SATELLITE AND SPACE COMMUNICATIONS **SSC**
http://www.comsoc.org/socstr/org/operation/techcom/satellite.html

IEEE COMMUNICATIONS SOCIETY

SSC Newsletter **Vol. 17, No. 2, November 2007**

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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: **Room Hamilton, Hilton Hotel.**

Date: **Wed. November 28, 2007**

Time: **11:45 - 14:00**

GLOBECOM 2007 SSC Committee Activities

WN-13: Satellite Networks
Thursday, 29 November, 10:00-11:45,
Conservatory/Terrace Level

WC-46: RFID, Cellular and Satellite Communications (Poster Session)

Future SSC Meetings

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

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

After the positive conclusion of the recertification process, as Chair of the Satellite and Space Communications Technical Committee, it is my duty to remind three main points for which an additional effort is required by all Technical Committees: 1. The lack of good candidates proposed for IEEE and ComSoc Awards. In this direction our Committee is warmly encouraged to consider to timely respond to the solicitations of the Award Committee Chair. 2. Technical Committees are not very active in proposing successful candidates to the positions of distinguished lecturer, senior member and fellow. Also in this case this action should be considered as a duty of the Committee and strongly encouraged. 3. ComSoc is not heavily involved in standardization processes and to related fora. Concerning this point we have inserted a link to the IEEE standard and to other related web sites in our web page. The aim is to gather information on the participation of TC members to standardization activities and to foster structured participation.

Concerning the three mentioned points I think that a discussion during our Meeting at Globecom 2007, Washington, D.C., is very useful. I would like to be totally sure that the entire Committee has got the importance of these issues, not only to match the ComSoc request, but also to disseminate information about the activity of our scientific community, which should not be limited to write and present scientific papers but also to propose candidates for the awards as well as for distinguished lecturers, senior members and fellows, and to follow standardization activities.

Concerning the scientific activities, I would like to focus on an important aspect. There is a good number of important conferences dedicated to satellites. We have endorsed most of them. Only speaking of 2007, I can remind: SPECTS 2007, IWSSC 2007, CAMAD 2007, WRECOM 2007, Ka-Band and Broadband Communications 2007. These conferences conveyed many interesting papers on satellite communications and networking. That is a positive aspect. Nevertheless our scientific community should not forget the scientific and strategic importance of ICC and Globecom. Unfortunately our recent results in this direction are not so satisfying. One note should be enough to make understand what I mean: at ICC 2008, we have endorsed the General Conference (GC) Symposium, also called Symposium of Selected Areas in Communications (SAC) from Globecom 2008 on. We had a Special Track in the General Conference (GC) Symposium, called Satellite and Space Communications (SSC), so to give a clear indication to SSC TC Members where to address their scientific articles. Nevertheless we received only 28 papers on satellites. It is not an impressive number. To stimulate paper submissions to next ICC and Globecom, I would like to remind that we will endorse the SAC Symposium at Globecom 2008 and both the Wireless Communications (WC) and the Wireless Networking (WN) Symposium at ICC 2009. After this experimental phase we will decide all together if going on endorsing both WC and WN Symposia, or one of them alternatively, or to focus on a Special Track in the GC/SAC Symposium.

Additionally I would like to stimulate SCC Members activity on the possible proposal of Special Issues in International Journals and Magazines. It is very meaningful for our Community. In this direction I remind the recent Special Issue of the IEEE Systems Journal on “Recent Advances in Global Navigation and Communication Satellite Systems (GNCSS)”, Guest Editors: Prof. M. S. Obaidat and Prof. M. Marchese, whose aim is to highlight the importance of integrating systems that are traditionally dedicated to transport information with systems devoted to acquire data about the user position completed by context aware information, as, for instance, in the case of emergency applications over isolated areas where it is important to install and configure an efficient telecommunication network as soon as possible. Designing and implementing mobile stations that can self-determine their physical location, acquire data and transmit them over a QoS-guaranteed satellite system may be important. The topics of the 11 accepted original papers include: emerging solutions for advanced global navigation satellite systems, technology for the integration of satellite communication and navigation systems, integration of terrestrial, satellite and wireless communication systems, air interfaces, improved physical layers, power and bandwidth allocation solutions.

Finally, I would like to thank all members for their support during these six months after ICC 2007. Without their help, we could not organize any conference or review any paper. I look forward to working with you in other occasions towards the enhancement of the knowledge in the field of satellite communications and networking.

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

SCANNING THE WORLD

Takaya Yamazato

According to a Reuter report on 19 November 2007, participants at the World Radio communication Conference (WRC-07) were set to conclude an agreement on how to divide spectrum among satellite operators, mobile phone companies and broadcasters [1]. Good thing is that the International Telecommunication Union (ITU) decided to keep a section of spectrum in the C-band, from 3.4 to 4.2 GHz, reserved for satellite. There were proposals to allow terrestrial wireless services to use that spectrum band. ITU-R Working Party 4-9S (WP 4-9S), aiming to study on frequency sharing between the fixed-satellite service and the fixed (terrestrial) service, is disbanded. This study group has worked for study period of 2003 to 2007.

