Performance Analysis of Multi-channel 802.11MAC for Wireless Mesh Network

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Abstract - There are various channel access methods include Schedule based, contention based and Hybrid based in which IEEE 802.11 Medium Access Control (MAC) is including contention based category. The IEEE 802.11MAC is based on carrier sensing, and contention, i.e., collision avoidance of frame transmissions from different radio stations. This contention-based protocol is argued in this paper and extended for the usage in multiple parallel frequency channels, in which a multi-channel station sets of channels for increasing its own achievable throughput that is used in Wireless Mesh Network Performance analysis Single channel single interface scheme using IEEE 802.11 MAC and TDMA channel as relative study. Measure performance parameter of existing Multipath and Multi-channel network with multichannel interface using IEEE 802.11 MAC channel. In addition, performance of Wireless mesh network using IEEE 802.11 MAC is best interesting subject for researcher.

Keywords – IEEE 802.11 MAC, Multichannel, Multipath.

1. INTRODUCTION

In traditional single channel single interface network capacity decreases with increasing mobile nodes, interference and due to collision in single shared medium. By effectively utilizing non overlapping channel the network capacity can be significantly enhanced by allowing more concurrent transmissions that is multichannel network allow concurrent transmission [1]. IEEE 802.11 MAC is existing in single channel single interface facility. According to writer Mohammad Eslami [3] Channel Assignment and Multichannel MAC Layer are most challenging issues in MAC layer. Generally multichannel MAC is used in wireless mesh network. In wireless mesh networks, MAC is communicate with only one hop communication and as well as provide multi-point to multi-point communication according to distributing and collaborative concepts. In addition, it should be self-organized for better cooperation between nodes according to low mobility in nodes. Various Multichannel MAC protocols are available but none of them accepted as standard [2]. Detail mentioned in section 3. This is because the MAC protocol is application specific. Mainly works on the single-channel MAC in WSNs focuses primarily on the efficiency of energy. Nevertheless, multi-channel MAC protocols proposed for WSNs mostly focus on efficient channel assignment and less works have been done on energy efficiency [2].Due to not accept as standard of multichannel MAC protocols according to author so IEEE 802.11 MAC protocol used as standard for multichannel multi-interface in Wireless Mesh Network for researcher. The rest of papers is organized as follows System model in section 2.Previous work in section 3.Prroposed methodology in section 4 and finally simulation results in section 5.

2. SYSTEM MODEL

When a call arrives and a route is established, a data interface becomes active (where a data channel is assigned to it) and changes to either send mode or receive mode, depending on the direction of the traffic flow. To save energy, an inactive data interface can be switch off, or put in sleep mode. The control interface is not assigned with any working mode, as it continuously operates in the pre-determined common control channel for both receiving and sending. Send mode and receive mode differ as follows.

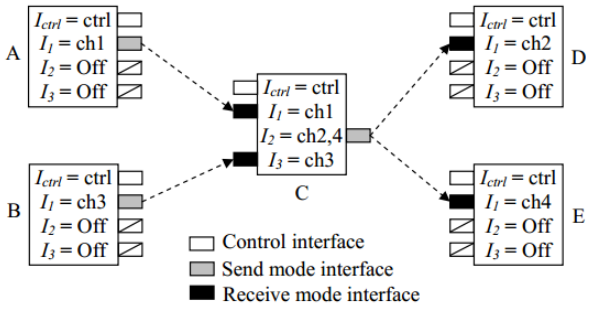


Fig.1 The use of multiple interfaces for two active connections [1]

In send mode, an interface can switch to different data channels to send data packets to different neighbors (so effectively it works on multiple channels), but it is forbidden from getting data packets. In receive mode, an interface can only work on a single data channel, mainly for receiving of data, and restricted data sending is also allowed (e.g. there is only one data interface in an intermediate node for data forwarding, or when the send mode interface is overloaded;

to be detailed later). When a call/route finishes/expires, the data interface returns to sleep mode, and may switch to an appropriate working mode when a new route request arrives. It should be noted that since the 802.11 handshaking is performed in the data channel, a send/receive mode interface can also receive/send CTS and ACK packets.

