

SATELLITE AND SPACE COMMUNICATIONS

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IEEE COMMUNICATIONS SOCIETY



SSC Newsletter

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CONTENTS

SSC Committee Meetings	1
GLOBECOM 2006 SSC Activities	1
How to join SSC Committee and mailing list.....	2
Officers	2
Message from the Chair.....	2
Scanning the World	3
Forthcoming ICC and GLOBECOM.....	4
Cosponsoring/Related Conferences and Workshops.....	4
Conference Calendar	5
Perspective Article.....	6

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.

**Location: Room
Florentine/Garden,
Hotel Mark Hopkins**

Date: Tue. 28 November 2006

Time: 17:00 - 18:30

GLOBECOM 2006 SSC Committee Activities TUTORIALS & WORKSHOP (Nov. 27th and Dec. 1st)

TECHNICAL SYMPOSIA (Nov. 28th – Nov. 30th)

- SAT-01: Performance Evaluation of Satellite Communication Systems, Wednesday, 29 Nov., 14:00–15:45.
- SAT-02: Physical Layer Solutions for Satellite Communications, Wednesday, 29 Nov., 16:15–18:00.
- SAT-03: Resource Optimization in Satellite Systems, Thursday, 30 Nov., 10:00–11:45.
- SAT-04: Routing and Mobile Networking in Satellite Networks, Thursday, 30 Nov., 14:00–15:45.
- SAT-05: Solutions for Next Generation Satellite Networks, Thursday, 30 Nov., 16:15–18:00.

Future SSC Meetings

Nov. 2006 San Francisco, CA, USA

June 2007 Glasgow, Scotland, UK

Nov. 2007 Washington, D.C., USA



HOW TO JOIN SSC COMMITTEE AND MAILING LIST

If you like to join SSC Technical Committee: Please send your name and e-mail address to the SSC Secretary, optionally include your mail address, telephone and fax numbers.

If you like to join SSC Mailing List: Instructions on how to subscribe/unsubscribe are available at <http://cassius.ee.usyd.edu.au/mailman/listinfo/ssc>.

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MESSAGE FROM THE CHAIR

Mario Marchese

This is my first "Message from Chair". I was elected during our last Meeting in Istanbul. First of all, I would like to deeply thank the Past Chair, Prof. Abbas Jamalipour, for his hard work within SSC TC. I am convinced that most of the recent results we have obtained are due to his scientific and service skills. I hope he will continue to work with our Committee for the benefit of the Committee itself. I would like also to thank Prof. Takaya Yamazato and Dr. Tarik Taleb, the new Vice-Chair and Secretary of the Committee, respectively, for their availability. I am sure we will work together with great strength to reach fruitful results.

The first duty of my role has been the recertification process. I sent our recertification document to Prof. Sergio Benedetto, Vice President - Technical Activities, on last September. The main activity of the TC has concerned the dissemination of the results produced by the Satellite and Space Communication community. Many conferences have been sponsored and co-sponsored. A list with the

main conferences organized by SSC TC members/sponsored by the TC/heavily involving SSC TC Members in the TPC, has been reported in the recertification document including recent Globecom and ICC conferences. We have our own TC Newsletter published twice per year, distributed at ICC and Globecom, e-mailed to TC members and posted permanently on SSC TC website. It is edited by SSC Vice-Chair and it is composed of 8 pages. It includes a Perspective Article, which is structured in three double columns pages, is formatted as IEEE Communications Letters and reports a contribution of one or more SSC Members concerning topics of interest for the community. It can be either a research or a tutorial contribution.