In addition to ensuring their uninterrupted use of the C-band, WRC-07 also gave satellite operators assurances that any future IMT (International Mobile Telecommunications) networks will provide them with full protection from interference [2]. The endorsement of the satellite industry's use of this highly valuable spectrum will ensure that operators will also have adequate bandwidth to roll out future service. The WRC restricted IMT and they have clearly signaled that these bands are not globally harmonized for IMT, including WiMax.

Spectrum sharing has been discussed almost three decade ago. I found a paper published in 1974, entitled "Orbit-spectrum sharing between the fixed-satellite and broadcasting-satellite services at 12GHz" by Reinhart. E. E. In 1990s, CDMA and TDMA/FDMA spectrum sharing were well studied. Nowadays, US government is interested in legation to allow unlicensed wireless devices access to so-called "white space," or the empty channels on the airwaves resulting from unused broadcast spectrum. The FCC is developing rules to utilize the space with WiFi-style technologies capable of detecting and avoiding broadcast signals in the vicinity. These devices would take advantage of "smart" or "cognitive" radio technology to enable wireless networks to share the white space spectrum.

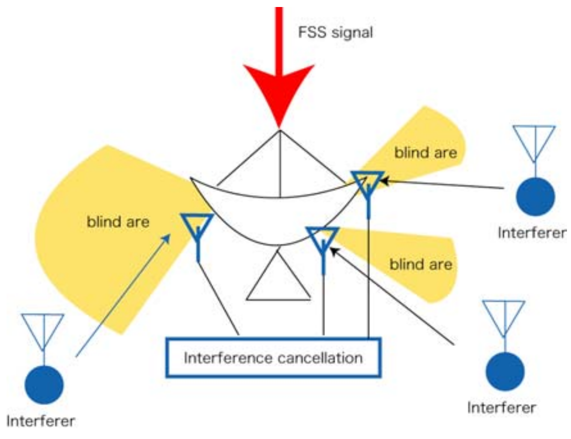

Figure 1 is one example of sharing the white space spectrum with fixed satellite services (FSS). The experiment results were presented JC-SAT conference [3]. Although C-band spectrum have reserved, we need to start working on technology to enable terrestrial systems to share the white space spectrum.

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

[1] http://news.yahoo.com/
[2] http://www.broadcastnewsroom.com/
[3] N. Kawai, H. Fujii, I. Nomura, H. Oki, H. Kihara, N. Kariya, "Development of Interference Cancellation System by Adaptive-array Antenna Techniques for Sharing between Satellite Communication Services and Other Radio Communication Services," IEICE Technical Report, SAT2007-33, Nov., 2007.

FORTHCOMING ICC AND GLOBECOM CONFERENCES

ICC 2008
May 19-23, 2008, Beijing, China.
http://www.ieee-icc.org/2008/

The 2008 IEEE International Conference on Communications (ICC 2008) will be held in Beijing, China, from 19-23 May, in the year of the Beijing Olympic Games, with the theme "Communications: Faster-Higher-Stronger".

GLOBECOM 2008
November30-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.

COSPONSORING / RELATED CONFERENCES AND WORKSHOPS

IWSSC 2008
October 1-3, 2008, Toulouse, France.
http://www.tesa.prd.fr/iwssc08/

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.

MILCOM 2008
November 16 – 19, 2008, San Diego, California, USA
http://www.milcom.org/

CONFERENCES CALENDAR

CONFERENCE	DATE & LOCATION	INFORMATION
WCNC 2008 IEEE Wireless Communications & Networking Conference	March 31-April 3, 2008 Las Vegas, Nevada, USA	http://www.ieee-wcnc.org/
ICTTA 2008 International Conference on Information & Communication Technologies: from Theory to Applications	April 7 - 11, 2008 Damascus, Syria	http://conferences.enst-bretagne.fr/ictta/
CAMAD 2008 13th International Workshop on Computer-Aided Modeling, Analysis and Design of Communication Links and Networks	May, 2008 Beijing, China	http://dit.unitn.it/~camad08/ CAMAD'08 will be held in conjunction with ICC 2008 (Beijing, China), as part of the conference workshops.
ICSSC 2008 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/
WICOM 2008 International Conference on Wireless Communications, Networking and Mobile Computing	September 19-21, 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	URL: not available yet Check here http://www.comsoc.org/confs/calendar/2008/confdate.html
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/.

