A REVIEW ON ISSUES OF MAC PROTOCOL FOR WIRELESS AD HOC NETWORK

S.Mythili,
Research Scholar,
Periyar University,
Salem,Tamilnadu,India.

Dr.N.Rajendran,
Principal,
Vivekanandha Arts and Science College for Women,
Sankari,Tamilnadu,India.

Abstract: A wireless ad hoc network is a collection of independent nodes or stations which communicate with each other by creating a multihop radio network. Ad hoc wireless networks present even greater challenges than infrastructure wireless networks at the MAC layer. MAC protocols are of significant importance since the wireless communication channel is inherently prone to errors and unique problems such as the hidden-terminal problem, the exposed-terminal problem, deafness and signal fading effects etc. Medium access control (MAC) protocols provide a means to nodes to access the wireless medium efficiently and collision free to the best of their ability. In this paper we provide some information about MAC and issues of MAC protocols.

Keywords: **ad hoc networks, MAC protocols, IEEE 802.11**

I.INTRODUCTION

The IEEE 802.11 standard is the most popular Media Access Control (MAC) protocol for infrastructure-based wireless local area networks. However, in an ad-hoc environment, the Point Coordination Function (PCF), defined in the standard, cannot be readïiy used. This is due to the fact that there is no central authority to act as a Point Coordinator (PC). Peer-to-peer ad-hoc mode in the IEEE 802.11 standard only implernents the Distributed Coordination Function (DCF). Our MAC protocol extends the IEEE 802.11 standard for use in multihop wireless ad-hoc networks implementing both the DCF and PCF modes of operation. The goal, and also the challenge, is to achieve QoS delivery and priority access for real-time traffic in ad-hoc wireless environments while maintaining backward compatibility with the IEEE 802.11 standard. The DFC scheme has been developed to use within both IBSS and infrastructure network configurations, whereas PCF only applies for infrastructure network configurations. The DFC is based on CSMA/CA [1].

ALOHA Protocols: In contrast to the elegant solutions introduced so far, the ALOHA protocols attempt to share the channel bandwidth in a more brute force manner. The original ALOHA protocol was developed as part of the ALOHANET project at the University of Hawaii. Strangely enough, the main feature of ALOHA is the lack of channel access control. When a node has a packet to transmit, it is allowed to do so immediately. Collisions are common in such a system, and some form of feedback mechanism, such as automatic repeat request (ARQ), is needed to ensure packet delivery. When a node discovers that its packet was not delivered successfully, it simply schedules the packet for retransmission. Naturally, the channel utilization of ALOHA is quite poor due to packet vulnerability [2].

Carrier Sense Multiple Access (CSMA): The poor efficiency of the ALOHA scheme can be attributed to the fact that a node start transmission without paying any attention to what others are doing. In situations where propagation delay of the signal between two nodes is small compared to the transmission time of a packet, all other nodes will know very quickly when a node starts transmission. This observation is the basis of the carrier-sense multiple-access (CSMA) protocol. In this scheme, a node having data to transmit first listens to the medium to check whether another transmission is in progress or not. The node starts sending only when the channel is free, that is there is no carrier[3].

Time Division Multiple Access (TDMA): segments the medium by splitting it into several fixed time frames that are subdivided into slots. To ensure that nodes keep track of time frames and slots, TDMA protocols must maintain synchronization among the nodes. In these protocols, only one station may transmit during a particular time slot. Because of their periodic nature, TDMA protocols are most suitable for real-time and deadline-sensitive traffic [4].

II. TYPES OF MAC PROTOCOLS

A possible taxonomy of ad hoc MAC protocols includes three broad protocol categories that differ in their channel access strategy: Contention protocols, allocation protocols, and a combination of the two (hybrid protocols) [5].

Contention protocols use direct competition to determine channel access rights, and resolve collisions through randomized retransmissions. With the exception of slotted ALOHA, most contention protocols employ an asynchronous communication model. Collision avoidance is also a key design element that is realized through some form of control signaling. The contention protocols are simple and tend to perform well at low traffic loads, i.e., when there are few collision, leading to high channel utilization and low packet delay. However, protocol performance tends to degrade as the traffic loads are increased and the number of collisions rise. At very high traffic loads, a contention protocol can become unstable as the channel utilization drops. This can result in exponentially growing packet delay and network service breakdown since few, if any, packets can be successfully exchanged.

