I would like to update the members about some recent news on satellite communications industry. Satellite communications industry same as other sections of the telecommunications industry and in particular the 3G wireless cellular has experienced many difficulties in the past few years. For the satellite industry with huge investment requirements and strong competition with the terrestrial cellular networks the situation was even worse. It was in September 1998 that the complex LEO satellite system Iridium started its global satellite service after almost a decade of intense research and development and spending atop \$5 billion. Almost a year after that the company slid into bankruptcy leaving the sky with around 70 satellites that used the most advanced technologies to be burned up in the atmosphere.

Iridium was one-of-a-kind satellite phone system that could provide coverage to all parts of the world, thanks to its unique 66-satellite constellation on six polar orbit planes, inter-satellite links, and spot-beam cellular-like design. No other satellite or terrestrial system could provide such global coverage but it seems that the high running and service cost of Iridium has overshadowed all its benefits. However, the recent development during the Afghanistan war has changed this situation when the company has gone into a really fat contract with the Pentagon. The Iridium could demonstrate a stellar performance there and now is looking to get new customers. It would be a long way until those satellite phones become an everyday accessory for ordinary people but keeping the first systems running will maintain the hope for such a day alive.

Other news on satellite communications industry are also positive. A report given during the US Space Foundation's International Space Symposium in Toulouse, France, 10-13 September 2002 suggests some recovery signs in satellite industry, according to SatNews Online Magazine. The report which is based on a recent survey by the Teal Group (an aerospace and defense consulting firm which provides market intelligence to government and industry) forecasts a 52% increase in both the number and value of

satellites that will be launched this year, compared to last year. In the year 2000, 40 commercial satellites with a value of \$4.24 billion were launched. In 2001 and 2002 these numbers were 16 and 33 with respective values of \$1.65 and \$3.42 billion. The 61% drop in value of commercial satellites in 2001 is a clear indication of market problem with satellite technology during last year. The study also suggests that in 2003, 31 satellites will be launched to earth orbit. Of the total 120 satellites 95% are communications satellites and the rest are for earth imaging. 84% of those satellites were GEO and 16% LEO.

Satellite IP service is among future facilitators for the satellite communications recovery. Among the news on this fascinating service, it is announced that the new Inmarsat's Regional Broadband Global Area Network (Regional BGAN) will be launched by the end of this year. The Regional BGAN offers reliable, 24-hour a day IP connectivity at up to 144 kbps via a secure channel and will be available in Europe, Asia, and northern and central Africa. The system provides simple, more cost-effective, portable satellite communications, faster than GPRS to LANs, WANs, intranets, and the Internet, regardless of the availability of local terrestrial networks.

Global spread of broadband Internet would not be achievable without satellites. Both GEO and LEO satellites are potential systems to make this a reality regardless of availability of terrestrial infrastructures. The future of satellite communications is bright and should not be underestimated by recent economic downturn that affected all industries. The high-speed IP connectivity via broadband downlink satellite channels to small office/home office (SOHO) and in-flight LANs will be a reality in near future. Some examples of SOHO has already deployed in some countries such as Brazil by the Star One operator using VSAT terminals.

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

**FORTHCOMING  
GLOBECOM AND  
ICC CONFERENCES**

**COSPONSORING / RELATED  
CONFERENCES AND WORKSHOPS**

**ICC 2003**

May 11 - 15, 2003,  
Anchorage, Alaska

**Globecom 2003**

Dec. 1-5, 2003,  
San Francisco, CA, USA

**ICC 2004**

June 20 - 24, 2004,  
Paris, France

**Milcom 2003** (Oct. 13 - 16, 2003, Boston, MA, USA)

MILCOM 2003 is soliciting both unclassified and classified papers on military communications. The conference theme for 2002 is "Transformation: Power to the Edge". Abstracts due is January 10, 2003 and draft papers due is March 1, 2001. There will be related topics of "Architectures", "Mobile Networks" and "Military Satellite Systems".