Our Members are involved as Editors of international journals and magazines: IEEE Wireless Communications Magazine, "Scanning the Literature", International Journal of Communications Systems (Wiley), Journal of Communications and Networks (JCN), International Journal of Sensor

Networks, and the International Journal of Business Data, Communications and Networking. The following Special Issues have been organized: IEEE Journal on Selected Areas in Communications (J-SAC) in February and April 2004, on the topic of "Broadband IP Networks via Satellites" - Guest Editors Abbas Jamalipour, Satchandi N. Verma, Jason Neale, Mario Marchese, Haitham S. Cruickshank; IEEE Wireless Communications - Special Issue on Key Technologies and Applications of Present and Future Satellite Communications - Guest Editors Prof. Abbas Jamalipour and Prof. Mario Marchese, October 2005, vol. 12, no 5; IEEE Wireless Communications - Special Issue on The Synergy of Space and Terrestrial Communications in Next-generation Hybrid Wireless Systems - Guest Editors Prof. Antonio Iera, Prof. Antonella Molinaro, Dr. Ki-Dong Lee and Dr. Apostolis Salkintzis, October 2005, vol. 12, no 5; Publication of a Feature Topic issue on satellite communications in December 2005, IEEE Wireless Communications Magazine (4 papers); Computers and Electrical Engineering Journal - Special Issue on Recent Advances in Wireless Networks and Systems - Guest Editors Prof. Mohammad Obaidat and Prof. Mario Marchese.

TC promotes the Satellite Communications Distinguished Service Award. This award aims to promote research and development activities in the area of satellite communications within the industry and academia research community. The award is established as part of the Satellite and Space Communications Technical Committee activities in involvement in the new developments taking place in

the field. The award is announced and given during the IEEE GLOBECOM conference.

Major achievements of the TC consist in its recent intensive activities in ICC/GC and the great scientific push given by the TC concerning publications about satellite communications. As a result of this hard work, the TC could secure a symposium exclusively devoted for research works in the area of satellite and space communications at upcoming Globecom'06.

Despite the significant research work in the field of satellite and space communications, the TC officers see that there is lack of special symposia at ICC/GC devoted for researches on satellites. The committee members and officers should push for more recognition of the importance of satellite activities from the COMSOC community both in COMSOC conferences and in COMSOC journals.

I would like to promote further the presence of satellite communications in IEEE main conferences, issues of journal and magazines. I strongly invite all the Members to contribute to make the activity of our Committee a success.

*Prof. Mario Marchese, Chair
Satellite and Space Communications
Technical Committee*

SCANNING THE WORLD

Takaya Yamazato

In this issue, I will introduce two Japanese satellites projects, ETS-VIII and WINDS, and a trend in satellite communications, software-radio in space.

ETS-VIII



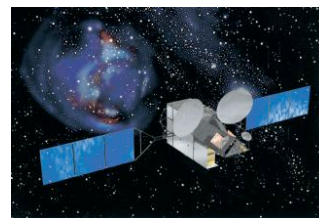
Japan's first 3-ton-class geostationary satellite, ETS-VIII (Engineering Test Satellite), will be launched on December 16, 2006, two weeks after Globecom2006.



The ETS-VIII is equipped with two Large Deployable Antenna Reflectors (LDRs). The LDR will be deployed on orbit by expanding its 14 hexagonal umbrella-like modules simultaneously forms a

parabola surface with expanding metal mesh (19m x 17m), as large as the size of a tennis court. The ETS-VIII will conduct orbital experiments on mobile satellite communications and high-speed packet communications with hand-held terminals in the S-band frequency.

WINDS



In February 2008, WIDS (Wideband InterNetworking engineering test and Demonstration Satellite) will be launched. The

WINDS is equipped with Ka-band active phased array antenna, that makes it possible to control the antenna communication direction flexibly and rapidly, and onboard ATM switching router, that conduct

packet cell based switching up to 155Mbps x 3 channels. The downlink data rate and the uplink data rate are 155Mbps and 6Mbps respectively with a small dish of 45cm (diameter). With 5-meter dish, 1.2Gbps transmission is possible.

Software-radio in Space

Although the transmission rate of 1.2Gbps is impressive, ATM switching is out of date for terrestrial switching technology. OFDM and the other advanced air-interfaces have already released to the market. To cope with the evolution of terrestrial transmission technology, software-radio based regenerative processor for satellite communication is drawing attentions.

European Space Agency (ESA) is considering an activity to implement a prototype platform, having demultiplexing-demodulating-decoding functionality for a multicarrier link, using an existing multicarrier

design and outcomes of an ongoing ARTES 1 activity.

