SATELLITE AND SPACE COMMUNICATIONS **SSC**

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IEEE COMMUNICATIONS SOCIETY

SSC Newsletter **Vol. 20, No. 2, Dec. 2010**

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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: **Tuttle (InterContinental Miami)**

Date: **Thu, Dec. 9, 2010**

Time: **12:30 - 14:00**

Future SSC Meetings

June 2011, Kyoto, Japan
Dec. 2011, Huston, TX, U.S.A.
June 2012, Ottawa, Canada.

GC2010 SSC Committee Activities

Symposium on Selected Areas in Communications:

- *Tuesday, 7 December 2010 • 10:00 – 11:10*

Location: Gardenia
SAC01: Deep Space Networking
Chair: William Ivancic, NASA Glenn Research Center, USA

- *Wednesday, 8 December 2010 • 10:00 – 11:10*

Location: Gardenia
SAC05: Coding for Satellite Communications
Chair: Muriel Medard, MIT, USA

- *Thursday, 9 December 2010 • 10:00 – 11:10*

Location: Merrick I
SAC18: Satellite Resource Management
Chair: Mario Marchese, University of Genoa, Italy

- *Thursday, 9 December 2010 • 11:20 – 12:30*

Location: Riverfront North Hall
SAC2P: Topics in Satellite and Space Communications (Poster)
Chair: Takaya Yamazato, Nagoya University, Japan

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://lists.scnl.dist.unige.it/listinfo/ssc.

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MESSAGE FROM THE CHAIR

Prof. Nei Kato

It is my immense pleasure to convey my message in this column for the very first time as the Chair of Satellite and Space Communications (SSC). I would like to take this opportunity to express my deep thanks towards the SSC TC Officers Selection and Nomination Committee for nominating me as one of the candidates for the Chairperson and also towards the SSC members who have placed their trust by selecting me for this privileged position. I would also like to state that I will do my level best to carry out the duty as the SSC Chair. Furthermore, my heartfelt thanks go to our former Chair, Prof. Takaya Yamazato, and former Vice Chair, Dr. Tarik Taleb, for their valuable contributions to sustain the activities of our TC.

According to the outcome of the election held in July earlier this year, Dr. Igor Bisio and Dr. Hiromitsu Wakana are to serve as Vice Chair and Secretary of SSC for the next two years' term, respectively. We appreciate your continuing support and really look forward to your valuable opinions so that we may make our TC even better and active in future.

As our past chairs, Prof. Abbas Jamalipour and Prof. Mario Marchese, repeatedly emphasized in this column during the last couple of years, I believe the first priority of the new officers is to bring more active members to this TC and significantly increase the number of submissions in the two IEEE flagship conferences, namely ICC and GLOBECOM.

However, achieving the goal of increasing the submissions may not be so easy. From my personal points of view, there are two main obstacles lying ahead in this respect. The first obstacle consists in the stagnant economy. Many countries have reduced their budgets in satellite communication area although satellite communication systems play a crucial role in disaster relief and solve the problems of the digital divide. The other reason is the severe competition with terrestrial networks. On a personal level, I think that the development of satellite technologies depends on two factors. The first factor consists in the intention of the governments to invest in satellite research for future prospective in terms of providing real seamless communication environment regardless of time and locations. The second factor arises from the necessity of facilitating our global environment to emphasize the need for natural disasters monitoring and so forth.

Furthermore, we need to take into account how to treat the papers which are submitted to GLOBECOM or ICC. Unfortunately, unlike ICSSC or IAC that cover a wide range of topics, the papers submitted to GLOBECOM and ICC tend to have a relatively narrow scope limited to analysis and simulations. For attracting more researchers to present their work, the results of system development and experiments having good and mature prospects for satellites communications should also be considered as good contributions. In a sense, encouraging industrial researchers to submit their experiment results based on real implementation is crucial to the progress of our TC in terms of exchanging ideas and technologies from all perspectives.

