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RESEARCH ARTICLE

WIRELESS MESH NETWORKS: ISSUES AND CHALLENGES

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***Abstract** - Wireless mesh networks (WMNs) have emerged as a key technology for next-generation wireless networking. Wireless mesh networks (WMNs) consist of mesh routers and mesh clients, where mesh routers have minimal mobility and form the backbone of WMNs. WMNs have large variety of applications in the field of military and disaster management. WMNs are undergoing rapid progress and inspiring numerous applications. However, many technical issues still exist in this field. They are queuing delay, unpredictable node mobility, wireless multi-hop communication, limited battery power and wireless range of mobile devices, as well as the absence of a central coordination authority in WMNs. This paper presents a study on recent advances and open research issues in WMNs*

1. INTRODUCTION

TDMA based mesh networks can guarantee quality of service (QoS) in wireless environments. However, there are various hurdles that have to overcome .Queuing delay experienced by each node in this environment increases multihop packet transmission delay, resulting in not meeting the delay bound of real-time applications in multihop wireless networks. Recently, TDMA-based QoS-aware scheduling schemes have been proposed for supporting various applications such as voice and video calls in WMNs. However, these schemes necessarily need a centralized base station for achieving their goals, such as a minimum length schedule considering the scheduling delay, delay-constrained schedule of flows, and link activation schedule to bound end-to-end delay. Moreover, wireless mesh network (WMN) have lack of mobility supports and the line of sight requirement. If a customer does not have a clear line of sight to the WMN base station, it is not possible for him to receive the service. it is relatively easy to design and build a WMN and will forward packets to and from the destinations; however, while ensuring security and robustness, it is very difficult to achieve optimum (or near-optimum) performance of this network. In this article I present many of the problems that have to be solved in order to make a high-performance, secure and reliable WMN.

2. QUEUING DELAY IN MULTIHOP WIRELESS NETWORKS

There are two main factors that cause an increase in the multihop packet transmission delay in multihop wireless networks. In previous studies TDMA to determine the minimum length schedules may cause additional queuing delays, which have a negative influence on delay-sensitive networks. As an effect QoS of real- time applications in multihop wireless networks may not be guaranteed if additional queuing delays occur. In single-hop wireless networks, queuing delay happens when the packet transmission rate a in a source node is lower than the packet arrival rate. Such a queuing delay is referred to as the primary queuing delay and primary queuing points (QPs). On the other hand, there is a chance for an additional queuing delay may occur, which is referred to as the secondary queuing delay in this article. The secondary queuing delay occurs when multiple flows pass through an outbound link of a relay node. The secondary Queuing point is the point where the secondary queuing delay occurs. This article proposes a new distributed scheduling scheme to eliminate the secondary queuing delay, thereby ultimately reducing the multihop packet transmission delay.

3. PROPOSED SCHEDULING SCHEME

The operational procedures are classified into two phases: During Phase I, selection of path by the nodes carried out using the ad-hoc on-demand distance vector (AODV) routing protocol. Once the node obtains the path it will gathers the information on its one-hop neighbors. These two tasks are also performed in the conventional schemes prior to the TDMA scheduling, although both the routing algorithms and the approaches for obtaining the neighbor information are slightly different. Moreover, during the overhead analysis in the conventional tasks, these tasks are generally excluded as these tasks are considered as input parameters for scheduling. On the other hand, Phase II involves three steps for slot allocation: an initial frame length synchronization process used for slot allocation in the network, a multihop slot allocation (MSA) process allocates a different slot to each flow in a link to eliminate the secondary queuing delay, and global frame length synchronization (GFLS). Therefore, the proposed scheme allocates two different slots for two flows in the Node. Although such a slot allocation can eliminate the secondary queuing delay, it results in a large frame length. In such a case, it is important to consider the order of the slots allocated on a path.