**ICSSC 2003** (April 15-19, 2003, Yokohama, Japan)

21st AIAA International Communications Satellite Systems Conference and Exhibit; <http://www.aiaa-icssc.org/>  
The theme of the conference is "The Impact of Communications Satellites on the Information Infrastructure." It will focus on satellite services and applications while addressing more traditional satellite technology topics. The conference will provide a forum to present advances in communication techniques, ground and on-board technologies, spacecraft and launch vehicles, satellite systems architecture, applications and services in the field of multimedia satellite communications, for fixed, broadcast, mobile, and personal applications.

**CONFERENCE CALENDAR**

<b>Conference</b>	<b>Date / Location</b>	<b>Information</b>
<b>WCNC 2003</b> IEEE Wireless Communications and Networking Conference	March 16-20, 2003 New Orleans, LA, USA	<a href="http://www.comsoc.org/confs/wcnc/2003/index.html">http://www.comsoc.org/confs/wcnc/2003/index.html</a>
<b>INFOCOM 2003</b> 22 <sup>nd</sup> IEEE International Conference on Computer Communications	March 30 - April 3, 2003 San Francisco, CA, USA	<a href="http://www.ieee-infocom.org/2003/">http://www.ieee-infocom.org/2003/</a>
<b>ICSSC 2003</b> 21st AIAA International Communications Satellite Systems Conference and Exhibit	April 15-19, 2003 Yokohama, Japan	<a href="http://www.aiaa-icssc.org/">http://www.aiaa-icssc.org/</a>
<b>VTC 2003 Spring</b> The 57th IEEE Semiannual Vehicular Technology Conference	April 22-25, 2003 Jeju, Korea	<a href="http://www.vtc2003spring.org/">http://www.vtc2003spring.org/</a>
<b>ICC 2003</b> International Conference on Communications	May 11 - 15, 2003 Anchorage, Alaska	<a href="http://www.icc2003.com/">http://www.icc2003.com/</a>

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<b>PIMRC 2003</b> Personal, Indoor and Mobile Radio Communications	September 7 - 10, 2003, Beijing, China	e-mail: hamid.aghvami@kcl.ac.uk
<b>VTC 2003 Fall</b> The 58th IEEE Semiannual Vehicular Technology Conference	Oct 4-9, 2003 Orlando, Florida, USA	<a href="http://www.vtc2003.org/">http://www.vtc2003.org/</a>
<b>MILCOM 2003</b> IEEE/AFCEA Military Communications Conference	Oct 13 - 16, 2003, Boston, MA, USA	<a href="http://www.milcom.org/2003/">http://www.milcom.org/2003/</a>
<b>GLOBECOM 2003</b> IEEE Global Communications Conference	Dec 1 - 5, 2003, San Francisco, CA, USA	<a href="http://www.globecom2003.com/">http://www.globecom2003.com/</a>
<b>INFOCOM 2004</b> 23rd IEEE International Conference on Computer Communications	March 7-11, 2004 Honk Hong	<a href="http://www.ieee-infocom.org/2004/">http://www.ieee-infocom.org/2004/</a>
<b>WCNC 2004</b> IEEE Wireless Communications and Networking Conference	March 29-31, 2004 Dallas, TX, USA	e-mail: WCNC2004x@comsoc.org
<b>ICSSC 2004</b> 22nd AIAA International Communications Satellite Systems Conference and Exhibit	9-12 May 2004 Monterey, CA, USA	<a href="http://www.aiaa-icssc.org/">http://www.aiaa-icssc.org/</a>
<b>VTC 2004 Spring</b> The 59th IEEE Semiannual Vehicular Technology Conference	May, 2004 Genoa, Italy	<a href="http://ewh.ieee.org/soc/vts/conf/vtsconf.html">http://ewh.ieee.org/soc/vts/conf/vtsconf.html</a> Contact: Prof. F. Vatalaro e-mail: vatalaro@ing.uniroma2.it
<b>ICC 2004</b> International Conference on Communications	June 20 - 24, 2004, Paris, France	<a href="http://www.icc2004.org/">http://www.icc2004.org/</a>
<b>MILCOM 2004</b> IEEE/AFCEA Military Communications Conference	Oct 31 – Nov. 3, 2004, Monterey, CA, USA	e-mail: MILCOM2004x@comsoc.org
<b>VTC 2004 Fall</b> The 60th IEEE Semiannual Vehicular Technology Conference	Fall, 2004 Los Angeles, CA, USA	<a href="http://ewh.ieee.org/soc/vts/conf/vtsconf.html">http://ewh.ieee.org/soc/vts/conf/vtsconf.html</a> Contact: Dr. Sumner. S. Matsunaga e-mail: Sumner.S.Matsunaga@aero.org

