



SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution



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DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

19EC402- WIRELESS ADHOC AND SENSOR NETWORKS IV ECE / VII SEMESTER

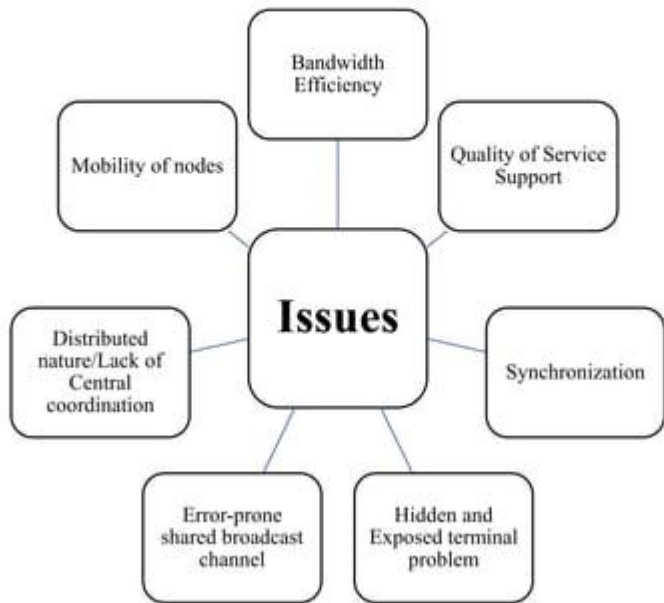
UNIT 2 – MEDIA ACCESS CONTROL (MAC) PROTOCOLS

TOPIC 1 –Issues in designing MAC protocols-Bandwidth efficiency-Quality of service support- Synchronization hidden node-exposed node problems.

INTRODUCTION

- Nodes in an ad hoc wireless network share a common broadcast radio channel.
- Bandwidth available for wireless communication is limited.
- Characteristics of wireless medium are completely different from wired medium.
- Wireless network needs to address issues such as:
 - Node mobility
 - Limited bandwidth availability
 - Error-prone broadcast channel
 - Hidden and exposed terminal problem
 - Power constraints.
- Access to the shared medium should be controlled in such a manner that all the nodes receive fair share of available bandwidth and it is utilized efficiently.
- Hence, different set of protocols are required for controlling access to shared medium in Ad hoc wireless network.

ISSUES IN DESIGNING A MAC PROTOCOL FOR AD HOC WIRELESS NETWORKS

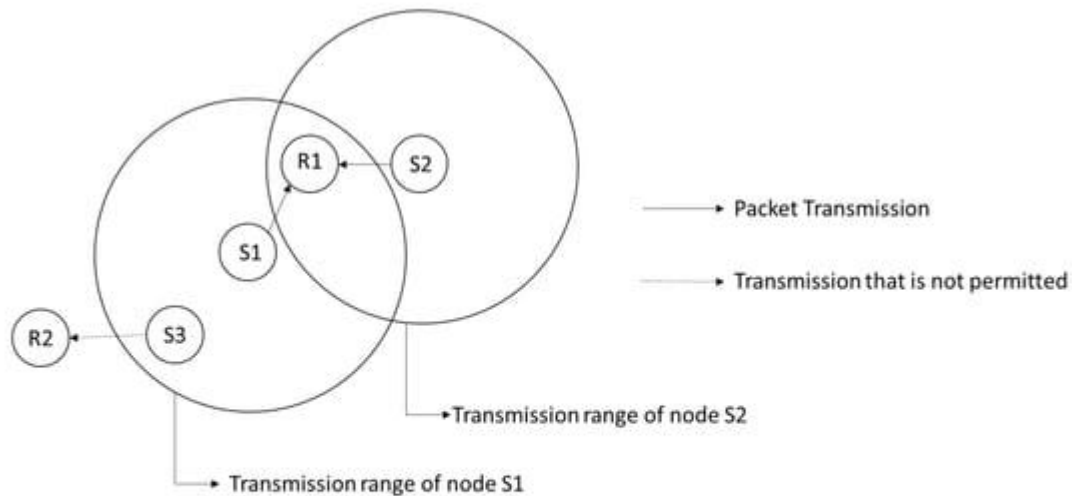


Bandwidth Efficiency:

- The radio spectrum is limited, hence the bandwidth available for communication is also very limited.
- The MAC protocol must be designed in such a way that the scarce bandwidth is utilized in an efficient manner.
- The control overhead involved must be kept as minimum as possible.
- Bandwidth efficiency can be defined as the ratio of the bandwidth used for actual data transmission to the total available bandwidth .
- The MAC protocol must try to maximize the bandwidth efficiency.

Quality of Service Support:

- Due to inherent nature of Ad hoc wireless network, where the nodes are usually mobile most of the time, providing quality of service support to data session in such network is very difficult.
- Bandwidth reservation made at one point of time may become invalid once the node move out of the region where the reservation was made.
- QoS support is essential for supporting time critical traffic session such as military communications.
- The MAC protocol for ad hoc wireless networks that are to be used in such real-time applications must have concise resource reservation mechanism that takes into consideration the nature of the wireless channel and the mobility of nodes.



- 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.
- Here, a transmission from node S1 to another node R1 is already in progress, node S3 cannot transmit to node R2, as it concludes that its neighbour node S1 is in transmitting mode and hence it should not interfere with the ongoing transmission.

Error-Prone Shared Broadcast Channel

- Another important factor in the design of a MAC protocol is the broadcast nature of the radio channel, that is, transmissions made by a node are received by all nodes within its direct transmission range.
- When a node is receiving data, no other node in its neighborhood, apart from the sender, should transmit.
- A node should get access to the shared medium only when its transmissions do not affect any ongoing session.
- Since multiple nodes may contend for the channel simultaneously, the possibility of packet collisions is quite high in wireless networks.
- A MAC protocol should grant channel access to nodes in such a manner that collisions are minimized. Also, the protocol should ensure that all nodes are treated fairly with respect to bandwidth allocation.

Distributed Nature/Lack of Central Coordination

- Ad hoc wireless networks do not have centralized coordinators as nodes keep moving continuously.
- Therefore, nodes must be scheduled in a distributed fashion for gaining access to the channel.
- This may require exchange of control information.
- The MAC protocol must make sure that the additional overhead, in terms of bandwidth consumption, incurred due to this control information exchange is not very high.

Mobility of Nodes

- This is a very important factor affecting the performance (throughput) of the protocol.
- Nodes in an ad hoc wireless network are mobile most of the time.
- The bandwidth reservations made, or the control information exchanged may end up being of no use if the node mobility is very high.
- The MAC protocol obviously has no role to play in influencing the mobility of the nodes.
- The protocol design must take this mobility factor into consideration so that the performance of the system is not significantly affected due to node mobility.

DESIGN GOALS OF A MAC PROTOCOL FOR AD HOC WIRELESS NETWORKS

- The operation of the protocol should be distributed.
- The protocol should provide QoS support for real-time traffic.
- The access delay, which refers to the average delay experienced by any packet to get transmitted, must be kept low.
- The available bandwidth must be utilized efficiently.
- The protocol should ensure fair allocation (either equal allocation or weighted allocation) of bandwidth to nodes.
- Control overhead must be kept as low as possible.
- The protocol should minimize the effects of hidden and exposed terminal problems.
- The protocol must be scalable to large networks.
- It should have power control mechanisms in order to efficiently manage energy consumption of the nodes.
- The protocol should have mechanisms for adaptive data rate control (adaptive rate control refers to the ability to control the rate of outgoing traffic from a node after taking into consideration such factors as load in the network and the status of neighbour nodes).
- It should try to use directional antennas which can provide advantages such as reduced interference, increased spectrum reuse, and reduced power consumption.
- Since synchronization among nodes is very important for bandwidth reservations, the protocol should provide time synchronization among nodes.

THANK YOU