FROST & SULLIVAN

Mobile and Wireless Communications Technology Alert (Technical Insights)

This month's issue focuses on developments pertaining to wireless ad-hoc networks, multi hop relay networks. rotuing, VoIP, WLAN, wireless backhaul, TD-SCDMA. The articles give an account of the solutions/framework in the mobile and wireless domain and provide an overview of how these developments address the challenges.

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1. MOBILE AND WIRELESS COMMUNICATION TECHNOLOGY ALERT. LOW-COST ROUTING METHODOLOGY FOR WIRELESS NETWORKS; REDUCING BACKGROUND NOISE FOR VOIP; COST-EFFECTIVE WLAN ARCHITECTURE

In This Issue

DISTRIBUTED OPPORTUNISTIC SCHEDULING FOR WIRELESS AD HOC NETWORKS

Existing wireless network infrastructures use dedicated central nodes to facilitate communication between the participants of the network. With the drastic increase in number of mobile phone users, existing network architectures are slowly becoming infeasible for handling high traffic. Wireless ad hoc networks are often cited as the solution for this challenge. In an ad hoc network, all participant nodes are responsible for routing the communication traffic across the network. Each participating node implements a routing algorithm that permits messages to be directed towards the next node along a route to the receiver. This way, traffic can be handled in an efficient manner and communication between devices is possible without a planned fixed infrastructure.

However, there are certain design issues that need to be overcome for facilitating large scale deployment of wireless ad hoc networks. Most importantly, there are two issues that are to be considered--co-channel interference among active links in a neighborhood and time varying channel conditions over fading channels. For handling these issues, the link losses caused by fading and interference were separated by designing the Physical (PHY) network layer to address the issues of fading and the media access control (MAC) layer to address the issue of contention. However, this design has proved to be inefficient as fading can adversely affect the MAC layer in many realistic scenarios.

For solving the above mentioned problems, channel aware distributed scheduling is under consideration. However, channel-aware distributed scheduling is a challenging concept since the distributed nature of ad hoc communications dictates that each link has no knowledge of others' channel conditions and interference conditions.

Researchers at Arizona State University, USA, have come out with a through analysis of the prospects of distributed opportunistic scheduling (DOS) in countering the challenges limiting the deployment of ad hoc networks. In ad hoc networks, DOS involves a process of joint channel probing and distributed scheduling.

Due to the presence of channel fading, the link condition corresponding to a successful channel probing could either be of good or poor quality. If the link condition is poor, further channel probing may lead to better conditions and yield higher throughput. Thus, the desired tradeoff boils down to judiciously choosing the optimal stopping rule for channel probing and distributed scheduling.

The researchers have analyzed DOS from a network-centric perspective, where all links cooperate to maximize the throughput of the network, and a user-centric view, where each link tries to maximize its own throughput. In the network-centric perspective, the DOS is considered as a team game where all links look to improve the overall throughput of the network. The process of channel probing and scheduling is regarded as a maximum-rate-of-return problem, where the rate of return refers to the average of throughput. An optimal strategy has been developed for DOS by utilizing the optimal stopping rule to control the channel probing process and hence increase overall throughput. The researchers have shown that the optimal strategy is a pure threshold policy as the threshold is time-invariant. Also, the decision on further channel probing or data transmission is based on local channel conditions. This has been proved for both homogenous and heterogeneous networks.

In the user-centric perspective, the DOS is considered as a non-cooperative game as each link looks for maximizing its own throughput. The researchers have proved the existence of Nash equilibrium and its uniqueness under some sufficient conditions. By utilizing the best response strategy, a distributed iterative algorithm has been developed and its convergence to Nash equilibrium has been shown. As the best response strategy requires message passing from neighboring nodes, an online stochastic iterative algorithm based on local observations has been designed and its convergence has been established under some regularity conditions. Also, to mitigate the efficiency loss observed at the Nash equilibrium, the researchers have proposed a pricing-based mechanism.

Talking to *Technical Insights*, Junshan Zhang, a researcher involved in this work, says, "There has recently been much interest in distributed scheduling for wireless networks. The complexity level of existing wireless scheduling algorithms in the research literature is typically high, in the sense of requiring a lot of message passing between communication links/nodes. The complexity renders it harder to implement. In contrast, our distributed scheduling algorithm has a threshold structure and the thresholds can be pre-set offline. The algorithm is very simple-to-implement, since it requires no message passing and all scheduling decisions can be made locally." He also mentioned that the results of this research can be useful for enhancing MAC protocol design for wireless local area networks (WLANs), Worldwide Interoperability for Microwave Access (WiMAX), cognitive radio networks, and wireless mesh networks.

The researchers are collaborating with University of Illinois, USA and Princeton University, USA to generalize this research to wireless networks with multiple antennas and cognitive radio networks. This study has shown that rich PHY/MAC layer diversities are available for utilization in ad hoc networks. Ad hoc networks are considered as the panacea for problems in existing networks and this research buttresses the consideration.

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ANALYSIS OF CAPACITY AND RANGE OF MULTI-HOP RELAY NETWORKS

SEQUENCE-BASED LOCALIZATION TECHNIQUE ENHANCING LOCALIZATION ACCURACY

NOVEL LOW-COST ROUTING METHODOLOGY FOR WIRELESS NETWORKS

Y-COMM: THE NEW ARCHITECTURE FOR PERIPHERAL AND CORE FRAMEWORKS

REDUCING BACKGROUND NOISE FOR VOIP

NEW SCALABLE AND COST-EFFECTIVE WLAN ARCHITECTURE

HIGH-CAPACITY WIRELESS BACKHAUL SYSTEMS FOR EMERGING WIRELESS TECHNOLOGIES

WIRELESS TECHNOLOGIES AIDING DISASTER MANAGEMENT COMMUNICATIONS AND INFORMATION SYSTEM

TD-SCDMA: THE NEW TECHNOLOGY ON THE BLOCK