The network consists of five nodes, each has four interfaces labeled as Ictrl, I1, I2, and I3, and where Ictrlis the control interface listening on the control channel (ctrl), I1, I2, and I3 are data interfaces. There are two paths, A-C-D and B-C-E, intersect at node C. Consider the path AC-D. With J-CAR, data channel 1 (ch1) is selected by link A-C. The two nodes communicate by having I1 at node A in send mode and I1 at node C in receive mode. Similarly, ch2 is selected by link C-D, occupying I2 at C (send mode) and I1 at D (receive mode). We can see that the two links use different channels. This eliminates mutual interference. Consider the second path B-C-E. With J-CAR, ch3 is selected by link B-C, occupying I1 at B (send mode) and I3 at C (receive mode). In order not to interfere with the data receiving at I1 and I3, and assume Ictrl is not desired; node C selects I2 and ch4 for link C-E.Since I2 at node C is in send mode, it can switch between ch2 and ch4 for data sending. Finally, node E switches its I1 to ch4 (receive mode). It should be noted that node C receives data using two interfaces; the performance of throughput is improved than the receiving channel pre-assignment schemes due to the reduced packet collision probability [1].

3. PREVIOUS WORK

In this section, a range of multi-channel MAC protocols in WSN literature is described and their main shortcomings are outlined. Then, these protocols are classified according to some parameters and are compared with each other in the following section.

MC-LMAC [4] is a schedule-based single-radio multi-channel MAC protocol designed with the objective of maximizing the throughput of WSNs by coordinating transmissions over multiple frequency channels. It is available on the single channel LMAC [5] protocol. MC-LMAC is based on scheduled access that nodes switch their inter-MC-LMAC is based on scheduled access that nodes switch their inter-faces between channels dynamically. Time slot T and each node are allocated the control over a time slot to transmit on a particular channel. In fact, a node selects a time slot and a channel on which it is allowed to transmit.

MMSN is the first multi-frequency MAC protocol designed especially for WSNs. It is based on slotted CSMA where at the beginning of each timeslot; nodes need to contend for the medium before they can transmit. The beginning of each timeslot is reserved for broadcasts. When a node want to convey a packet it has to listen for the incoming packets on both its own frequency and the destination's frequency.

Rainbow [6] is a tree-based MAC protocol designed for reliable data collection in WSNs in scenarios with RF interference. It uses local TDMA and Frequency Hopping Spread Spectrum (FHSS) together. The FHSS scheme is used to reduction collisions improve throughput and avoid RF interference.

CMAC [7] is a desynchronized multi-channel MAC protocol that uses two radios. CMAC relies on three types of control messages for its operation: Request (REQ), Confirm (CONF), and Wait (WAIT), that all are sent and received through the LR.

TMCP [8] is a tree-based multi-channel protocol for data collection applications in WSNs. The chief idea of TMCP protocol is to partition the whole network into multiple vertex-disjoint sub-trees all rooted at the base station Tree-Based Multi-Channel Protocol has three modules, Channel Detection (CD), Channel Assignment (CA), and Data Communication (DC).

Y-MAC [9] is an energy-efficient multi-channel MAC protocol for dense WSNs that utilize a hybrid access method. It allocates time slots to the receivers instead of senders. The time slot length is long enough only to receive one message. The frame arrangement of Y-MAC is be made of broadcast and unicast periods.

COM-MAC [10] is a cluster based on-demand multi-channel MAC protocol for Wireless Multimedia Sensor Networks (WMSNs). The frame structure of COM-MAC is composed of three sessions, request, scheduling, and data transmission session.

HyMAC [9] is a combination of TDMA and FDMA protocols proposed for WSN applications in which data gathered by sensor nodes has to be delivered to at least one sink node in a timely manner. HyMAC is designed to provide great throughput and small bounded end-to-end delay for the packets exchanged between each node and the sink.

MCMAC [10] is a coordinator-based multi-channel MAC protocol for WSNs. It assumes that the nodes within the same cluster are synchronized. In MCMAC, the CH is responsible for synchronization. It broadcasts the synchronous information within the cluster.

4. PROPOSED METHODOLOGY

Incoming packet arrives through various corresponding channel and travel through the different entities in ascending order; since the last module of interface, the "Link layer" is connected to same common point the address multiplexer all packets are handle by the appropri- ate agent either routing protocol or the application.