**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](http://www.comsoc.org/socstr/techcom/ssc)

**NOTES ON SATELLITE COMMUNICATION NETWORKS: ENVISIONING PAST AND FUTURE IMPROVEMENTS**

Romano Fantacci (2002 SSC Award Recipient)

Dipartimento di Elettronica e Telecomunicazioni, Università di Firenze, Firenze, ITALY

Satellite communication buffs might remember that it was Arthur C. Clarke who first envisioned exploiting the 36,000 km equatorial orbit for global communications in 1945 [1]. Proof of his farsightedness was not long in coming: In 1964, Syncom III, the world's first operating geostationary satellite, successfully broadcast the Tokyo Olympics to TV audiences all over the United States. Since then, satellite communication systems have made remarkable advances in implementation technologies, transmission schemes, and access protocols that have become increasingly efficient in an ever-broadening range of user services. Today, in order to fulfill the rapidly increasing demand for multimedia services sparked by the exponential growth of TCP/IP applications, satellite communication systems must provide an adequate number of broadband connections. This requires highly efficient multiple access control (MAC) and resource management schemes to provide affordable quality of service (QoS) comparable to terrestrial for all types of satellite traffic. What follows is a summary of the recent developments in satellite communication networks, with a brief description of the research projects I've been involved in as part of our worldwide efforts to reach the stated goals.

**IMPROVING MULTIPLE ACCESS CONTROL**

MAC schemes that provide diverse types of service according to individual QoS constraints are of paramount importance in satellite communication networks. To this end, we recently proposed two efficient MAC schemes capable of operating with real-time and best-effort traffic [2-3]. The scheme in [2] is based on a modified version of the packet reservation multiple access (PRMA), which is a time division multiple access (TDMA) protocol combining random access with slot reservation. Two types of traffic were analyzed: conversational, which is delay-sensitive and loss-tolerant and best-effort data, which is loss-less, but delay tolerant. In the modified scheme, access on the shared channel is statistically arbitrated, i.e., the user terminals independently access the shared channel according to a specified permission probability. The slots are not permanently allocated, but are rather dynamically handled on the basis of the number of active user terminals and type of traffic. By applying the queuing system theory, we can demonstrate that the modified scheme outperforms its classical TDMA counterpart with negligible degradation in comparison to terrestrial systems. We also investigated the influence of satellite constellation altitude on performance and demonstrated that low earth orbit (LEO) constellations outperformed all others. We proposed and analyzed a MAC scheme based on the wideband code division multiple access (W-CDMA) technique [3]. The W-CDMA technique currently being applied in third generation (3G) mobile communication systems has many advantages: It enables frequencies to be fully reutilized, it is easily adaptable to variable rate services, and it can be used with adaptive interference mitigation techniques. Of primary importance in 3G mobile communication systems is the efficient handling of the W-CDMA signals at the physical layer. In these systems, the number of simultaneously served users must be increased as much as possible and, by the same token, the effects of multiple access interference on receiver performance must be decreased as much as possible without excessively increasing implementation complexity. We have developed three high efficiency detection schemes that fulfill both requirements: one [4] based on a modified version of the parallel interference cancellation approach; one [5] based on the minimum mean square error criterion; one [6] based on the use of an advanced neural network to increase convergence speed. Our most recent effort [3] involves a W-CDMA MAC scheme designed to fulfill the requirements of the next-generation mobile satellite networks. Also in this case, we examined both conversational and best-effort traffic. In view of its excellent performance under different traffic load conditions and with different transmission scenarios, we can recommend its application to the integrated satellite-terrestrial universal mobile telecommunication systems (UMTS) presently undergoing development.