The new officers have taken the office since August 2010. We will work closely with our members to promote the activities of our TC. If you have any suggestions, please feel free to send them to us. We are looking forward to discussing with you in the coming Globecom 2010 TC meeting and via email as well. Your kind support is highly appreciated.

Prof. Nei Kato, Chair
Satellite and Space Communications
Technical Committee

SCANNING THE WORLD

Dr. Igor Bisio

In this my "*Scanning the World*" article, first of all I would like to thank all members who have placed their trust in me. I am deeply honored to serve and I will do my best to cooperate in the development of the technical committee activities with the new Chair Prof. Nei Kato and the new Secretary Dr. Hiromitsu Wakana.

As all members know, one of the main activities of the technical committee concerns the editorial initiatives that allow disseminating the research results in the Satellite and Space Communication field. This is the subject of my fist *scan*.

In the last two years we worked in two directions: we organized two special issues in important International Journals/Magazines and we continued the effort within the IEEE ICC/GC technical program committees.

The first special issue concerns the "*Recent Advances in Satellite and Space Communications*" and it will be tentatively published on December 2010 in the Journal of Communications and Networks, technically co-sponsored by the IEEE Communications Society. The guest editorial team is composed by Dr. Riccardo De Gaudenzi, European Space Agency, Netherlands; Dr. Hung Henry Nguyen, The Aerospace Corporation, USA; Prof. Fotini-Niovi Pavlidou, Aristotle University, Greece; Prof. Takaya Yamazato, Nagoya University, Japan and me.

The issue includes papers that cover a wide range of topics such as air interface over satellite networks; payload architectures and techniques; internetworking, architecture, protocols, applications, standards; control and algorithms for satellite networks; new paradigms in satellite and space communications.

We received 40 submissions and we have accepted 9 papers (acceptance rate is very severe 22.5%). The quality of the special issue is expected to be very high.

The other special issue concerns the "*Recent Trends in Interplanetary Communications Systems*" and it will be published in the IEEE Aerospace & Electronics Systems Magazine, which is sponsored by the IEEE Aerospace & Electronics Systems Society where several members of our technical committee are involved. The guest editorial team is composed by Dr. Mauro De Sanctis, University of Rome "Tor Vergata", Italy; Dr. Giuseppe Araniti, University Mediterranea of Reggio Calabria, Italy; Prof. Ruhai Wang, Lamar University, Beaumont, Texas, USA; Dr. Scott C. Burleigh, Jet Propulsion Laboratory, California, USA and me.

The issue is focused on topics such as architecture design and specific mission analysis; satellite constellations and infrastructures for space missions; innovative protocol stacks and paradigms for interplanetary networks; DTN protocols; RF and optical communication technologies; physical and MAC layer schemes and advanced modulation/coding techniques.

In this case, the number of submissions is quite limited probably due to the restricted topic of interplanetary environment: 6 papers, but the quality of the submitted works is very high. The review

process is ongoing and the expected number of accepted papers is 4.
Concerning the activity in the IEEE ICC/GC technical program committees, the Satellite and Space Communications community has been for years a specific track in the Symposium on Selected Areas in Communications (SAC). The achieved results – in terms of submissions – in the last two years are, on average, encouraging: GC'09 SSC track received 40 submissions; ICC'10 SSC track 18; GC'10 SSC track 42; ICC'11 SSC track 34. In all cases, the average acceptance rate of the SAC Symposium is around 35%. It means that the SSC papers presented during conferences and, as a consequence, the visibility of the related scientific results are limited.

The numbers shown both for journals and conferences are quite satisfying but if we want to get more visibility and importance in the IEEE ComSoc community, we need to increase the number of submitted papers in particular concentrating effort towards the editorial initiatives of the technical committee.