Dr. Nozomu Nishinaga, National Institute of Information and Communications Technology (NICT) of Japan, is currently working on the Reconfigurable Communication Equipment (RCE) on SmartSat-1, 200kg-class small X-band satellite scheduled to be launched in 2009. The RCE is one of implementations of onboard Software Defined Radio (SDR) system. Two Bread Board Models of the onboard SDR has already developed. A multi-rate QPSK modulation and demodulation function from 2 kbps to 2 Mbps is implemented using seven FPGAs. An engineering flight model design is currently underway. Dr. Nishinaga plans to open this on-orbit satellite communications demonstration test bed to the research community.

*Prof. Takaya Yamazato, Vice-Chair
Satellite and Space Communications
Technical Committee*

FORTHCOMING GLOBECOM AND ICC CONFERENCES

ICC 2007

June 24 – 28, 2007, Glasgow, Scotland, UK

The Conference is aimed at addressing key themes on "Smart Communications Technologies for Tomorrow". The program will feature a General Conference, ten Specific Symposia, Applications Sessions and Tutorials. Prospective authors are invited to submit original technical papers for oral or poster presentations at ICC 2007 and publication in the Conference Proceedings.

IWSSC 2007 - 2nd Int. Workshop on Satellite and Space Communications

September 13 – 14, 2007, Salzburg, Austria

The objective of this workshop is to provide a forum for researchers and technologists to present new ideas and contributions in the form of technical papers, panel discussions and tutorials of ideas in the field of satellite communications. It is intended to bring together various satellite communication systems developers to discuss the current status, technical challenges, standards, fundamental issues, and future services and applications.

COSPONSORING / RELATED CONFERENCES AND WORKSHOPS

MILCOM 2007

October 29 – 31, 2007, Orlando, Florida, USA

MILCOM 2007 is soliciting both unclassified and classified papers (up to DoD Secret) relevant to communications and information processing system technologies and capabilities that address the 21st century challenges of National Defense, Homeland Security, Disaster Response and Interoperability as summarized above. Industry, academic and government organizations from both the US and countries around the globe are invited and encouraged to participate.

GLOBECOM 2007

November 26-30, 2007, Washington DC, USA

The theme of the IEEE GLOBECOM 2007 conference is "Innovate • Educate • Accelerate", which exemplifies the accomplishments that we are hoping achieve during this special Globecom Anniversary Conference. The technical program will consist of the General Symposium, 9 Technical Symposia, Tutorials and Workshops, Telecom Business Forums, Design and Developers and a Student Program

CONFERENCES CALENDAR

CONFERENCE	LOCATION	INFORMATION
WCNC 2007 Wireless Communications. And Networking Conference	11-15, March, 2007 Hong Kong, China	http://www.ieee-wcnc.org/
25th AIAA International Communications Satellite Systems Conference	10 – 13, April 2007 Seoul, South Korea	http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1447
ICC 2007	24-28, June 2007, Glasgow, Scotland, UK	http://www.ieee-icc.org/2007
SPECTS 2007 Int. Symp.on Performance Evaluation of Computer and Telecommunication Systems	16-18, July 2007, San Diego, California ,USA	http://eia.udg.es/SPECTS2007/
PIRMC 2007 18 th IEEE Int. Symp. On Personal , Indoor & Mobile Radio Communications	7-11, September 2007 Athens, Greece	http://www.pimrc2007.org/
IWSSC 2007 3 th Int. Workshop on Satellite and Space Communications	13-14, September2007 Salzburg, Austria	http://iwssc2007.sbg.ac.at/index.html
VTC2007 Fall 66th IEEE Vehicular Technology Conference	1-3, October 2007 Baltimore, USA	http://www.ieeevtc.org/vtc2007fall/
MILCOM 2007 Military Communications Conference	29–31, October 2007 Orlando, Florida, USA	http://www.milcom.org/2007/
GLOBECOM 2007 IEEE Global Communications Conference	26-30, November 2007 Washington, DC, USA	http://www.comsoc.org/confs/globecom/2007/

To all SSC members: If your postal address, telephone or fax numbers have changed, please update them with the committee secretary. You can review our current records on our web page at <http://www.comsoc.org/~ssc/>.

