

Broadband convergence Networks (BcN)

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The advent of multimedia applications with high bandwidth and quality of service requirements has initiated a new era in telecommunications technology. At the same time, rapid development of various wireless and wired networks including third generation cellular mobile networks (UMTS and cdma2000), ADSL, Wi-Fi, WiMax, terrestrial and satellite DVB networks have emerged the next research topic toward integration and convergence of those networks. The convergence of mobile and fixed networks will provide new business models for the communications systems and generate new applications. The seamless movement of a user subscribed to one network to another network using a unique multimode handheld device will therefore create new problems to be solved by the telecommunications researchers. Billing and security, maintaining the quality of service while moving from the home network to a visiting network and fast and lossless handoff among networks are some of those topics.

Broadband convergence Network (BcN) will be one of the most important keywords in the next few years toward the implementation of next generation mobile networks. In BcN the connection among heterogeneous networks both on horizontal and vertical structures, interaction among network-dependent elements of those networks, and security and quality of service policies including scheduling and admission control must be carefully designed.

There has been a tremendous research activity on next generation mobile network in the past few years and BcN has started to illustrate its importance in this way. This Special Issue of the *Journal of Communication Networks* tries to cover some of those activities currently undergoing in different parts of the world. We have received an overwhelming response to our open call for papers and after a peer review process, in which each paper was reviewed by at least three experts in the field, we have selected 12 papers which are grouped in four categories, as summarized below.

Hybrid Networks

This section of the Special Issue consists of three papers dealing with the configuration, infrastructure and other issues in heterogeneous networks of both wired and wireless systems. The first paper by Tarchi and Fantacci, entitled *Bridging Solutions for an Heterogeneous WiMAX-WiFi Scenario*, considers interconnecting the most popular wireless LAN standard, IEEE 802.11 with its emerging wireless MAN counterpart, IEEE 802.16. Wi-Fi and Wi-Max, as they are more common terminologies for the two aforementioned standards, will surely have an important role in future generations of the mobile network, due to several factors. Both standards promise much higher data rates compared with cellular networks and at the same time can ask for less infrastructure cost. They also have the advantage of being more compatible with the IP network, which will be a key factor in future BcN. The second paper, *Autonomous, Scalable and Resilient Overlay Infrastructure*, by Shami, Magoni, and Lorenz proposes to design an efficient and robust addressing, routing and naming infrastructure for overlays on top of the network layer. The proposed infrastructure is based on the separation of the naming and the addressing planes and provides a convergence plane for the current heterogeneous Internet environment. To implement this property, the authors has designed a scalable distributed k -resilient name to address binding system. The third paper by Nishiyama, Taleb, Nemoto, Jamalipour, and Kato, *Enhancement of T-REFWA to Mitigate Link Error-related Degradations in Hybrid Wired and Wireless Network* proposes a new scheme called T-REFWA with a new error recovery scheme that can compensate problems of the TCP in wireless networks.

Load and Resource Management

The second section of the Special Issue is devoted to more technical aspects of the BcN, including providing service quality, resource management and load balancing, and includes four papers. The first paper by Li and Niu, *A Multi-dimensional Radio Resource Scheduling Scheme for MIMO-OFDM Wireless Systems* introduces multi-dimensional radio resource management in OFDM (orthogonal frequency division multiplexing) and MIMO (multiple-input-multiple-output) systems. The proposed scheme in this paper maximizes system throughput subjected to the minimum data rate guarantee for heterogeneous users and transmit power constraint. In the second paper, *Flow-Aware Link Dimensioning for Guaranteed-QoS Services in Broadband Convergence Networks*, authored by Lee and Sohraby, an analytic framework for dimensioning the link capacity of broadband access networks is proposed. This framework provides universal broadband access services to a diverse kind of customers such as patient and impatient customers. The flow-level QoS of a connection as well as the packet-level Quos are considered here. The third paper, *ARCA: An Adaptive Routing Protocol for Converged Ad Hoc and Cellular Networks*, written by Wu, Yang, and Chen proposes a new routing protocol for converged ad hoc and cellular network, where the converged network can offer a flexible traffic diversion mechanism that allows a mobile host to use the bandwidth in another cell to ease the congestion problem and increase the throughput in a cellular network. The last paper authored by Lo, Lai, and Chen, *An Adaptive Fast Expansion, Loading Statistics with Dynamic Swapping Algorithm to Support Real Time Services over CATV Networks*, considers the Community Antenna Television (CATV) networks for interconnecting heterogeneous networks to provide broadband access to subscribers. The paper proposes a time guaranteed and efficient upstream mini-slot allocation algorithm for supporting quality-of-service traffic over CATV networks to fulfill real-time interactive services, such as video telephony, video on demand, and distance learning.