Allocation protocols employ a synchronous communication model, and use a scheduling algorithm that generates a mapping of time slots to nodes. This mapping results in a transmission schedule that determines in which particular slots a node is allowed to access the channel. Most allocation protocols create collision-free transmission schedules, thus the schedule length (measured in slots) forms the basis of protocol performance. The time slots can either be allocated statically or dynamically, leading to a fixed and variable schedule length. The allocation protocols tend to perform well at moderate to heavy traffic loads as all slots are likely to be utilized. These protocols also remain stable even when the traffic loads are extremely high. This is due to the fact that most allocation protocols ensure that each node has collision-free access to at least one time slot per frame. On the other hand, these protocols are disadvantaged at low traffic loads due to the artificial delay induced by the slotted channel. This results in significantly higher packet delays with respect to the contention protocols.

Hybrid protocols can be loosely described as any combination of two or more protocols. However, in this section, the definition of the term hybrid will be constrained to include only those protocols that combine elements of contention and allocation based channel access schemes in such a way as to maintain their individual advantages while avoiding their drawbacks. Thus the performance of a hybrid protocol should approximate a contention protocol when traffic is light and an allocation protocol during periods of high load.

III.ISSUES OF MAC IN AD HOC NETWORK

A). Bandwidth Efficiency: The scarcity of bandwidth resources in these networks calls for its efficient usage. To quantify this, we could say that bandwidth efficiency is the ratio of the bandwidth utilized for data transmission to the total available bandwidth. Bandwidth is a very crucial resource in wireless networking; that's why the MAC protocols must be design in such a way that the limited bandwidth should utilized in an efficient manner. This approach kept the involved control overhead as minimum as possible and protect the network from extra over loaded [6].

B). Mobility of nodes: The QoS reservations or the exchanged information might become useless, due to node mobility. The MAC protocol must be such that mobility has as little influence as possible on the performance of the whole network. The bandwidth reservation made or the control information exchanged may end up being of no use if the node's mobility is very high. Therefore the design technology of MAC protocol must take this mobility factor into consideration so that the wastage of reserved bandwidth can be minimized and the performance of the system is not significantly affected due to node mobility [7].

C). Hidden and Exposed terminal problem : These problems are very unique to wireless networks. *Hidden terminal problem* – two nodes that are outside each-other's range perform simultaneous transmission to a node that is within the range of each of them, hence, there is a packet collision. *Exposed terminal problem* – the node is within the range of a node that is transmitting, and it cannot transmit to any node. Hidden terminal problems are refers to the collision of a packet at a receiving node due to the simultaneous transmission of those nodes that are not in the direct transmission range of the sender, but are within the transmission range of the receiver [8]. Collision occurs when both nodes transmit packets at the same time without knowing about the transmission of each other. The exposed terminal problem refers to the inability of a node, which is blocked due to transmission by a nearby transmitting node, to transmit to another node [9].

D). Quality of Service (QoS) Support: Providing QoS in these networks is very difficult, due to the high mobility of the nodes comprising them. Once a node moves out of another node's reach, the reservation in it is lost. On the other hand, in these networks QoS is sometimes extremely important, for example in military environments. Therefore, QoS should be provided somehow, despite the characteristics of ad hoc networks. Qos refers to the capability of a network to provide better services to selected network traffic over various technologies. In ad hoc networks QoS support is essential for supporting time-critical traffic session such as in military communication [8]. The QoS parameters such as bandwidth, throughput, delay, and jitter require reservation of resources like network bandwidth, buffer space and processing power. The inherent mobility of nodes in ad hoc wireless networks makes such reservation of resource a difficult task and become complicated to provide QoS support in real-time applications [6]. Therefore MAC protocols for ad hoc networks must have some kind of a resource reservation mechanism that takes into consideration the nature of wireless channel and the mobility of nodes [7].