In practice, large numbers of submissions to the Satellite and Space Communications tracks at ICC/GC is the indispensable condition not only to have our own symposium at ICC/GC conferences (as we had same years ago) but also to increase the number of the special issues in international journals and, as a possible dream, to have a dedicated publication for the SSC community in the framework of the IEEE Communications Society.
The first opportunity to accomplish this aim is the next IEEE GC'11. The conference will be held in Huston, Texas, USA. The submission deadline is the 1st March 2011. Also in this case our members can find the SSC dedicated track in the SAC symposium: let us not lose this opportunity!

Dr. Igor Bisio, Vice Chair
Satellite and Space Communications
Technical Committee

FORTHCOMING GLOBECOM AND ICC CONFERENCES

COSPONSORING / RELATED CONFERENCES AND WORKSHOPS

ICC 2011
June 5-9, 2011, Kyoto, Japan.
http://www.ieee-icc.org/2011/
The Premier Telecommunications Event for Industry Professionals and Academics from Companies, Governmental Agencies, and Universities around the World.
Themed "Source of Innovation: Back to the Origin," IEEE ICC 2011 covers the entire range of communications technologies, offering in-depth information on the latest developments in voice, data, image, and multimedia.

MILCOM 2011
November 7-10, 2011, Baltimore, MD, USA
http://www.milcom.org/
MILCOM 2011 celebrates the 30th anniversary of the premier international conference for military communications. "Networks … Attaining the Value" gathers the leading minds of government, military, industry and academia in an interactive forum to further explore, define and leverage the benefits networks bring to today's and tomorrow's challenges. MILCOM 2011 gives industry the opportunity to promote communications technologies and services to commanders from all branches of the armed forces, Department of Defense, federal government, and the heads of multi-national forces from around the globe.

GLOBECOM 2011
December 5-9, 2011, Houston, TX, USA
http://www.ieee-globecom.org/2011
The IEEE Global Communications Conference (GLOBECOM), the annual flagship conference of the IEEE Communications Society (ComSoc), is the premier telecommunications event for industry professionals, academics, companies and government agencies from around the world. IEEE GLOBECOM 2011 will host its 54th annual conference from 5 – 9 December 2011 in Houston, Texas.
Themed "Energizing Global Communications", IEEE GLOBECOM 2011 covers the entire range of communications technologies, offering in-depth information on the latest developments in voice, data, image, and multimedia. IEEE GLOBECOM 2011 features 12 Specific Symposia, Tutorials, Workshops and the Industrial Forum and Exhibition.

CONFERENCES CALENDAR

CONFERENCE	DATE & LOCATION	INFORMATION
SPECTS 2011 International Symposium on Performance Evaluation of Computer and Telecommunication Systems	June 27-30, 2011, The Hague, The Netherlands	http://atc.udg.edu/SPECTS2011/
SPACOMM 2011 The Third International Conference on Advances in Satellite and Space Communications	April 17-22, 2011, Budapest, Hungary	http://www.iaria.org/conferences2010/SPACOMM11.html
AIAA International Communications Satellite Systems Conference (AIAA ICSSC-2011	Nov. 28 – Dec. 1, 2011 Nara, Japan	http://www.ilcc.com/icssc2011/
WCNC 2011 IEEE Wireless Communications & Networking Conference	March 28-31, 2011 Cancun, Quintana-Roo, Mexico	http://www.ieee-wcnc.org/
PSATS 2011 3rd International Conference on Personal Satellite Services	Feb 17-18, 2011 Malaga, Spain	http://www.psats.eu/
ICSOS 2011 International Conference on Space Optical Systems and Applications	May 11-13, 2011 Santa Monica, CA, USA	http://icsos2011.nict.go.jp/

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/.

