Secure QoS based multichannel scheduler with packet concatenation for high speed wireless backhaul links

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Abstract
Security and quality are the important issues of wireless backhaul networks. To increase the throughput of the wireless channel and to better utilize the channel bandwidth previously, a multichannel scheduler with packet concatenation was proposed. This is the integrated design of packet concatenation and multiple parallel channels mechanism. Most of the concatenation techniques introduce additional delay inpacket delivery. So to overcome this, there is a need for QoS based mechanism. In this paper, to improve thequality of service a QoS extension module is added. In addition to this for ensuring integrity a checksum fieldis added in the packet header. And also digital signature and secure neighbor discovery techniques are used for protection.

Keywords- *Wireless Backhaul Links, QoS mechanism*, Security

1 Introduction

Wireless mesh networks (WMNs) have emerged as a key technology for next generation wireless networking. Because of their advantages over other networks, WMNs are undergoing rapid progress and inspiring numerous applications. The critical factors influence the performance of WMN [1] are radio technique, scalability, mesh connectivity, ease of use and security. In the case of 802.11 or 802.16 wireless networks backhaul capacity has an important role. Due to their multihop nature and large per packet overhead can leads to its low channel Efficiency. To overcome this problem integrated design of packet concatenation and multiple parallel channels are used.

The multichannel scheduler is used to increase the throughput [2] of the wireless channel and to utilize the channel capacity efficiently. The previous packet concatenation approaches addresses many problems such as increased latency, acknowledgement overhead, additional delay during the concatenation process. To overcome this problems in the scheduler approach strictly deadline ordered and loosened deadline ordered algorithms are used. The resequencing delay of strictly deadline ordered algorithms is less as compared to loosened deadline ordered algorithm. So in the proposed approach only the strictly deadline ordered algorithms is considered. In the traditional approaches single channel approaches are used. To speed up the transmission multiple channel are used. By using suitable channel selection algorithms the idle channels which is appropriate for transmission is selected.
The QoS module is used in the proposed approach consist of different concatenation modules. So this will help us to increase overall system performance. Although many security schemes have been proposed for wireless LAN in recent years, they are still not fully applicable for WMNs. The existing security schemes proposed for ad hoc networks can be adapted for WMNs. Similar to mobile adhoc networks WMNs still lack efficient and scalable security solutions, because their security is more easily compromised due to several factors such as their distributed network architecture, the vulnerability of channels and nodes in the shared wireless medium and the dynamic change of network topology. To provide integrity of the messages checksum field is added in the header of the packet .Various security approaches are also used for protection.

The rest of the paper is organized as follows. In section 2, perform a study on the previous works. Section 3 specifies the proposed solution. Paper is concluded in the next section.