E). Error probe shared broadcast channel: In radio transmission, a node can listen to all traffic within its range.

Therefore, when there is communication going on no other node should transmit, otherwise there would be interferences. Access to the physical medium should be granted only if there is no session going on. Nodes will often compete for the channel at the same time; therefore, there is high probability of collisions. Radio channels are the only communication medium for the nodes in wireless networks. Though radio channel is broadcast in nature but only one node at a time can start transmission and can access channel if its transmission do not affect any ongoing session i.e. when a node is receiving data, no other node in its neighborhood, apart from the sender, should transmit [8]. Since several nodes may contend possibility of packet collision is quit high in wireless network. Therefore the MAC protocols should provide the grant of accessing the channel in such a way that collisions are minimized [9].

F). Fairness: Fairness refers to the ability of the MAC protocols to provide an equivalent share or weighted share of the bandwidth to all competing nodes. Fairness can be either node-based or flow based. The former attempts to provide an equal bandwidth to all competing nodes where the later provides an equal share for competing data transfer session. In ad hoc wireless network fairness is important due to the multi-hop relying done by the node. An unfair relying load for a node results in draining the resources of that node much faster than that of the other nodes.

G). Time synchronization: Some mechanism has to be found in order to provide synchronization among the nodes. Synchronization is important for regulating the bandwidth reservation. Absolute synchronization in between nodes for bandwidth (time slots) reservation is a very important issue of ad hoc networks. To achieve this synchronization among nodes exchange of control packets is required [7]. Control packets carried the carrier signal between sender, receiver and intermediate nodes in the networks which help them by providing the knowledge about the ongoing session. However a particular amount of available bandwidth is used in the exchange mechanism of these control packets which may lead to an enormous wastage of network services. Therefore while designing a MAC protocol it should be keep in mind that the control packets must not consume too much of network bandwidth.

H). Distributed Operation: Fairness Unlike cellular network, ad hoc wireless network do not have central coordinator to distribute bandwidth fairly among nodes. Therefore nodes must be scheduled in a distributed fashion for gaining access to the channel and for this exchange of control information among nodes is required. Therefore the MAC protocol design should be fully distributed and must make sure that the additional overhead incurred due to this control information exchange is not elevated [7].

I). Degradation of battery power: Most radio-receivers are designed in such a way that only halfduplex communication can take place. When a node is transmitting, the power level of the outgoing signal is higher than any received signal; therefore, the node receives its own. Battery power is the key resource to keep an ad hoc network alive for a long time. Each and every node in the ad hoc network is constrained with limited power supply and each transmission reduces the power at the nodes, causes early degradation in lifetime of the network. Therefore the MAC protocols must design in such a way that power should utilized in efficient manner and introduced some controlling technique so that the network gain capability for controlling transmission power [8].

J).Error-prone shared broadcast channel: In radio transmission, a node can listen to all traffic within its range. Therefore, when there is communication going on no other node should transmit, otherwise there would be interferences. Access to the physical medium should be granted only if there is no session going on. Nodes will often compete for the channel at the same time; therefore, there is high probability of collisions. The aim of a MAC protocol will be to minimize them, while maintaining fairness.

K). No central coordination: in ad hoc networks, there is no central point of coordination due to the mobility of the nodes. Therefore, the control of the access to the channel must be distributed among them. In order for this to be coordinated, the nodes must exchange information. It is the responsibility of the MAC protocol to make sure this overhead is not a burden for the scarce bandwidth.

L).Mobility of nodes: The mobility of the nodes is one of its key features. The QoS reservations or the exchanged information might become useless, due to node mobility. The MAC protocol must be such that mobility has as little influence as possible on the performance of the whole network.

M). Signal propagation delay: Signal propagation delay is the amount of time needed for the transmission to reach the receiver. If the value of this parameter is considerable, a node may start transmitting, when in fact, transmission from other nodes is taking place, but it has not reached the node yet. The ad hoc networks that utilize synchronization, therefore, will have to expand the time slot to accommodate the propagation delay.