A Functional Architecture for Future Aeronautical Communications

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Abstract— **The EU SANDRA (Seamless Aeronautical Networking through integration of Data-Links, Radios and Antennas) project aims to design, specify and develop an integrated aircraft communication system to improve efficiency and cost-effectiveness by ensuring a high degree of flexibility, scalability, modularity and reconfigurability. For these goals a new and future-oriented concept for the required functional architecture has to be developed. SANDRA aims at the definition of an access to an open system resulting in a collection of communications technologies targeted at specific operational settings. This represents a considerable extra burden to be carried by the aircraft, should the new radio links be implemented in stand-alone equipments. Hence, a new approach aiming at a broader level of integration is needed to achieve the required increase of capacity, safety, security and efficiency of air transportation operations while at the same time keeping complexity and cost of on-board networks and equipments within a sustainable level.**

Index Terms— **Aeronautical communications, Seamless networking, aeronautical networking, functional architecture.**

I. Introduction

THE overall air transportation sector is currently under significant stress. With the demand in aircraft operations expected at least to double by the 2025 timeframe [1], there are well-founded concerns that current air transportation systems will not be able to accommodate this growth. Existing systems are unable to process and provide flight information in real time, and current processes and procedures do not provide the flexibility needed to meet the growing demand. New security requirements are affecting the ability to efficiently move people and cargo.

The integration of different service domains with very heterogeneous requirements through a cost-effective and flexible avionic architecture is thus one of the main challenges addressed by the EU research project SANDRA [2]. In this light, the SANDRA communication system will represent a key enabler for the global provision of distributed services for Common Decision Making based on the System Wide Information Management concept, and for meeting the high market demand for broadband passenger and enhanced cabin communication services.

The SANDRA system is considered as a 'system of systems' addressing four levels of integration: Service Integration, Network Integration, Radio Integration and Antenna Integration. From the communications network point of view, SANDRA spans across three segments, namely, Aircraft segment, Transport segment and the Ground segment, as shown in Figure 1. The Aircraft segment consists of the main functional components: the Integrated Router (IR), the Integrated Modular Radio (IMR) and the Antennas consisting of a hybrid Ku/L band Integrated Antenna (IA), a VHF band antenna and a C-band antenna.

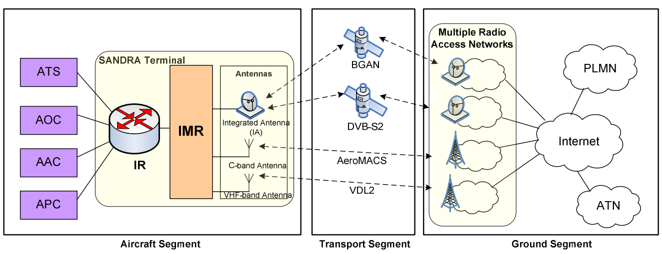

Figure 1. SANDRA Network Architecture

The definition of a functional architecture for such a complex system is then aimed at integrating the main network functions and the message flow exchanges between main functions. Hence, a description of the data exchange for the data plane, the control plane, and the management plane is needed. Furthermore, a specification of the characteristics depending on the type of services is required in the data plane.

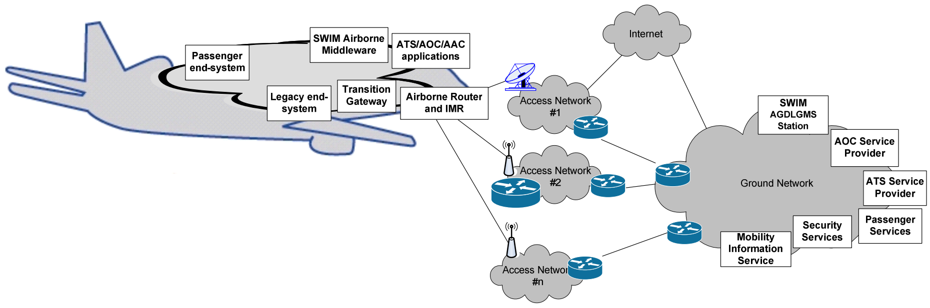

Figure 2. High Level overview of the SANDRA system from a functional point of view

This perspective paper gives an overview of the developed future-oriented functional architecture for a seamless aeronautical networking. Section II begins by describing the functional architecture on the topology level in the first part followed by the specification of the airborne level functional architecture in the second part. Finally, this perspective article is concluded in the last Section and gives an outlook on the upcoming challenges.