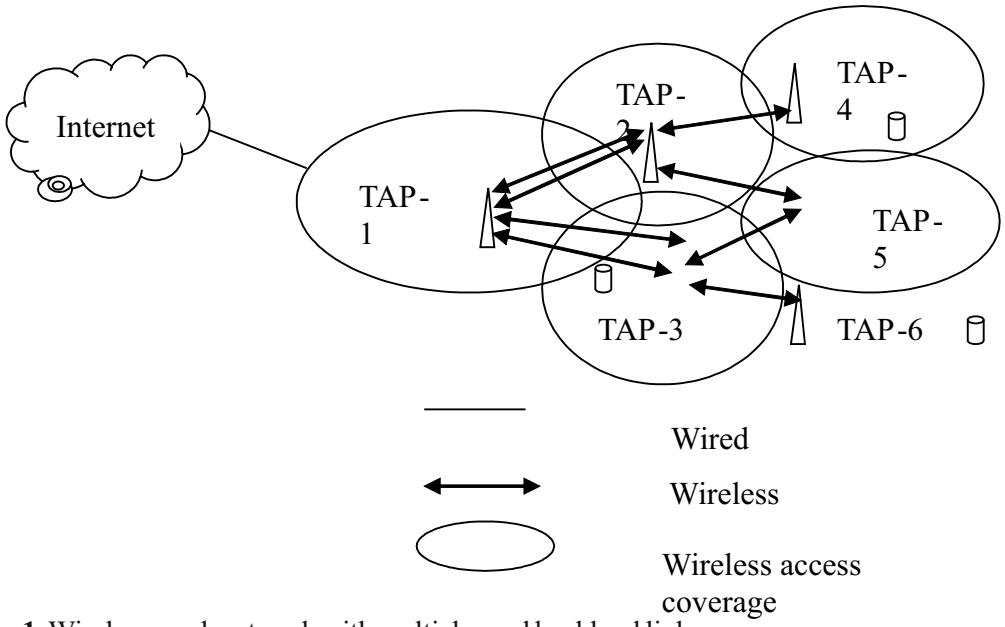


Fig. 1. Wireless mesh network with multichannel backhaul links

In wireless mesh network each network node called transient access points can be equipped with more than one radio interfaces and use of multiple channels to transmit its traffic among its nodes.

2. Previous Works

The applications of packet concatenation algorithms [5]-[7] are used to increase the performance of the system. The packet scheduling protocol provides quality of service over multiple channels [3] [4]. The delay due to the packet concatenation is reduced by using some QoS based mechanism in some aggregation approaches.The design of multichannel scheduler [8] which is the integrated design of packet concatenation and multiple channel is used to increase throughput and to utilize the bandwidth efficiently. To increase the quality of service of the integrated design QoS mechanism is added.

The main idea of multichannel scheduler is to concatenate packets into frames and send these frames though appropriate channels by using suitable channel selection algorithms. In fig.2 there are M flows of input traffic each being regulated by some prenegotiated service contract. Each regulator calculates the eligible time for each packet for entering in the DOQ. Every eligible packet will assign a dead line and sorted according to it in the DOQ.

In this two packet concatenation algorithms are used. First is strictly deadline ordered algorithm [8].Here the concatenation operation is stopped every time when the accumulated length of the packets of the dead line ordered queue will larger than equal to Lmax, where Lmax is the maximum frame size. As compared to another approaches the main advantage is its less resequencing delay. Second is loosened dead line order algorithm [8].It is used to avoid the inefficiency caused by the first method. The idea is to check for eligible packet from the any gated flow with slightly larger dead line [9] than the head of line packet of the DOQ (p1) when there is still space in the pushed frame (but smaller than l1).

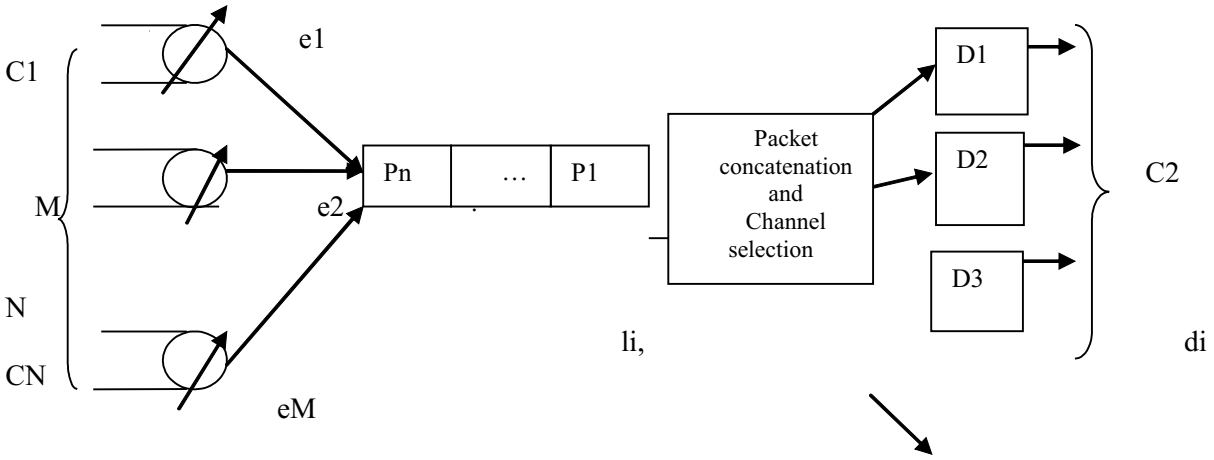
The channel selection is based on the minimum expected transmission time (MET) [8].First, check there are any available idle channel .If all the channels are busy then wait for some idle channel. Otherwise compute the Fj (Expected transmission time) for each idle channel for the forwarded frame length with l. Then select the idle channel with minimum Fj.

