
SATELLITE AND SPACE COMMUNICATIONS

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IEEE COMMUNICATIONS SOCIETY



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-three Technical Committees in the Society. The committee belongs to the Technical Committee Clusters of Communication/Signal Processing (C/SP).

SATELLITE & SPACE

- JOIN US -

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

Location: Conference Room 5 at BICC

Date: Wednesday, May 21, 2008

Time: 16:30 - 18:00

ICC 2008 SSC Committee Activities

GS01: Satellite Communications
Wednesday, May 21, 2008, 8:30 AM - 10:15 AM
Room 202, BICC

GS02: Satellite Networking
Wednesday, May 21, 2008, 10:45 AM - 12:30 PM
Room 202, BICC

GS03: Multimedia Satellite Systems
Thursday, May 22, 2008, 8:30 AM - 10:15 AM
Room 201-C, BICC

Future SSC Meetings

Nov.-Dec. 2008, New Orleans, U.S.A
Jun. 2009, Dresden, Germany
Nov.-Dec. 2009, Honolulu, U.S.A
May 2010, Cape Town, South Africa



19-23 MAY 2008

ICC 2008, BEIJING, CHINA

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 last Message of the Chair. I served as Secretary from July 2002 to June 2004, as Vice from July 2004 to June 2006, and as Chair from July 2006 up to June 2008. As Chair, first of all I would like to deeply thank the Past Chair, Prof. Abbas Jamalipour, for his hard work within SSC TC, Prof. Takaya Yamazato and Dr. Tarik Taleb, Vice-Chair and Secretary of the Committee, respectively, for their availability and capacity and for their constant support.

The first duty of my Chair role was the recertification process: the ComSoc BoG, upon recommendation of the Recertification Committee, have positively evaluated the overall activity of our Committee and approved its recertification up to year 2009. One of the suggestions to further improve our activity was to consider carefully the Charter of our TC and revise it. I worked immediately to match this last important request and, together with Past-Chair Abbas Jamalipour, Vice-Chair Takaya Yamazato and

Secretary Tarik Taleb, proposed our new Charter, approved by BoG and published on our web site. The text of our Charter is now: *"The Committee facilitates technical interchange in the field of satellite and space communications. It explores the evolution of new satellite and space-based systems and the application of new and emerging technologies, at all layers of the network protocol suite. The Committee maintains a keen interest in the development and maintenance of standards in this area and facilitates nomination of suitable candidates for IEEE awards, distinguished lecturer program, and IEEE Fellow elevation among its members. Specific technologies of current interest include: Satellite Air interfaces, Advanced Modulation/Demodulation and On-board Signal Processing; Advanced and Active Antennas; Architectures, Protocols and Applications for Satellites; Satellite IP; Integration with Terrestrial and Wireless Networks; LEO/MEO/GEO and HAPs Communications; Deep Space Communications; Broadcasting and High-definition television (HDTV); Advanced Global Navigation Satellite Systems; Integration of Communication and Navigation Systems; Satellite Network Control and Management."*

Major achievement of the TC consists in its intensive activities in ICC/GC and the great scientific push given by the TC concerning publications about satellite communications. In other words: the dissemination of the results produced by the Satellite and Space Communication community.

There is a good number of important conferences dedicated to satellites. We endorse most of them. These conferences convey many interesting papers on satellite communications and networking. That is a positive aspect.

Concerning ICC and GLOBECOM, we have an important strategic and scientific role. We had a Satellite and Space Communications Symposium at Globecom 2006; we endorsed the Wireless Networking Symposium at Globecom 2007 where satellite communications received a special attention; we have a dedicated Track about Satellite and Space Communications in the General Symposium here at ICC'08; we will have a dedicated Track about Satellite and Space Communications at Globecom 2008 in the Symposium on Selected Areas in Communications; and we will endorse both Wireless Networking and Wireless Communications Symposium at ICC'09.

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, 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; 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; IEEE Systems Journal on "Recent Advances in Global Navigation and Communication Satellite Systems (GNSS)", Guest Editors: Prof. M. S. Obaidat and Prof. M. 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.

My last words concern ICC'08 - GC, Satellite and Space Communications Track and GC'08 - SAC, Satellite and Space Communications Track, which we have endorsed and organized. Concerning the former, we have received 28 papers (39.3 % about communications at physical layer, 50 % about networking, and 10.7 % about radars). It is interesting to note that nearly 43 % of submitted papers may be classified within the framework of "Resource Allocation and Control" and implies the use of control techniques and methods to provide a solution, not necessarily for networking. Due to the very high quality of papers 17 out of 28, above 60%, were accepted at ICC'08. This is an excellent result nevertheless the small number of submitted papers. Among the accepted papers 47% concerns communications at physical layer, 41 % relates to networking, and 12 % concerns radar. More than 35 % of accepted papers may be classified within the "Resource Allocation and Control" framework.