IV.CONCLUSION

We have discussed the categories of MAC protocols and IEEE 802.11 information. We review the issues involve with MAC protocols In particular, we have looked some special design issues associated with different MAC protocols which are very important to keep in mind before designing them.

V.REFERENCES

[1] C.-K. Toh, Ad Hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR, NJ, 2002.

[2] N. Abramson, "The ALOHA System-Another Alternative for Computer Communications," Proc. Fall Joint Computer Conf., NJ, 1970, Vol. 37, pp. 281-285.

[3] N. Jain, S. R. Das and A. Nasipuri, "A Multichannel CSMA MAC Protocol with Receiver-Based Channel Selection for Multihop Wireless Networks," Proc. 9th Intl. Conf. Computer Commun. and Networks (IC3N), Oct. 2001.

[4] M. Gerla and J. Tzu-Chieh Tsai, "Multicluster, Mobile, Multimedia Radio Network," Wireless Networks, Vol. 1, 1995.

[5] F. Tobagi and L. Kleinrock. "Packet Switching in Radio Channels. II. The Hidden Terminal Problem in Carrier Sense Multiple-Access and the Busy-Tone Solution," IEEE Trans. on Commun., vol. COM-23, no. 12, pp. 1417-33, Dec. 1975.

[4] M. Rubinstein, I. Moraes, M. Campista, L.K. Costa, O.B. Duarte, "A Survey on Wireless Ad Hoc Networks", in:
G. Pujolle (Ed.) Mobile and Wireless Communication Networks, Springer US, 2006, pp. 1-33.

[5] Maali ALBALT, Qassim NASIR, "Adaptive Backoff Algorithm for IEEE 802.11 MAC Protocol", International Journal of Communications, Network and System Science, Vol. 4, pp. 249-324, 2009.

[6] V.K Sing, Sanjay Ghatak, Lekhika Chetri, Biswaraj Sen, "Effect of Exponential Back-off Mechanism in MACA and MACAW for MANETs: A Survey", International Journal of Latest Trends in Engineering and Technology, Vol.1, Issue 2, pp. 53-57, July 2012.

[7] C.Siva Ram Murthy, B.S. Manoj, "Ad hoc Wireless Network: Architecture and Protocol", PEARSON Publication, 2004.

[8] Michele Zorzi, James Zeidler, A. Lee Swindlehurst, Michael Jensen, "Cross-Layer Issues in MAC protocol Design for MIMO Ad Hoc Networks", IEEE Wireless Communication, pp. 62-76. August 2006.

[9] Neha Trivedi, G. Kuamr, Teena Raikwar, "Survey on MAC protocol for Wireless Sensor Network", International Journal of Emerging Technology and Advanced Engineering, Vol. 3, Issue 2, pp.558-562, February 2013.

[10] Vinay Kolar, "Challenges in Directional Antennas" CSE Department, State University of New York, 2004.

[11] Wang, Lin; Aghvami, A.H.; Chambers, W.G., "Design issues of uplink media access control (MAC) protocols for multimedia traffic over DS-CDMA systems," Multimedia, IEEE Transactions on , vol.7, no.3, pp.551,562, June 2005.

AUTHOR'S PROFILE

S.Mythili received her M.Phil(C.S) Degree from periyar University,Salem in the year 2006. She has received her M.Sc.,(CS) Degree from Periyar University, Salem in the year 2004. She is working as Assistant Professor, Department of Computer Science, Siri PSG College Of Arts and Science for Women, Sankari, Tamilnadu, India. Her areas of interest include Data Mining and Networking

Dr.N.Rajendran received his Ph.D Degree from Periyar University, Salem in the year 2011. He has received his M.Phil, Degree from Bharathiar University, Coimbatore in the year 2000. He has received his M.C.A Degree from Madras University, Chennai in the year 1990. He is working as Principal of Vivekanandha Arts and Science College for Women, Sankari, Salem , Tamilnadu, . He has 24 years of experience in academic field. He has published 22 International Journal papers and 15 papers in National and International Conferences. His areas of interest include Digital Image Processing and Networking.