Security is another major issue concerned here. In many wireless networks various techniques such as cryptographic protection, secure neighbor discovery [10], plausibility checks are used. The Multichannel scheduler requires a security solution that is tailored to its specific characteristics, while meeting the requirements of secure communication system.

The main draw backs of the existing multichannel scheduler are: 1) The performance will degrade when there is high traffic in the network 2) No security solution for protection.

Gated Flows Dead Line Ordered Queue Delayed Channels

Fig. 2. Existing Multichannel scheduler with packet concatenation



3 Secure QoS based Multichannel Scheduler

In the proposed approach, for improving the Quality of service a QoS extension module is added. And also protect the frames from the unauthorized access a security solution is provided.Gated Flows Dead Line Ordered Queue Packet concatenation and Delayed Channels selection module

3.1 QoS Mechanism

In many existing packet aggregation approaches QoS module was used to reduce the concatenation delay. There, the major issue was the resequencing delay. But in this scheduler the packets are deadline ordered. so resequencing delay is not an issue. The QoS module will improve overall performance of the scheduler. Here a QoS classifier is used to classify each packet and forward in to appropriate concatenation module. Different concatenation modules are used to speed up the concatenation process when the traffic is high.

3.2 Security Solution

Providing strong security in multichannel scheduler raises important privacy concerns that must also be considered. To address these challenges, propose a set of security solutions that can be used as the building blocks of secure applications. To ensure protection checksum field is added in the packet header. This will helps to check the integrity of the message .Wireless mesh network uses multihop packet transmission.

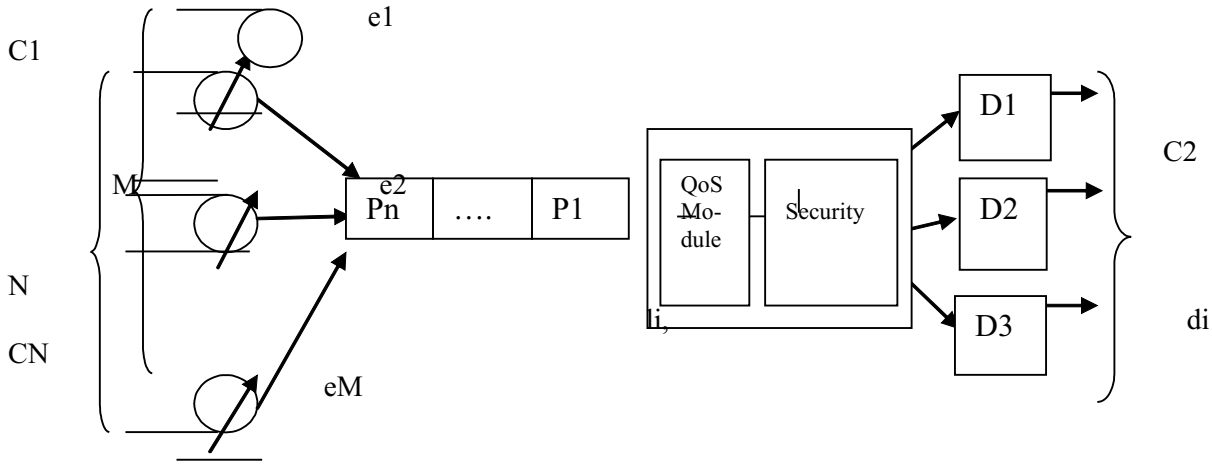
During the frame transmission some nodes in the routing path will malfunctioned. To find out such nodes, in the scheduler there is no approach. So Digital signature and secure neighbor discovery approaches are applicable here.