II. SANDRA Functional Architecture

This section presents a high level overview of the SANDRA network functional architecture. While a detailed presentation of all the functional blocks and their interconnection is provided in [3], the goal of this section is to provide a global presentation of the system from a functional point of view. After presenting the architecture from a topology level, the focus is made on the airborne architecture which is the core of the SANDRA network functional architecture.

A. Topology Level

The aim of the SANDRA network architecture is to allow for onboard end systems to communicate with other end systems located on the ground through potentially more than one radio link at a given time (e.g. combining higher throughput satellite with lower latency AeroMACs). From a topology point of view, the functional architecture can be illustrated as shown on Figure 2.

On the airborne side of the network, several functional entities are represented, like the passenger end systems which will mainly use the SANDRA network architecture in order to access the Internet and specific ATS/AOC applications which will communicate with ATS/AOC service providers on ground through the use of multiple access networks technologies (e.g., AeroMACs, Satellite Communications, etc.).

On the ground side of the network, the counterparts to several of the airborne side functional entities are presented. In order to provide efficient service, the SANDRA network architecture relies on various functionalities provided on the ground like the Mobility Information Services and the Security Services. Finally, the figure also presents the ATS/AOC Service Providers which are the ground counterparts of the corresponding onboard systems and applications.

The SANDRA system supports the System Wide Information Management (SWIM) [4] architecture and the related airborne and ground components of the SWIM architecture are also shown in Figure 2. The SWIM based ATS/AOC applications will interface with the SWIM airborne middleware on the airborne side and the SWIM Air-Ground Datalink Ground Management System (AGDLGMS) stations on the ground.

In order to support multiple data links with variable characteristics and constraints (e.g. local coverage of AeroMACs vs. global coverage of the satellite, variable data rate and latency), the onboard network and the various access networks are interconnected by the Airborne router and the IMR. It is at this level that all the functionalities related to Quality of Service, Resource Management, Packet Scheduling and Link Selection take place. Furthermore, mobility and security functions are also strongly linked to the Packet Processing that takes place in the Airborne router and IMR.

Finally, in order to provide interoperability with legacy end systems which might be using protocols not natively supported by the SANDRA system, the airborne architecture includes a transition gateway. This gateway implements transition mechanisms required in order to adapt legacy protocols to the SANDRA network architecture (these include but might not be limited to tunneling, protocol translation, higher layer proxying, etc.).

B. Airborne Level

The main focus of the SANDRA project is on the airborne aspects of the functional architecture. However, some of the functions to be supported by the system may require the presence of a ground located counterpart. In this case, the study of these ground elements will be performed for completeness purposes.

Figure 3 presents a high level overview of the functional architecture focusing on the airborne level. In order to simplify the description, the presentation is made following a layered architecture (similar to the OSI model) to which

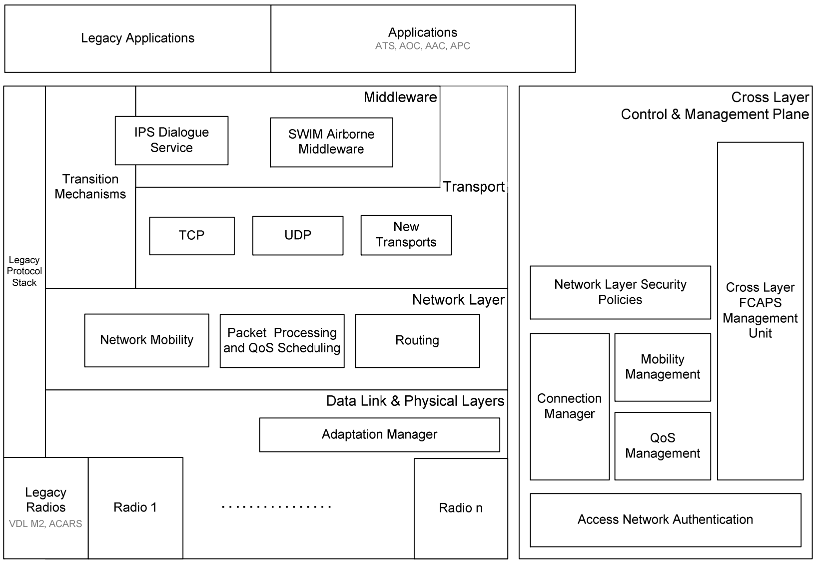

Figure 3. High level overview of the Airborne Functional Architecture

several cross-layer extensions are provided following the principles described in [5].