Handover Management

Handover probably is one the most important techniques in heterogeneous networks and can decide real implementation of BcN in future. This section of the Special Issue consists of three papers discussing the handover management in different networks. The first paper, *Optimal Vertical Handover Control Policies for Co-operative Wireless Networks* by Papadaki and Friderikos looks at the interconnection of heterogeneous radio access technologies and formulates the problem of load balancing between co-operative radio access technologies as a mathematical program. By trading off a pre-defined delay tolerance per request the authors propose a vertical handover batch processing (VHBP) scheme. The second paper authored by Tuysuz and Alagoz, entitled *Handover Management Algorithms in LEO Satellite Communication Networks* considers satellites as one of the elements in future heterogeneous mobile networks for global mobility. The paper proposes a new handover management scheme that aims at decreasing latency, data loss, and handover blocking probability. The authors also present another interesting handover management model called Satellite Mobility Pattern Based Handover Management in LEO Satellites (PatHO-LEO) which takes mobility pattern of both satellites and mobile terminals into account to minimize the handover messaging traffic. The last paper, *Group Key Exchange over Combined Wired and Wireless Networks* by Nam and Won looks at the security aspects of the BcN and heterogeneous networks. This paper presents a group key exchange protocol that is specifically designed to be well suited for hybrid wired and wireless networks which consist of both stationary computers with sufficient computational capabilities and mobile devices with relatively restricted computing resources.

Network Development and Administration

Last but not the least, there are important factors in administration and maintenance of the heterogeneous networks that should not be forgotten. This last section of the Special Issue includes two papers noting this important part. In the first paper, *Next-generation Converged Networking in Korea: The concept and its R&D Activities*, Kang, Park, Lee, Kim, and Jun have introduced the concept and the vision of BcN with a viewpoint of a new paradigm to prepare future-proof communication environment. The paper outlines the BcN R&D activities in detail including R&D philosophy, R&D phases, key technologies required, and

current development issues. The second paper, authored by Chun, Song, and Lee, entitled *Review on the operation, Administration and Maintenance (OAM) of BcN* provides detailed information on control, data, and service planes in an architectural model of the BcN, and how maintenance should be related throughout the layered architecture for the BcN.

Before ending this Guest Editorial, we would like to thank all authors who have submitted their research papers to the special issue and our reviewers for their invaluable effort in evaluating papers in rather short period of time. We would like also to thank the Journal Editor-in-Chiefs Raymond Pickholtz and Hyung Jin Choi for their guidance and support toward completion of the issue, the Journal's Assistant Editor, Hak Jun Kim, and all other publication staff at JCN. We hope you enjoy reading and forward your comments and feedback to us.



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Nei Kato received his M.S. and Ph.D. degrees from Tohoku University, Japan in 1988 and 1991, respectively. He has been working with Tohoku University since then and is currently a full professor at the Graduate School of Information Sciences. He has been engaged in research on computer networking, wireless mobile communications, image processing, and neural networks. He has published over 100 papers in journals and peer-reviewed conference proceedings. Nei Kato has served as TPC member on a large number of IEEE international conferences including ICC, GLOBECOM, WCNC and HPSR. From 2006, he is a technical editor of *IEEE Wireless Communications*. He is the recipient of the 2005 Distinguished Contributions to Satellite Communications Award from the IEEE Communications Society, Satellite and Space Communications Technical Committee. Nei Kato is a member of the Institute of Electronics, Information and Communication Engineers (IEICE) and a senior member of IEEE.

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founding Director of the Institute of Communications Engineering of the University. Under his leadership the institute was ranked the 2nd place in the country in terms of SCI journal publications and National Science Council funding per faculty in 2004. He has been a visiting Professor to Department of Electrical Engineering, University of Kaiserslautern, Germany, in 1999, the Institute of Applied Physics, Tsukuba University, Japan, in 2000, and Institute of Experimental Mathematics, University of Essen, Germany in 2002. He is a recipient of numerous Research and Teaching Awards from the National Science Council and Ministry of Education, Taiwan. He has authored or co-authored over 150 technical papers in major international journals and conferences, and four books and several book chapters in the areas of communications. He served as a symposium chair of major international conferences, including IEEE VTC, IEEE ICC, and IEEE Globecom, IEEE WCNC, etc. He served or is serving as the Editor or Guest Editor for IEEE Communications Magazine, IEEE JSAC, IEEE Networks Magazine, IEEE Wireless Communications Magazine, IEEE Trans. on Wireless Communications, IEEE Vehicular Technology Magazine, Wireless Communications and Mobile Computing (WCMC) Journal and International Journal of Communication Systems, etc. He is an Honorary Guest Professor of Zhejiang University, China, and Shanghai Jiao-Tong University, China.



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developing the TDX-10 ISDN, AIN (Advanced Intelligent Network) SCP (Service Control Point) for intelligent network services, and communications processing systems for PC communications. He became the Executive Director of IT R&D Project Division in February 2002. Just before his current position, he contributed to establish optical Internet project and managed system-engineering task of optical Internet project as the director of Optical Networking Department. He is currently leading the BcN(Broadband Convergence Network) Research Division where driving research and development to achieve BcN related technology deemed as the most imminent and strategic field by Government and industries. He is also the chair of the steering committee in the KOIF. His research interests include soft switches, the design of telecommunications networks, Internet traffic measurements, and optical Internet technologies.