

EDITORIAL PREFACE

Debashis Saha, Indian Institute of Management Calcutta, India

Varadharajan Sridhar, Sasken Communication Technologies, India

Welcome to the last issue of the year 2011. In this issue, we bring to you three research papers. We are also pleased to introduce Research Essay section in this issue. The idea behind this initiative is to invite academic/industry experts to write a short essay on the emerging technology, business and policy trends in the area of data communications and networking. We hope that this will provide our readers a look-ahead and synergistic view of this rapidly evolving field.

The first paper is on security aspects of Mobile Adhoc Networks (MANETs). The MANETs are open to a wide range of attacks due to their unique characteristics such as dynamic topology, shared medium, absence of infrastructure, multi-hop scenario and resource constraints. Data packets sent by a source node may reach destination through a number of intermediate nodes. In the absence of security mechanism, it is easy for an intermediate node to intercept or modify the messages, thus attacking the normal operation of MANET. One such attack is the *Black Hole attack*, in which, a malicious node called Black Hole node attracts all the traffic of the network towards itself, and discards all the packets without forwarding them to the intended recipients. This paper evaluates the performance of Adhoc On-demand Distance Vector (AODV) and its multi-path variant Adhoc On-demand Multi-path Distance Vector (AOMDV) routing protocols under black hole attack. Non-cryptographic solutions such as Secure Blackhole AODV (SBAODV) and

Secure Blackhole AOMDV (SBAOMDV) have been proposed to mitigate the effect of black hole attack with video streaming. The authors provide simulation results of their proposed algorithms and benchmark their results. The results show that, the proposed solutions provide better performance than the conventional AODV and AOMDV in terms of metrics such as packet delivery ratio, average throughput, average end to end delay, average jitter and Peak Signal to Noise Ratio of received video.

The second paper is on wireless sensor networks with energy heterogeneity. Clustering is always an important issue in this type of network, and the paper discusses how to enhance clustering subject to energy heterogeneity constraint. We have talked about M2M systems earlier that, with the advent of MEMS based sensor devices, wireless sensor networks are being increasingly deployed in large numbers in the industry and in our daily life – starting from monitoring production systems to keeping a vigil on social environments. Commensurately, there is a growing need for the efficient management of these sensor networks where battery-operated nodes have to handle complex functions in data acquisition and processing. Energy is traditionally a big bottleneck in these networks, and so energy saving solutions have always been in great demand. A major requirement for these battery-powered sensor nodes is to optimize between cooperation and competition. Another important issue with these

networks, which is usually ignored in most of the works, is the non-uniformity among the nodes in terms of energy content. Energy, being a crucial resource, imparts dominance to the nodes, which may result in an interesting behavioral pattern among the players. To address this constraint in this paper, the authors propose to use a heterogeneous three-tier node setting in their clustering algorithm. Nodes elect themselves as cluster heads based on their energy levels, therefore retaining a more-or-less uniform distribution of energy left with sensor nodes. Their result shows that the new protocol, proposed by them as SEP-E, is more robust in terms of network life time and resource sharing. The stability period offered by SEP-E shows significant improvement over ‘de-facto’ standard protocol LEACH typically when the degree of energy heterogeneity is high within the network.

The third paper of the issue looks back at one of the classical network algorithms which most of us have learnt about during our undergraduate days. The authors have considered Kruskal’s algorithm in a multicast routing environment keeping obviously recent multimedia applications in mind. The Internet and cellular networks are full of such applications that demand guaranteed end-to-end quality of service (QoS), and accordingly the underlying delivery networks are characterized by stringent constraints on delay, jitter, bandwidth, cost etc. The problem of multicasting is now almost synonymous with finding a minimum spanning sub tree of a given connected network. More than five decades ago, this problem was first solved by Kruskal, soon to be followed by Prim and Dijkstra who suggested better algorithms. However, Kruskal’s algorithm remains computationally more efficient in a number of interesting cases, in particular when the network

under consideration is sparse. The authors of this paper worked with the original algorithm in a somewhat different setting as they have considered the problem of determining multicast trees that guarantee certain bounds on the overall cost, and end-to-end delays from the source to each of the destination nodes. They propose to organize the priority queue of the original Kruskal’s algorithm into multiple classes, which are formed by the edge containing the source node, the edges containing destination nodes and the edges containing relay nodes respectively. Then, they introduce a new strategy in edge selection, giving priority to edges containing one or two destination nodes to be selected. Finally, based on these two strategies, they address the problem of constructing the delay constrained multicast tree using a fast and simple heuristic algorithm named the Extended Kruskal’s (EKRUS) algorithm. Further, they have developed two important strategies. The first one deals with the organization of the priority queue in Kruskal’s algorithm, and the second one concerns edge priority aggregation.

In the Research Essay at the end of the issue, Saha and Sridhar explore the emerging technologies, market evolution, business models and regulatory interventions and indicate possible research directions in the area of data communications and networking in the coming days. We hope that this will provide our readers a look-ahead of the future issues of IJBDCN.

We hope that you enjoy reading this issue as much as we do in compiling the interesting articles in it.

*Debashis Saha
Varadharajan Sridhar
Editors-in-Chief
IJBDCN*

Debashis Saha is a professor with the MIS Group, Indian Institute of Management (IIM)-Calcutta. Previously, he was with CSE Department at Jadavpur University (Kolkata, India). He received his BE (Hons) degree from Jadavpur University (Kolkata, India), and the MTech and PhD degrees from the Indian Institute of Technology (IIT-Kharagpur, India) all in electronics and telecommunications engineering. His research interests include pervasive communication and computing, network operations, management and security, wireless networking and mobile computing, ICT for development, and network economics. He has supervised thirteen doctoral theses, published about 230 research papers in various conferences and journals, and directed four funded research projects on networking. He has co-authored several book chapters, a monograph, and five books including Networking Infrastructure for Pervasive Computing: Enabling Technologies and Systems (Norwell, MA: Kluwer, 2002) and Location Management and Routing in Mobile Wireless Networks (Boston, MA: Artech House, 2003). Dr. Saha is the recipient of the prestigious career award for Young Teachers from AICTE, Government of India, and is a SERC Visiting Fellow with the Department of Science and Technology (DST), Government of India. He is a Fellow of West Bengal Academy of Science and Technology (WAST), Senior Life Member of Computer Society of India, Senior Member of IEEE, member of ACM, member of AIS, and member of the International Federation of Information Processing Working Group's 6.8 and 6.10. He was the founding Chair of Calcutta Chapter of IEEE Communications Society (2003-2008).

Varadharajan Sridhar is a Research Fellow at Sasken Communication Technologies (Bangalore, India). He received his BE from the University of Madras (India), Post Graduate Diploma in industrial engineering from the National Institute for Training in Industrial Engineering (Mumbai, India), and PhD in MIS from the University of Iowa (USA). He had taught at Ohio University and American University in the US; at the Management Development Institute (India) and Indian Institute of Management (Lucknow, India). He was a visiting Professor at the University of Auckland, New Zealand and at Aalto University, Finland. Dr. Sridhar's primary research interests are in the area of telecommunication management and policy and global software development. He has published many research articles, business cases, and chapters in edited books in his area of research. Dr. Sridhar is a member of various committees relating to telecommunications and IT set up by the Indian government. He was the recipient of the Nokia Visiting Fellowship awarded by the Nokia Research Foundation. He is on the editorial board of the Journal of Global Information Management and is a member of ACM and AIS. The book edited by Dr. Saha and Dr. Sridhar titled Recent Advances in Broadband Integrated Network Operations and Services Management (Hershey, PA, USA: IGI Global) is now available.