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Guest Editorial

Special Issue on Satellite IP Quality of Service

This special issue represents a timely and a valuable contribution addressing a critical research issue of provisioning Quality of Service (QoS) for satellite IP networks and systems. Satellite communications is an excellent candidate to provide broadband multimedia applications due to its several characteristics such as global coverage, scalability, broadcast and multicast capability, bandwidth-on-demand flexibility, and reliability. Due to the ubiquitous nature of IP for terrestrial networks, IP based services have been the prime focus for satellite networks supporting multimedia applications. Some of the recent technologies such as Digital Video Broadcasting-Satellite (DVB-S), Digital Video Broadcasting-Interactive Return Channel via Satellite (DVB-RCS), satellite ATM, and satellite IP have received significant attention from the research community and industry. The emerging applications like media streaming, content delivery distribution, and IP multicast for enterprise and consumer services are best supported by broadband satellite networks. As the demand for these applications increases, 'best effort' service is inadequate and results in lack of user satisfaction. The success depends upon supporting the QoS requirements for both real-time and non-real-time multimedia applications.

QoS is the ability of a network element to have some level of assurance that its traffic and service requirements can be satisfied. From a user perspective an end-to-end QoS in satellite/terrestrial network depends on the QoS achieved at each layer of the network based on satellite dependent and independent functions to be performed at the layer interfaces. The recent QoS technologies for terrestrial environment include Integrated Services (IntServ), Differentiated Services (DiffServ) and MultiProtocol Label Switching (MPLS) traffic engineering. The applicability of these models for satellite networks requires research and experimental demonstrations prior to broadband satellite systems deployment. This special issue provides the status of the significant research on QoS for satellite IP networks and the current standardization activities.

The first paper *Quality of service for satellite IP networks: a survey* by Sastri Kota and Mario Marchese surveys the satellite IP networks including end-to-end QoS requirements, objectives, and the current state of QoS technologies. Several QoS research issues of bandwidth allocation, delays, satellite TCP enhancements, and security issues are discussed. This paper describes a few planned systems and projects, standardization efforts by ETSI, ITU, and IETF, and isolates the future research areas.

In the second paper *A gateway architecture for IP satellite networks with dynamic resource management and DiffServ QoS provision* by Luca Simone Ronga, Tommoso Pecorella, Enrico Del Re, and Romano Fantacci, a satellite network architecture is presented to provide QoS support for IP traffic based on the DiffServ paradigm, while minimizing the wastage of the valuable satellite resource. The performance has been evaluated in terms of throughput, packet jitter, TCP protection against UDP flooding and wasted bandwidth on the satellite link.

The third paper *QoS-oriented Traffic management in multimedia satellite systems* by Nicolas Courville describes the different buffer management techniques for a multimedia satellite system with ATM based onboard switch. The paper concludes that the combination of the Hot Spot Push Out (HSPO) and Early Packet Discard (EPD) methods, and Sharing with Maximum Queue (SMXQ) method can be used in the switch buffer, respectively, for non-real-time and real-time traffic.

Following that Nicolae Iuoras, Tho Le-Ngoc, Mohamed Ashour, and Tallal Elshabrawy in the fourth paper *An IP-based satellite communication system architecture for interactive multimedia services* describe a broadband satellite/terrestrial IP networks and Dynamic Capacity Allocation (DCA) strategies based on Combined Free and Demand Assignment Multiple Access (CFDAMA) scheme supporting DVB-RCS and DiffServ to achieve short delay and different QoS requirements. This paper concludes with simulation results showing that it is possible to achieve a high network load yet maintain service differentiation for various traffic classes with both short-range dependent (SRD) and long-range dependent (LRD) traffic inputs.

In the fifth paper *Dynamics of TCP over BoD satellite networks* by Mahesh Sooriyabandara and Gorry Fairhurst, the Bandwidth on Demand (BoD) mechanisms defined by DVB-RCS and the performance impact on TCP is described. Based on their simulation results the authors conclude that a longer-term solution as opposed a short-term TCP PEPs can be achieved by tuning the BoD techniques, accompanied by improved TCP implementations, use of Congestion Manager, and/or by the evolution of applications themselves.