Concerning the Satellite and Space Communications Track at GC'08, we have received 24 papers: 35 % is related to physical layer solutions, 52 % concerns networking, and 13% concerns radar. Also in this case it is important to note that 52 % of papers may be classified within "Resource Allocation and Control" framework.

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*

Giant of the SSC

On 14, February 2008, many of you received an email from our secretary, Dr. Tarik Taleb, asking the three following questions.

1. The most important technology in your S/C FOI (Field of Interest)
2. A short summary describing the technology and the state of development
3. Most importantly, the name and email address of a champion of the technology

The inquiries actually came from the new TAC Chair, Andrzej Jajszczyk, to all TCs. Thanks to Dr. Taleb, he quickly prepared the answers for 1 and 2, but three of SSC officers could not recommend the champion. The SSC chair, Prof. Mario Marchese, wrote in his reply email to me that *"I am convinced that a "champion" is a nearly mythic person such as Kleirock for the Internet. A person who funded and discovered new technologies."* I totally agree with Mario, but who that could be? If you have someone in your mind, please send me the name that you think a champion of SSC technology. I asked colleagues but none gave me the name that everyone agrees him as a SSC hero.

Although he might not be a champion of the SSC technology, he really was a satellite communication giant. The very tragic news of Sir Arthur C. Clarke's death on 19 March 2008 inspired many communication researchers around the world to re-recognize his idea for the geosynchronous satellite

for communication purpose. He proposed the geostationary satellites in his letter to the editor titled "Peacetime Uses of V2" published in the 1945 February issue of Wireless World. He wrote *"an artificial satellite at the correct distance from the earth would make one revolution every 24 hours; i.e., it would remain stationary above the same spot and would be with optical range of nearly half the earth's surface."* He also mentioned in his letter that three satellites could give the coverage to the entire earth. In 1945 October issue of Wireless World, he published the first satellite communication paper titled "Extra-Terrestrial Relays — Can Rocket Stations Give Worldwide Radio Coverage?" As the first launch of commercial geostationary communication satellite, Intelsat I Early Bird, is on 1965 his vision of the geostationary satellite was 20 years ahead of the time. A geostationary orbit (GEO) is sometimes referred to as the Clarke orbit and similarly the Clarke Belt is the part of space where near-geostationary orbits may be achieved.

The WINDS, Wideband InterNetworking engineering test and Demonstration Satellite, succeeded 1.2Gbps ultra-high speed data transmission, both up and down link, announced by NICT and JAXA on May 12, 2008. Comparing to 256kbps (up link)/1.5Mbps (down link) of Wildblue, do you consider the achievement as a giant step?

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

**FORTHCOMING
ICC AND GLOBECOM
CONFERENCES**

GLOBECOM 2008

November 30-December 4, 2008, New Orleans, Louisiana, USA

<http://www.ieee-globecom.org/2008/>

Themed for “Building A Better World Through Communications”, IEEE GLOBECOM 2008 will bring together academia, telecommunications manufacturing and suppliers, as well as industry engineers and management in a mutually beneficial environment.

ICC 2009

June 14-18, 2009, Dresden, Germany

<http://www.ieee-icc.org/2009/>

The 2009 IEEE International Conference on Communications (ICC 2009) will be held in Dresden, Germany. It brings together the world's leading scientists from academia and industry to facilitate scientific idea exchange, the identification of future trends in communications, and the illumination of business opportunities.

GLOBECOM 2009

November 30-December 4, 2009, Honolulu, USA

<http://www.comsoc.org/confs/globecom/2009/>

ICC 2010

May 23-27, 2010, Capetown, South Africa

<http://www.ieee-icc.org/2010/>

**COSPONSORING / RELATED
CONFERENCES AND WORKSHOPS**

PIMRC 2008

September 14-18, 2008, Cannes, France

<http://www.pimrc2008.org/>

The annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC) is one of the premier conferences in the wireless research arena and has a long history of bringing together academia, industry and regulatory bodies. Today, it has become one of IEEE ComSoc's flagship conferences in telecommunications.

MILCOM 2008

November 16 – 19, 2008, San Diego, California, USA

<http://www.milcom.org/>

For 27 years, MILCOM has been a must-attend event for members of the government, military, scientific and engineering communities. This year's conference will showcase new products, breakthrough technologies and exciting industry trends through special exhibits, interactive tutorials, keynote speeches and panel discussions. We'll see you in San Diego.