Towards the Revision of DVB-S2/RCS Standard for the Full Support of Mobility

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Introduction

Satellite communications developed to a tremendous global success in the field of analogue and then digital audio/TV broadcasting by exploiting the inherent wide-area coverage for the distribution of content. It appeared a "natural" consequence to extend the satellite services for point-to-point multimedia applications, by taking advantage of the ability of satellite to efficiently distribute multimedia information over very large geographical areas and of the existing / potential large available bandwidth in the Ku / Ka band. Particularly in Europe, due to the successful introduction of DVB-S [1], a promising technical fundament has been laid for the development of satellite communications into these new market opportunities using the second generation of DVB-S [2], as well as DVB-RCS [3] standards. Thus, for satellite systems currently under development and being designed to support mainly multimedia services, the application of the DVB-S2, for the high-capacity gateway-to-user (forward) links and of DVB-RCS for the user-to-gateway (return) links is generally accepted.

In addition to satellite multimedia services to fixed terminals, people are getting more and more eager to have broadband communications on the move. Mobile telephones subscriptions have exceeded fixed line subscription in many countries. Higher data rates for mobile devices are provided by new standards such as UMTS, HSDPA, 1xEV-DO. New standards for mobile broadcasting are also appearing, such as DVB-H [5].

At present, broadband access (e.g. to the Internet) and dedicated point-to-point links (for professional services) are primarily supplied by terrestrial networks. Broadband satcoms services are still a niche market, especially for mobile users. In this context, many transport operators announce the provision of TV services in ships, trains, busses and aircraft. Furthermore, Internet access is offered to passengers. With IP connectivity, also radio interfaces for GSM can be implemented for such mobile platforms by using satellite connectivity for backhauling.

Thus, DVB-S2/RCS appears an ideal candidate to be investigated for mobile usage, as it can ideally combine

digital TV broadcast reception in mobile environments (AirTV, luxury yachts, trains, etc...) and IP multimedia services.

Although an annex of RCS implementation guidelines [4] analyses the limitation under which the aforementioned standards could be used within mobile environments, it has to be kept in mind that they have not been designed for mobile use. Collective terminals installed in a mobile platform, such as train, ship or aircraft, are exposed to a challenging environment that will impact the system performance considering the current standard in absence of any specific provision.

Mobile terminals will have to cope in general with stringent frequency regulations (especially in Ku-band), Doppler effect, frequent handovers, and impairments in synchronization acquisition and maintenance. Furthermore, the railway scenario is affected by shadowing and fast fading due to mobility, such as deep and frequent fades due to the presence of metallic obstacles along electrified lines providing power to the locomotive [6] and long blockages due to the presence of tunnels and large train stations. This suggests that proper fading mitigation techniques and the interworking of satellite and terrestrial components are essential in order to guarantee service availability.

On October 26th, 2006, the Commercial Module of DVB (Digital Video Broadcasting) approved the commercial requirements for the extension of DVB-S2/RCS to mobile environment, thus clearing the way for a revision of the current standards towards the full support of mobility. The standardisation effort will first address the so called LOS (line of sight) scenario, namely aeronautical and maritime applications, and cover the non-LOS case (land vehicular and railway) at a later stage.

Envisaged Enhancements and Modifications

The possibility to define a new standard fully supporting mobility opens the way to propose enhancements and modifications to the existing standards that overcome the impairments of the mobile environment in its different scenarios, although backward compatibility must be kept in mind.

- **Need for Spectrum Spreading**

The stringent regulations for mobile terminals in Ku-band (having only secondary allocations for mobile satellite services) require careful consideration concerning the potential usage of spreading techniques, especially in the return link, and particularly for terminals with small antennas (e.g. down to 30 cm diameter for the maritime and aeronautical cases). This is due to the higher interference caused by adjacent satellites in the forward link and to the limitations about the radiated off-axis effective isotropic radiated power (EIRP) density in the return link when antennas with lower directivity are employed. The introduction of spectrum spreading is a possible solution to reduce the EIRP, while preserving the required SNR, at the obvious expense of a reduced spectral efficiency. In the forward link, the introduction of spreading requires the design of a new DVB-S2 receiver, where despread antennas anticipates the conventional blocks. In the return link, each terminal could in principle implement direct spreading within the assigned time and frequency slot according to the MF-TDMA approach used by DVB-RCS, as already proposed and tested in the framework of some experimental projects carried out by ETRI in South Korea.

