A study of Quality of Service on wireless mesh network

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Introduction

In recent years, there have been significant interests to use multi-hop wireless network for building Wireless Mesh Networks (WMNs), ad hoc networks and sensor networks. Despite the fact that some wireless mesh networks have been deployed as commercial network there have been still many issues in this network. One of the key challenges in wireless mesh network is to provision for sufficient network capacity to meet user requirements.

Research Aims

The research of this year focuses on routing algorithm for WMNs. In WMNs most of the nodes are either static or minimum mobility and do not rely on batteries. The goals of routing algorithms are hence to improve network capacity or the performance of individual communications instead of dealing with mobility or minimize power consumption. It is essential to understand the characteristics of WMNs to come up with a good routing algorithm. With this goal in mind, we have developed an analytic model of throughput performance for multi-hop wireless network and a QoS routing metric and protocol for WMNs.

Approaches

We have considered a multi-hop wireless network in which each node uses IEEE 802.11 DCF for medium access control (MAC) for developing the model. At the application layer, a single data flow has been assumed and hence, only intra-flow interference occurring for the packets of the same flow transmitted on different wireless links has been taken into account. To our best knowledge this is one of the first attempts to model the realistic case of multi-hop wireless networks that include hidden nodes from this perspective. It has been proved that the analytic model succeeds in estimating the saturation throughput of a given path in the multi-hop wireless network.

A QoS routing metric (CWB) has been proposed for WMNs. The metric accounts for load balancing among nodes in WMNs while considering interference. Our metric assigns weights to individual links based on both channel utilization and the average Contention Window used on this link. The individual link weights are combined into a path metric accounting for load balancing and interference between links using the same channel. Thus the CWB helps

the routing protocol to balance traffic and improve network capacity by avoiding routing traffic through congested area. The routing protocol is developed base on an well-known Optimized Link State Routing protocol (OLSR). Based on results from simulations, we unambiguously demonstrated that the feasibility of this proposed routing metric is quite promising although further work needs to be carried out and in this sense the present work opens up a lot of future investigation directions.

Progress of 2006

In 2007, an analytic model of throughput performance for IEEE 802.11 has been introduced. Based on the results of this model, a QoS routing metric and routing protocol are designed with characteristics of WMNs in mind.

Future directions

In 2008, the research will consist of two main parts:

- Improve the analytic model to predict per hop throughput, delay time and jitter with inter-flow interference
- Optimize the proposed routing protocol to decrease signaling overhead and extend both the routing metric and routing protocol for applying to IEEE 80.11e
- Integrate the analytic model with QOMET, a wireless emulator in StarBED, to perform extensive experiments with the proposed routing metric/protocol

Publications

1. R. Beuran, J. Nakata, T. Okada, **L. T. Nguyen**, Y. Tan, Y. Shinoda, "A Multi-purpose Wireless Network Emulator: QOMET", 22nd IEEE International Conference on Advanced Information Networking and Applications (AINA2008), Okinawa, Japan, March 25-28, 2008 (accepted for publication).

2. L. T. Nguyen, R. Beuran, Y. Shinoda, "Performance Analysis of IEEE 802.11 in Multi-hop Wireless Networks", 3rd International Conference on Mobile Ad-hoc and Sensor Networks (MSN 2007), Springer-Verlag LNCS 4864, Beijing, China, December 12-14, 2007, pp. 326-337.

3. R. Beuran, **L. T. Nguyen**, K. T. Latt, J. Nakata, Y. Shinoda, "QOMET: A Versatile WLAN Emulator", 21st IEEE International Conference on Advanced Information Networking and Applications (AINA-07), Niagara Falls, Ontario, Canada, May 21-23, 2007, pp. 348-353