3.2.1 Digital Signature

A signature is calculated and a certificate is added to the frame. In many existing methods signature is added in front of the packet. In the case of Single signature, a single signature is calculated and a certificate is added. Intermediate nodes are not allowed to change its header fields.

Hybrid signature scheme consist of two signatures .The source signature is calculated over the immutable field such as source id and destination information and the sender signature is calculated over mutable field such as sender information. On the reception of a packet, each forwarding node verifies the source and sender signatures. Updates the mutable field values and calculates the new sender signature. Then replace the old signature with the new one and then reforwards the packet. This will provide integrity for frames.

Fig. 3. Secure QoS based multichannel scheduler with packet concatenation



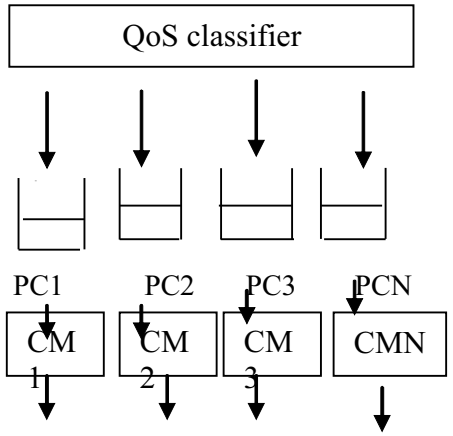


Fig. 4. QoS extension module

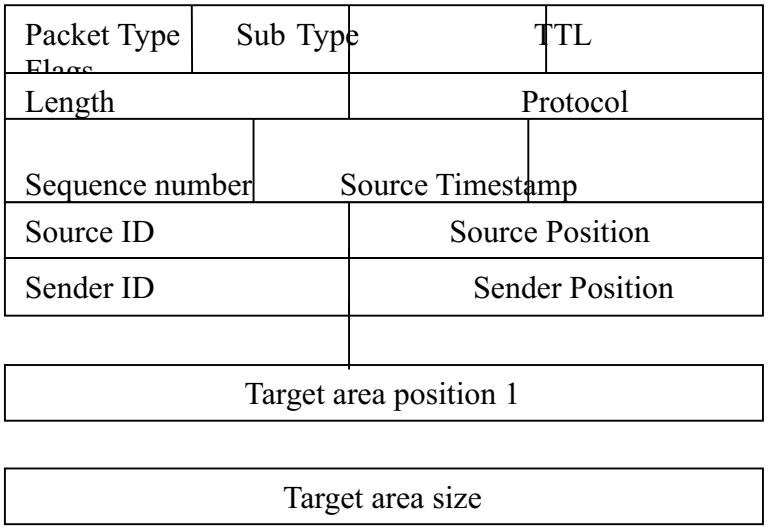


Fig. 5. New header format

3.2.2 Secure Neighbor Discovery

This method is used to find out the nodes which are not actually neighbors. Upon the reception of a packet the correct node determine its distance from the sender based on the location and time information from the sender.

Then calculates the time of flight of the packet by subtracting received timestamp from the current one. The product of the radio propagation frequency and time of flight will gives the second distance. If both the estimates are equal or below a neighborhood range R the sender is considered as a correct neighbor.

4 Conclusion

The multichannel scheduler is used to reduce the transmission overhead and utilize the channel capacity efficiently. The system performances will decreases when the traffic is high. So in this paper, to enlarge the packet concatenation process a QoS extension module is added. Previously, there is no security solution for multichannel scheduler. But here, for ensuing protection signature schemes and secure neighbor discovery techniques are used. This may result some overhead .Compared to the security provided by this system these overheads are negligible.

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