- **Handover Procedures**

Since DVB-RCS is designed for fixed terminals, its adaptation to the mobile environment encompasses the definition of a reliable handover procedure for beam, satellite and gateway handover. Terminal roaming between different networks, and the related interoperability issues, shall be also taken into due account. Finally, for the non-LOS case, service availability can be ensured in shadowed areas by interworking with terrestrial networks, which requires the definition of additional handover procedures between satellite and terrestrial components, as well as the functional architecture of dedicated terrestrial gap fillers for some specific cases such as e.g. railway tunnels.

- **Fading Countermeasures for the non-LOS Scenario**

The more challenging propagation conditions of this scenario can be mitigated by more advanced physical layer solutions combined with advanced link reliability techniques such as diversity of high layer Forward Error Correction (FEC). Moreover, it is necessary to revise the network synchronization acquisition and maintenance procedures and the forward link signalling defined in the existing standards in order to better cope with the frequent fades.

SatNEx Contribution to the Upcoming Standardisation Effort

As clearly shown in the previous section, the design of a technically sound and reliable solution involves several research disciplines. In this light, the *Satellite Communications Network of Excellence*, SatNEx, funded by the European Commission in the 6th Framework Programme [7], involving a large number of European research institutions and enclosing the relevant expertise for the purpose of defining a new DVB standard fully supporting mobility, has set up a working group aiming at supporting this standardisation effort.

Advanced fading countermeasures are currently being investigated for the non-LOS case by combining physical layer solutions, such as antenna diversity (when applicable), with upper layer FEC techniques, following different design approaches. An additional novelty in this investigation is the adaptive parameterization of the selected fade countermeasures according to different QoS requirements in unicast multimedia transmissions, following a cross-layer approach. Furthermore, SatNEx is taking the revision of the standard as an opportunity to propose additional enhancements not specifically linked to mobility, such as more flexible encapsulation for the return link, aiming at a more efficient support of IP.

Another important pillar of the SatNEx investigation is the development of efficient resource management strategies taking into account mobility and its implications, such as the impact of spreading in combination with the MF-TDMA access scheme of DVB-RCS, the possible introduction of alternative access schemes for the support of handover events and the interworking with terrestrial networks or dedicated gap fillers in the land mobile and railway environments. Furthermore, adaptive scheduling techniques for the forward link and resource allocation techniques for the return link that are aware of the physical layer behaviour are also investigated in a cross-layer approach.

Protocols for handover events are also being investigated, in line with the ongoing standardisation process of ETSI Broadband Satellite Multimedia (BSM) working group [8].

Finally, security management in mobile environments considering different encapsulation methods, such as Unidirectional Lightweight Encapsulation (ULE) and Generic Stream Encapsulation (GSE) is being investigated, inline with IETF efforts.

References

- [1] EN 300 421 v1.1.2: Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services.
- [2] ETSI EN 302 307 v1.1.1: Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications.

SSC Newsletter

- [3] ETSI EN 301 790 v1.4.1: Digital Video Broadcasting (DVB): Interaction channel for satellite distribution systems.
- [4] ETSI TR 101 790 v1.3.1: Digital Video Broadcasting (DVB): Interaction channel for satellite distribution systems; Guidelines for the use of EN 301 790.
- [5] ETSI EN 302 304 v1.1.1: Digital Video Broadcasting (DVB); Transmission System for Handheld Terminals (DVB-H).
- [6] S. Scalise, V. Mignone and R. Mura, "Air Interfaces for Satellite Based Digital TV Broadcasting in the Railway Environment", *IEEE Transactions on Broadcasting*, 52 (2), IEEE, pp. 158 – 166.
- [7] <http://www.satnexus.org>
- [8] <http://portal.etsi.org>