Following that Zhifeng Jiang and Victor C.M. Leung in the sixth paper *A predictive demand assignment multiple access protocol for Internet access over broadband satellite networks* present a novel PRedictive Demand Assignment Multiple Access (PRDAMA) protocol for packet communications over broadband satellite networks. Simulation results demonstrate that PRDAMA achieves a lower average delay and delay jitter compared with other DAMA protocols under highly bursty traffic due to its accurate traffic trend prediction.

In the seventh paper *Static and dynamic resource allocation in a multiservice satellite network with fading* by Nedo Celandroni, Franco Davoli, and Erina Ferro, a control architecture for resource allocation in satellite networks is proposed, along with the specification of performance indexes and control strategies for real-time, synchronous data (stream traffic), and best effort traffic (datagram traffic). Numerical results for a specific architecture in a real environment based on the Italsat satellite national coverage payload characteristics are provided.

Finally, the eighth paper *Networking issues in IP multicast over satellite* by Zhili Sun, M.P. Howarth, Haitham Cruickshank, S. Iyengar and L. Claverotte provides an overview of the networking issues for IP multicast for satellite communication platform. This paper emphasizes the modifications required for multicast networking protocols, e.g. IGMP, multicast routing, and reliable multicast protocols.

We believe that the contributions of this special issue covering projects from both North America and Europe represent significant highlights in the development of QoS provisioning for satellite IP networks for future multimedia applications. As most of the contributions are based on actual systems development, we hope the articles will serve as design guidelines for broadband satellite network researchers, developers, and service providers.

We are grateful to the Chief Editor Prof. Barry Evans and his staff for making this special issue possible. We thank the authors for their submissions and the reviewers for their valuable comments.

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BIOGRAPHIES

Sastri Kota received his BS in Physics from Andhra University, Visakhapatnam, BSEE in Telecommunications from Birla Institute of Technology and Science (BITS), Pilani, and MSEE from Indian Institute of Technology, Roorkee, India. He received the Electrical Engineer's Degree from North Eastern University, Boston, Massachusetts, U.S.A and PhD in Electrical and Information Engineering from University of Oulu, Finland. He is currently a technical consultant with Loral Skynet, Palo Alto, California, U.S. Prior to that he held various technical and management positions and contributed to military and commercial satellite systems in the areas of network design, broadband network architectures and protocols, and performance modeling and analysis at Lockheed Martin, SRI International, Ford Aerospace, The MITRE, Xerox, and Computer Sciences Corp. Currently he is the U.S. chair for ITU-R, Working Party 4B and Rapporteur for Ka-Band Fixed Satellite Systems. He was the chair for Wireless ATM Working Group and has been an ATM Forum Ambassador. He was the recipient of the ATM Forum Spotlight award. Kota has published and presented over 100 technical papers in book chapters, journals, and conference proceedings. He served as a guest editor for IEEE *Communications Magazine*. He was an invited speaker and panelist at various International seminars and conferences. He served as a satellite communications symposium chair and vice-chair for IEEE GLOBECOM 2000 and 2002, technical chair for Broadband Networking in the New Millennium, ATM Interact Symposium 2001, India, assistant technical chair for IEEE MILCOM'97,'90, and SPIE'91,'92 conferences, and as session chair for IEEE GLOBECOM, ICC, WCNC, MILCOM, and AIAA communication satellite systems conference. His research interests include satellite IP networks, traffic management, ATM networks, wireless and mobile IP networks, and broadband satellite access. He is a senior member of IEEE, Associate Fellow of AIAA, and member of ACM.

Mario Marchese was born in Genoa, Italy in 1967. He got his 'Laurea' degree cum laude at the University of Genoa, Italy in 1992 and the Qualification as Professional Engineer in April 1992. He obtained his PhD (Italian 'Dottorato di Ricerca') degree in 'Telecommunications' at the University of Genoa in 1996. After a short industrial experience with Marconi S.p.A., he got his PhD and worked as a member of the research staff of the Telecommunication Networking Research Group by the University of Genoa with a post-doctoral scholarship. From 1999 he has been working with the Italian Consortium of Telecommunications (CNIT), by the University of Genoa Research Unit, where he is now Head of Research. He is author and co-author of about 80 scientific works, including international magazines, international conferences and book chapters. He is the Official Representative of CNIT within the European Telecommunications Standard Institute (ETSI), Secretary of the IEEE Satellite and Space Communications Technical Committee and Member of the IEEE. His main research activity concerns: TCP/IP protocols, satellite networks, transport protocols for satellite links, ATM networks and related topics, best-effort multimedia networks.