A clear separation between the user (data) and control planes has been performed as presented on Figure 3. The user (data) plane includes all the functional blocks that are directly related with the transport of data while the control plane assures the control of this transport as well as the management of the SANDRA system. At the topmost layer of the architecture, theApplications, both legacy and non-legacy applications are to be supported by the SANDRA system. For legacy applications, three possibilities exist:

1. These applications can use the legacy protocol stack and legacy radio, which corresponds to them operating as they would without the SANDRA system.
2. These applications can use transition mechanisms in order for the traffic they generate to be transported using the SANDRA system
3. Or, these applications can be adapted in order for them to directly interface with a middleware such as the dialogue service or SWIM through the use of a SWIM adapter.

Non-legacy applications are considered to be using one of the supported middleware layers or to directly use any of the transport layer protocols supported by the architecture.

At the network layer, several functionalities such as packet processing and QoS scheduling are implemented in addition to functionalities related to network mobility and security. The network layer can either directly make use of radios if these radios implement the correct interface or it can be connected to the IMR.

The IMR implements the data links and physical layers of the protocol stack and also provides an abstraction layer between the radios and the network layer packet processing. The Adaptation Manager block in the user plane at the Data Link and Physical layers acts as this abstraction layer. The Adaptation Manager is responsible for interfacing the multiple radios to the network layer in a common and standard way even if these radios do not provide similar interfaces to be connected to the network layer.

In parallel to the data plane (in which user data is processed), the functional network architecture presented on Figure 3 includes a cross-layer control and management plane. The SANDRA system requires a close integration of the network, data link and physical layers in order to support complex networking scenarios such as seamless mobility, handover, QoS management and security. In order to perform this, several functional entities coordinating the interactions between the functions implemented at the various layers of the stack have been identified. These functionalities range from the overall management of the SANDRA system elements (based on the FCAPS model [6],[7]) to the control and management of connection in terms of QoS and Link Selection. Additionally, security and mobility related functional entities are also present.

III.Conclusions

In this perspective paper, the demands on an integrated aircraft communications system were laid out. Within the EU Project SANDRA a concept for a functional architecture is developed which satisfies these requirements. The architecture was presented from a topology level and then there was a focus on the airborne architecture which is the core of the SANDRA network functional architecture. During the project life-span an overall network architecture will be defined which also includes all functional interfaces between the IR and the IMR.

IV. Acknowledgement

The research leading to these results has been partially funded by the European Community's Seventh Framework Programme (FP7/2007-2013) under Grant Agreement n° 233679. The SANDRA project is a Large Scale Integrating Project for the FP7 Topic AAT.2008.4.4.2 (Integrated approach to network centric aircraft communications for global aircraft operations). The project has 31 partners and started on 1st October 2009.

References

[1] EUROCONTROL, *"EUROCONTROL's Challenges of Growth 2008 study report", 2008*
[2] SANDRA - www.sandra.aero
[3] SANDRA – FP7 233679, "D3.2.1 Consolidated SANDRA network and interoperability Architecture", July 2010
[4] SWIM - www.swim-suit.aero
[5] V. Srivastava and M. Motani, "Cross-layer design: a survey and the road ahead", Communications Magazine, IEEE, 43(12):112–119, 2005
[6] ITU-T Recommendation M.3010, "Principles for a Telecommunication management network", 1996.
[7] ITU-T Recommendation M.3400, "TMN management functions", 2000.