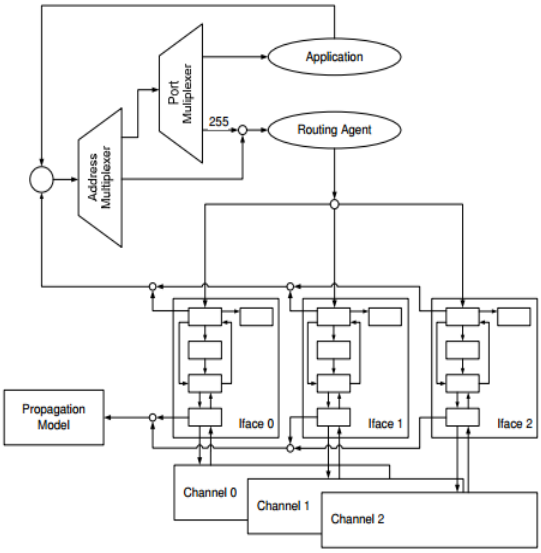


Fig.2 Node architecture with Multi-interface facility

Figure 3 shows the flowchart of multichannel Multii-interface facility using 802.11 MAC channels.one of the parameter must be included is the channel type which has set to wireless channel. There is new parameter, required to set maximum number of interface that the node with in scenario. In order to ensure that an appropriate memory management is performed, to include as many interfaces by the initialization of the god. Create node configurations in script file. Then indicate how many interface it has, using the new procedure change-numifs,as well as associating them with the corresponding channel i.e. by means of add-channel procedure.

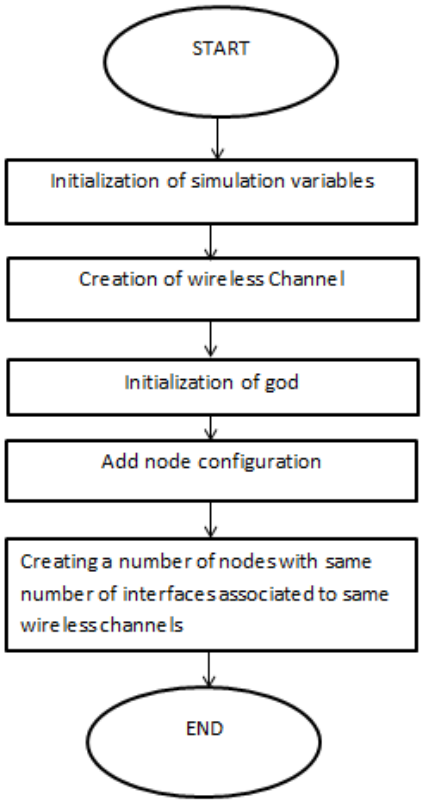
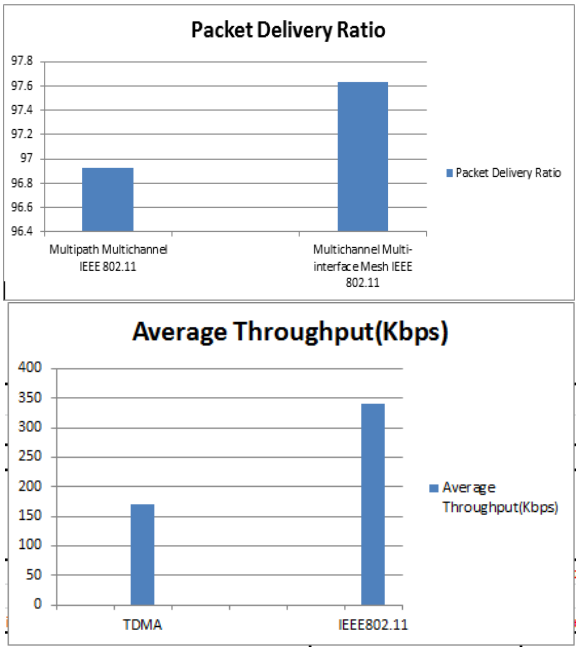


Fig.3 Flowchart of Proposed Method

5. SIMULATION/EXPERIMENTAL RESULTS

Here single channel single-interface implemented using different channel TDMA and IEEE 802.11 MAC in which 802.11 MAC give improved performance as shown in below figure.