Satellite-Based Sensor Networks for Information Retrieval

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I. INTRODUCTION

An Environmental Monitoring System employed in strategic and in civil protection environment has three main objectives: 1) to measure physical quantities (temperature, pressure, vibrations) and to reveal possible changes of them; 2) to individuate the position where measures are taken as precisely as possible; 3) to provide the information quickly and reliably where it is needed. Due to the need of transmitting information remotely from possibly isolated areas, the integration of existing terrestrial sensor networks and satellite components is a key issue for systems that allow achieving ubiquitous information exchange at affordable cost [1]. In this view, modern Environmental Monitoring Systems (EMSs) may be composed of widespread fixed and mobile sensor networks collecting information and of a satellite backbone whose role is to transport the information taken by sensors to a destination Remote Monitoring Host (RMH). In this context sensors should have the capability to get measures of physical quantities and information about their geographical location; to encapsulate this information within packets; to process data; and to forward messages. The access to the satellite channel is provided through earth stations that gather information from sensors. They are called Sinks for that. An example of EMS supported by a telecommunication network is shown in Fig. 1. Even if the redundant transmission of the same data from more than one Sink would increase the safety of the system, it would increase the costs of it. The selection of the Sink which forwards the information of a sensor to the destination is important to increase the performance of the EMS. It may be part of a control scheme applied to the network.

A practical example of the use of the proposed architecture is a modern weather prediction system [2]. It is composed of different sensors, deployed, for example, in the sea, which measure precise quantities (temperature, humidity, wind speed etc.), establish their position by proper localization techniques (e.g. GPS, Galileo) and transmit the overall information to specific destinations by using a satellite network, as shown in Fig. 2. Received data are processed at destinations by special computers that use a weather model to provide fast and precise predictions of the meteorological evolution and of possible emergency conditions.

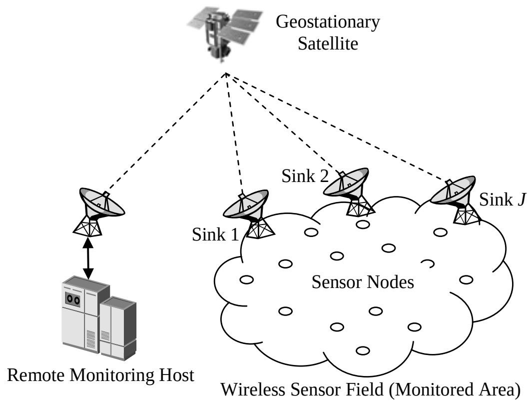

Fig. 1. EMS Architecture.

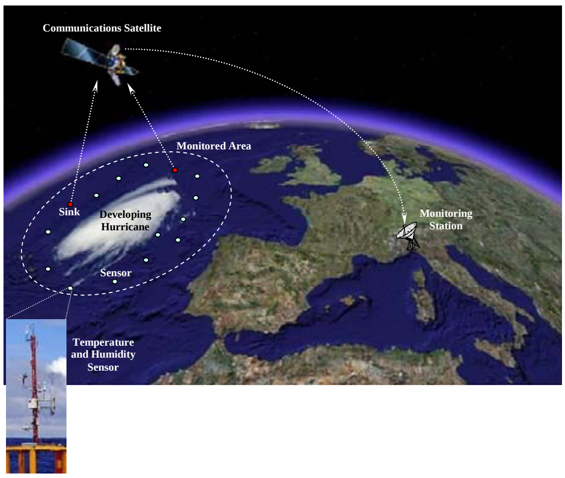

Fig. 2 Example of EMS for weather prediction.

The need to guarantee the whole system reliability, to limit both the delay to transfer information from sensors to the destination and the energy consumption of the network, so increasing the lifetime of the system, should be outstanding in this environment. The problem is that these aims are often in contrast. Increasing the offered bandwidth to limit losses and delays often implies the use of more energy. Also dropping packets and increasing losses may also mean lower end-to-end delays. So there is the need of a formal approach that, after translating the general efficiency needs into objective performance metrics, defines the problem, introduces a control algorithm (i.e. to select the sink dynamically), and proposes a solution. Concerning metrics possibly in contrast each other, the Multi Attribute Decision Making (MADM) theory [7] can give a great help.

II. Environmental Monitoring System

A. *Network Functionalities*

As previously said, the main aim of a distributed-sensor-based EMS is to measure physical quantities and to reveal possible changes of them [3]. This operation is called *Sensing*. In general, *Sensing* represents the ability to take inputs from the external world through proper devices and perform the translation of these inputs into electrical signals, which can be remotely transferred through a telecommunication network. Electrical signals are often digitalized and encapsulated into packets by using analogue-digital converter circuits and appropriate interfaces.

Typical environmental applications are habitat monitoring, precision agriculture, climate control, surveillance, and intelligent alarms. The aim of the EMS is more complex in these cases. It is necessary to define a high spatiotemporal resolution data collection in the monitored areas aimed at building accurate predictive models, as reported in [2], and at controlling complex systems in real time.