4. CHALLENGES FOR QOS PROVISIONING IN WMN

QoS provisioning in WMNs is very important in order to support real-time communications such as audio and video. However, provisioning of communication QoS over wireless networks is far more challenging than for wired networks because of variability of wireless links, the lack of any central coordination authority, node mobility, limited battery power, multihop communication and contention for accessing the wireless channel. QoS routing and provisioning in WMNs is relatively new compared to IP networks and MANETs. Compared to MANETs, WMNs seem to be a better candidate for provisioning QoS, as they have the advantage of the presence of relatively static mesh routers providing a relatively stable wireless backbone network. QoS routing and provisioning schemes for WMNs can utilize this specific feature. To meet the QoS demands of applications, extensions have been proposed to improve the performance of the existing protocols.

Unreliable Communication Medium: In multi-hop wireless networks the wireless medium used for communication is prone to errors due to interference generated from transmissions of other wireless devices in the vicinity, as well as multi-path fading effects. This makes it challenging to provide any guarantees regarding reliable packet delivery.

Unpredictable Channel Access Delay: In a multi-hop wireless network there is no centralized controller .In this case media access control is based on a distributed algorithm. This leads to the difficulty of calculating and guaranteeing tight delay bounds generally required for real-time communication.

Varied QoS Requirements: Different application of wireless multi-hop networks have different set of QoS requirements. This will makes it difficult to develop one single standard for QoS provisioning to cover all the different QoS requirements. For example, a sensor network deployed to identify a chemical leak might require high reliability, whereas a disaster relief and response network may want less end-to-end communication delay. It also require less route discovery latency in order to quickly inform rescuers and paramedics.

Absence of Centralized QoS Control: In a multi-hop wireless networks there is no centralized controller. It will keep track of client node's location and the remaining QoS resources information of the network. Therefore, QoS provisioning has to be done in a distributed fashion. It is much more challenging than for a centralized network.

5. CHALLENGES OF WIRELESS MESH NETWORKS

Beyond basic reliability requirement, there are other characteristics can make a significant difference for the performance of wireless mesh networks.

Directional Antennas: Omni-directional antennas are inexpensive and require less time for alignment; however, directional antennas allow WMNs to reduce the interference between simultaneous transmissions to achieve long range capabilities and reduce the transmission power. However, using directional antennas can significantly complicate the design of the upper layers.

Mobility: WMNs are not capable of supporting more user mobility. it is necessary for the physical layer to support the shift in frequency and adapt to the fast fading conditions commonly associated with mobile users.

Variable Transmission Power: Being able to vary the power of the wireless transmitter can be seen as an extra degree of freedom for the link adaptation algorithm. However, the "optimal" transmission power can be determined only using information from the upper layers.

Energy-management policy: Energy management policy requirement is a critical issue in the design of WMNs. Devices is usually fed by chemical batteries, which sharply restricts the life of network nodes in the case of continuous operation. Furthermore, in many occasions, the use of external power supply sources such as solar or wind is too costly or, not suitable for the type of application. In the case of large-scale mesh networks the number of hops between source and destination may be high. This will cause increasing the energy-demands associated to data transmissions, results shortening network lifetime. Energy-management mechanisms will handle these concerns. They reduce the power consumption of nodes by the temporary disconnection of specific hardware components.

Authentication: Each client (stationary or mobile) should be authenticated before allowing a user to join the network. This can prevent unauthorized users or those that simply are not willing to pay for the service.

Privacy: User data travels through multiple wireless hops in wireless mesh network. The clients will be concerned with the privacy of their information. User data should be secured both from sniffing by eavesdroppers and from being read by other network users at intermediate hops. An end-to-end encryption scheme will be effective.

6. CONCLUSION

WMNs are undergoing rapid progress and inspiring numerous applications over other wireless networks. The main drawback of the technology is its complexity. The main source of this complexity is a combination between wireless technology and the unusual role of each wireless node. The challenges are in large part unique to WMNs and considerable research has yet to be completed before WMNs can reach their full potential. This paper reviews the existing WMN and present various challenges must be achieved as a part of recent advances in WMN.

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