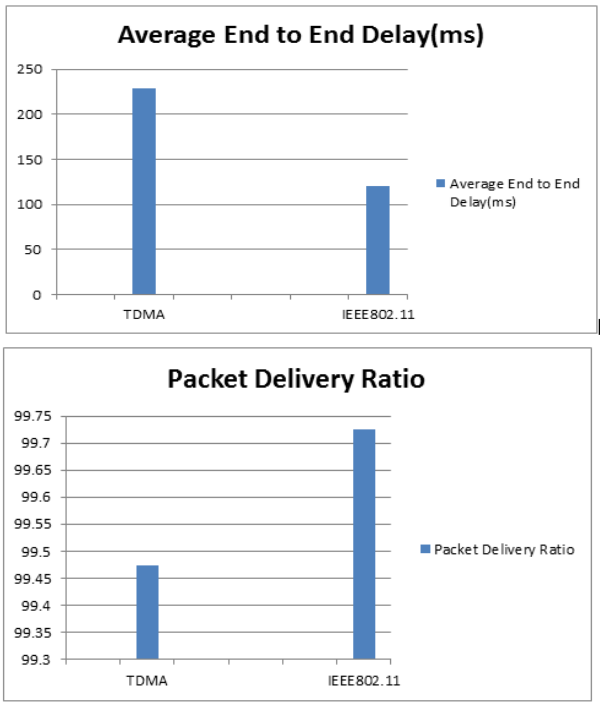


Fig.3 Performance analysis different channel access

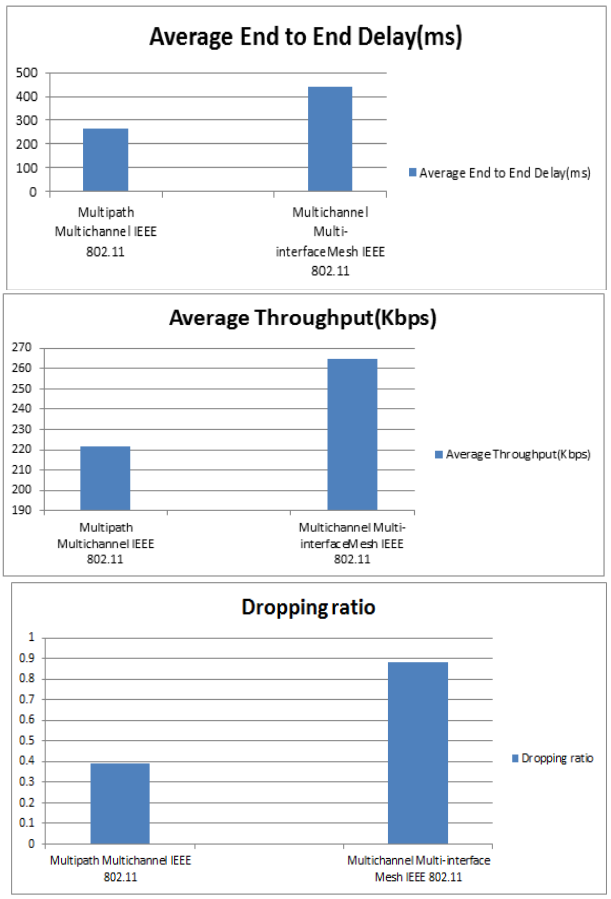


Fig.4 Comparative analysis Multichannel Multipath and Multichannel Multi-interface Mesh IEEE 802.11

Here packets reach its destination via two different paths using 6 nodes. There is no interfacing provide at particular node and measure their performance parameters. In another scenario two transmitter with two interface at node facility provided in this network so throughput, packet delivery ratio, end to end delay and dropping ratio increases as compared to previous cases. Throughput increases due to two interface facilities in this scenario so number of receive bits more that will effect on packet delivery ratio. In Multichannel Multi-interface packet drop is more as compared to Multichannel Multipath network.

6. CONCLUSION

From performing simulation in NS-2 software comparative analysis done two different channels in which IEEE 802.11 MAC give better performance. Further network is enhanced by multi-interface (two-interface) facility compare with existing method that is multichannel multipath in which multi-interface IEEE 802.11 MAC is better performance in terms of throughput and packet delivery ratio. End to end delay increases in multi-interface mesh due to updating routing table every time along with dropping ratio increases due to more drop packet in multi-interface IEEE 802.11 network.

7. FUTURE SCOPES

Further raise number of interfaces and test the limit of number of interface per node based on performance parameters such as throughout, packet delivery ratio and packet dropping ratio.

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