To increase the capability of the overall monitoring system, the operation of *Sensing* a quantity can be joined with the power of individuating the position where the quantity is measured. The operation is called *Positioning* and allows associating each measure with a geographical map [4]. It can be very important to provide specific services.

The Global Positioning System (GPS) may solve the positioning problem, if a GPS receiver is installed in each sensor. Actually, in several cases, GPS may not be used: the positioning service is available if at least four satellites of the GPS constellation are simultaneously visible. In case of indoor, under foliage and obscured by buildings networks, GPS based *Positioning* service may be compromised but other possible methodologies [4] may be used without affecting the general EMS architecture. An example of positioning approach may be the Collaborative Multilateration (CM) method [5], which consists of a set of mechanisms that enable the collaboration between nodes located several hops away from the designed beacon nodes, whose position is “a priori” known. This collaboration allows estimating the nodes location with accuracy. CM may be implemented both centralized and distributed. The latter has the advantage to distribute the computation cost among the network nodes but requires more complex hardware for sensors. Implementations are based on the inter-node physical distances, which are periodically measured by using ad hoc transmissions between beacon nodes and sensors and between sensors: the systems employed for measuring the inter-node distances are based either on ultrasonic devices or on the Received Signal Strength Indication (RSSI) approach, which is a measure of the received radio signal strength.

Sensing [2] and positioning [5] operations must be integrated with the management of the telecommunication network because it is aimed at guaranteeing the reliable and efficient delivery of *Positioning* and *Sensing* data independently of the techniques employed to get them.

Network Management is strictly related with the third important EMS functionality: to provide the information quickly and reliably where it is needed. It mainly depends on the specific network characteristics and involves solutions for resource reservation, call admission control, traffic control, traffic shaping, scheduling, queue management, buffer management; flow control, power control, routing, and planning.

B. *Requirements for EMS telecommunication networks*

Applying the general performance requirements of a sensor network, which are contained in the survey [6], to the EMS environment considered in this paper, it is possible to structure what is expected from a telecommunication network supporting EMS into four performance macro areas. It is the first step towards the formal definition of objective performance metrics.

Information Loss. Being wireless and possibly small, sensors and sinks may run out of energy or simply be damaged. It implies the loss of information. The problem is emphasized if the telecommunication network includes a satellite portion, as supposed in this paper, due to the particular nature of the satellite channel. Communication noise, rain fading and transmission failures compromise the reliability of the whole system because may reduce the transmission capability of the satellite components and introduce information loss. The satellite portion of the telecommunication network is a very important component of the whole architecture because it is the connection element between the sensor field (where sensors are deployed) and the RMH. In consequence it is important that the robustness of the sink selection algorithm against fading, noise, and component failure is considered during the design phase. It means that the loss of information (i.e. the packet loss) needs to be measured by applying the sink selection scheme in different properly modeled channel conditions so to check the algorithm tolerance to channel and element faults.

End-to-End Delay. End-to-End delay is a traditional metric for Quality of Service (QoS) –based networks. It comes from multimedia applications but may be useful also for EMS networks where applications require that message packets spend a limited time to go from the source sensor node to the destination RMH. End-to-End delay is composed of the propagation delay, both through the sensor network and the satellite link, and of the service and waiting time in each traversed network component.

Also in this case, as well as for the information loss, the peculiar features of the wireless and satellite communication (fading, noise, faults) have a great impact on this metric. In more details, the end-to-end delay may increase in consequence of fading countermeasures. Actually, when the satellite channel is corrupted by fading and noise, the trend is to protect the information with redundant bits by following a given Forward Error Correction (FEC) code. Increasing the FEC correction power (i.e. the number of redundant bits) can help make negligible the errors due to fading but reduces the available bandwidth (the packet service rate) and increases the time necessary to transmit the information to the RMH.

The importance of the end-to-end delay may be seen also in the weather prediction system of Fig. 2 where a small delay may guarantee a more precise weather prediction because updated data reduce the computation errors of the prediction systems but it is really essential in special cases such as in emergency situations for military and civil protection applications.

Lifetime. In sensor networks, nodes have a limited amount of energy provided by batteries. The replacement of batteries is usually not practicable when the energy limit is reached so any action and algorithm operating on a sensor network should consider that sensors must operate as long as possible. The concept of lifetime, which is the time when a network or a sensor are operative, is strictly related to the energy spent by sensors. A possible metric is the average quantity of energy spent to propagate each single packet from the source to the destination. It includes both the wireless sensor network and the satellite backbone.

Scalability. Due to the large number of sensor nodes included within a SSN EMS, the complexity of the employed algorithms, protocols and solution, in particular of the network control algorithms, should be independent of the number of nodes of the network.

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