**IMPROVING RESOURCE MANAGEMENT**

Owing to the severely limited amount of bandwidth allocated to current satellite communication networks with respect to forecast market demands, resource management is a critical factor in satellite communication systems. Two allocation methods are currently used to manage resources:

- Fixed allocation: In fixed allocation, a group of resources (either time slots, frequency bandwidths or codes) are permanently assigned to each satellite spotbeam or cell. While providing accurate multiple access interference control, this approach has the drawback of low resource utilization.
- Dynamic allocation. In dynamic allocation, the resources are temporarily assigned to a cell according to preset criteria [7-8]. While providing better performance in terms of low request blocking probability and high resource utilization, this approach has the drawback of usually resulting in steep increases in computational effort.

Of critical importance, especially in LEO satellite constellations, is the efficient management of interbeam handoff requests to ensure low blocking probability (i.e., handoff requests are blocked whenever the new cell lacks resources). The user-perceived QoS is far better if the network ensures the lowest probability of forced termination of outgoing rather than incoming sessions. We have proposed several schemes in keeping with this consideration [6-9]. They are based on the possibility of queuing handoff requests as an available resource from the time the handoff request has been notified to the satellite to the time the connection through the original beam is no longer possible. We analytically showed in [8] and [9] that first-in first-out (FIFO) queuing attains performance levels close to optimum as derived by an ideal prioritized queuing scheme where the handoff requests are dynamically queued according to the amount of time remaining before an active session is forcibly terminated.

To develop satellite networks compatible with 3G terrestrial mobile communication systems, we must define appropriate resource allocation schemes that take into account the physical layer schemes being used, i.e., we must necessarily consider the interference level from simultaneous users in a multirate W-CDMA scenario. According to recent research, this can be accomplished by a resource allocation scheme based on the estimation of the signal-to-noise-plus-interference ratio (SINR) for each session that prevents QoS degradation deriving from the entry of new sessions. Lastly, it should be emphasized that the next generation satellite networks will require more efficient resource management, especially with regard to estimating traffic loads. This may apparently be accomplished by modeling traffic behavior patterns through self-similar statistic processes. The validity of this approach has been demonstrated by the closeness of the models—which consider correlations among arrival processes—to actual network traffic behavior patterns. As a consequence, we have proposed a proactive resource allocation scheme in which traffic stream priorities are related to the required band estimation. In analytical results, the proposed scheme exhibits lower scheduling latency, thereby enhancing the QoS.

### **IMPROVING DATA TRANSMISSION RELIABILITY**

Greater efficiency in error control techniques at the data link layer to enhance data transmission reliability will make it possible to meet the stringent requirements of future satellite network services. The example in [10] is a generalized automatic repeat request (ARQ) scheme for error control in satellite communication systems. Its outstanding feature is the use of all the transmitted copies of a same packet at the receiving end to increase throughput performance while reducing packet transmission delay. Advanced research aimed at integrating efficient ARQ protocols with advanced channel coding schemes such as turbo coding for multirate W-CDMA based satellite networks is currently under way. The underlying principle is the reutilization of all the turbo-decoder outputs, even when the packets have been erroneously received. The results so far have been dramatic increases in throughput and network capacity combined with reduced transmission power demand at the satellite station.

### **CONCLUDING REMARKS**

The challenge for the satellite community is evident: We must provide mobile and fixed users with advanced broadband TCP/IP services over large geographic areas, as well as efficient interaction between terrestrial wired and wireless networks. This goal is not unattainable: As Arthur C. Clarke teaches, the visions of today are the operating schemes of tomorrow.

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## SSC COMMITTEE MEMBERSHIP APPLICATION

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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.