CONFERENCES CALENDAR

CONFERENCE	DATE & LOCATION	INFORMATION
ICSSC 2008 26th AIAA International Communications Satellite Systems	June 10-12, 2008 San Diego, California, USA	http://www.icssc2008.org/
SPECTS 2008 International Symposium on Performance Evaluation of Computer and Telecommunication Systems	June 16-18, 2008 Edinburgh, UK	http://atc.udg.edu/SPECTS2008/
ISSSTA 2008 International Symposium on Spread Spectrum Techniques and Applications	August 25-28, 2008 Bologna, Italy	http://www.isssta2008.org/
ASMS 2008 The 4th Advanced Satellite Mobile Systems Conference	August 26-28, 2008 Bologna, Italy	http://www.asms2008.org/
IWSSC 2008 International Workshop on Satellite and Space Communications 2008	October 1-3, 2008 Toulouse, France	http://www.tesa.prd.fr/iwssc08/
WICOM 2008 International Conference on Wireless Communications, Networking and Mobile Computing	October 12-14, 2008 Dalian, China	http://www.wicom-meeting.org/
DySPAN 2008 IEEE International Symposium on Dynamic Spectrum Access Networks	October 14-17, 2008 Chicago, Illinois, USA	http://www.ieee-dyspan.org/
ISWCS 2008 International Symposium on Wireless Communication Systems	October 21-24, 2008 Reykjavik, Iceland	http://www.iswcs.org/iswcs2008/
WCNC 2009 IEEE Wireless Communications & Networking Conference	April 5-8, 2009 Budapest, Hungary	http://www.ieee-wcnc.org/2009/
ICSSC 2009 AIAA International Communications Satellite Systems	June 1-5, 2009 Edinburgh, Scotland, UK	URL: not available yet Check here http://www.aiaa-icssc.org/futureconferences.html

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/>.

Quantum Information and Quantum Physics in Space

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Introduction

Quantum cryptography and quantum computation are based on the communication of single quantum states and quantum entanglement respectively. Particularly in view of these high potential applications the question arises, whether quantum correlations can be sufficiently well communicated over global distances to be used in communication protocols as predicted by quantum mechanics. Various experiments and possible application of quantum communications on ground and in space are discussed in this article. Thereby it confirms the feasibility of quantum communication in space on a global scale, involving the International Space Station (ISS) or satellites linking to optical ground stations.

Polarization effect

In all experiments proposed to be performed in a future space mission, using space- and ground-based terminals for the exchange of quantum states (in downlink- as well as in an uplink configuration), qubits will be encoded in two non-orthogonal polarization states of single and entangled photons. It is therefore a crucial issue to make sure that the channel preserves polarization with high accuracy.

Atmospheric effects, like scattering, turbulence and Faraday effect due to the Earth's magnetic field, affect slightly the polarization states: for typical experimental parameters they give a rotation of the polarization plane smaller than 10^{-3} rad. So the main source of polarization transformation is the optical communication system. In particular reflection on mirrors can affect polarization of light.

The satellite pointing and tracking system, on the other hand, consists of steering mirrors which guarantee the optical link between the source and the receiver, whatever the satellite position on the sky is. The effect of moving mirrors is to give a polarization transformation dependent on the position of the moving satellite. Moreover, due to the relative motion between the satellite and the ground station, the polarization reference frames of the two

communication parties will rotate with respect to one another over time. The global effect is therefore a time-dependent polarization transformation which must be tracked and compensated in real time.

Collaboration between University of Vienna and NICT

In close collaboration between the Austrian Academy of Science and National Institute of Information and Communications Technology (NICT) in Japan, several techniques will be theoretically and experimentally tested in order to compensate polarization degree mismatch between space and ground. We propose two compensation strategies: to exploit the tracking beam (at a different wavelength) to analyze polarization or to time-multiplex the polarization probing beam and the signal photons in the same channel. Both schemes can be realized using state-of-art technology. By polarizing the beacon laser along one of the directions chosen for the quantum communication, we could monitor online the alignment of the satellite with the ground station by reading the variation of the ratio of the clicks between the two polarization channels of the beacon laser. Additionally possible effect on the polarization of light from the transition through the atmosphere will be measured using polarized stars measured on various elevation angles with an optical ground station in Japan.

Free-space entangled pair transmission experiments

Additionally we report a series of proof-of-principle experiments where we were able to generate a quantum cryptographic key over a record-breaking distance 144 km over a free-space link between the Canary Islands La Palma and Tenerife [6, 7]. One photon from the entangled pair was measured locally. The second photon was sent via a transmitter telescope over the 144 km long free-space link to the Optical Ground Station (OGS) of the European Space Agency (ESA) on Tenerife [8]. We measured a loss

of -30 dB on the entire quantum link. Entangled photons shared between the two parties were used to establish 178 bits unconditional secure key [9] in total. Any attempt by an eavesdropper to intercept and copy the key is obvious to the receiving party, who notices errors in the transmission. This experiment demonstrated for the first time the use of an entangled photon source delivering the pair production rate required to realize an optical downlink from low-Earth satellites, such as the International Space Station (ISS) [10], to optical ground stations on Earth. The polarization contrast sent and received over the 144 km link suggests, that the atmosphere does not change the polarization of light whatsoever. Nor optical activity nor birefringence were observed on the link. Future measurements will provide more representative measurements by using polarized starlight. Such experiments are necessary to further show the experimental feasibility of a space based quantum communication source and polarized photons. This would allow a separation of the two entangled photons by more than 1400 km, clearly exceeding the possible distances for today's fiber technology [11].

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