Internal Assessment Test 1 (Scheme and Solutions) – Mar. 2018

Sub:	**Ad-hoc Networks**					Sub code:	**10IS841**	Branch:	**ISE**
Date:	14-03-18	Duration:	90 min’s	Max Marks:	50	Sem / Sec:	VIII/A,B		OBE

		Marks	CO	RBT
1 (a)	**Explain the wireless Sensor Networks with its issues compared to ad-hoc networks**	[5]	CO1	L4

Table 1. The difference between WMN and mobile Ad hoc network

Network	WMN	Mobile Ad Hoc Network
Mobility	The network main body is Mesh routers, which are of low mobility but without any power restraint.	The network main body is user noc have high mobility but power e
Network Scale and Scalability	Being an integration of various wireless networks, it supports a large number of nodes.	Being a single wireless network, it c several dozens of nodes
Services	It provides wireless access from the user terminal to the gateway or from wireless access subnet to the network.	It mainly provides P2MP data collect as well as access for the use

WMN: Wireless Mesh Network

		Marks	CO	RBT
1(b)	**Explain classifications of MAC Protocol**	[5]	CO1	L4

Contention-based protocols

• **Sender-initiated protocols**: Packet transmissions are initiated by the sender node.

• Single-channel sender-initiated protocols: A node that wins the contention to the channel can make use of the entire bandwidth.

• Multichannel sender-initiated protocols: The available bandwidth is divided into multiple channels.

Receiver-initiated protocols: The receiver node initiates the contention resolution protocol.

Contention-based protocols with reservation mechanisms

- **Synchronous protocols**: All nodes need to be synchronized. Global time synchronization is difficult to achieve.
- **Asynchronous protocols:** These protocols use relative time information for effecting reservations.

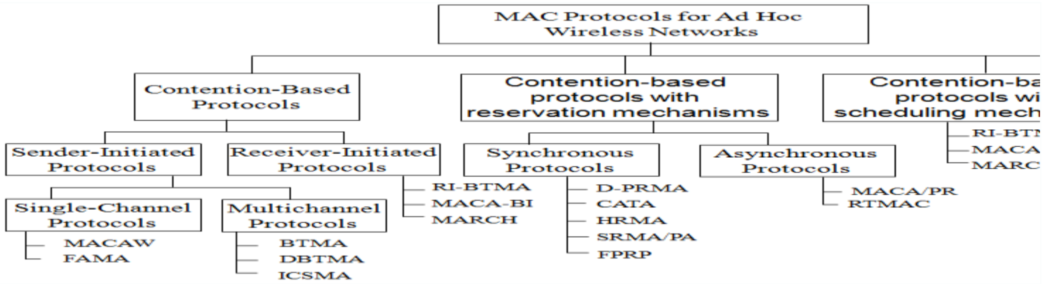
Contention-based protocols with scheduling mechanisms

• Node scheduling is done in a manner so that all nodes are treated fairly and no node is starved of bandwidth.

• Scheduling-based schemes are also used for enforcing priorities among flows whose packets are queued at nodes.

• Some scheduling schemes also consider battery characteristics.

□**Other protocols** are those MAC protocols that do not strictly fall under the above categories.



2 (a) **Explain issues of Ad-hoc Networks in detail** [10] CO1 L4

The major issues that affect the design, deployment, & performance of an ad hoc wireless network system are :

- Medium Access Scheme.
- Transport Layer Protocol.
- Routing.
- Multicasting.
- Energy Management.
- Self-Organisation.
- Security.
- Addressing & Service discovery.
- Deployment considerations.
- Scalability.
- Pricing Scheme.
- Quality of Service Provisioning

3(a) **Describe in detail MACAW and MACA-BY Invitation Protocol** [10] CO2 L2

The sender senses the carrier to see and transmits a **RTS** (**Request To Send)** frame if no nearby station transmits a RTS.

• The receiver replies with a **CTS** (**Clear To Send**) frame.

• The MACAW protocol uses one more control packet called the **request-for-request-to-send (RRTS)**

Neighbors

• see CTS, and then keep quiet.

• see RTS but not CTS, and then keep quiet until the CTS is back to the sender.

• The receiver sends an ACK when receiving an frame.

• Neighbors keep silent until see ACK.

• Collisions

• There is no collision detection.

They each wait for the exponential back-off time.

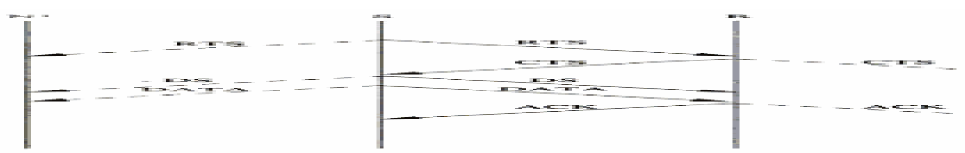


Figure 6.7. Packet exchange in MACA

4 (a) **Explain Hidden and Exposed Terminal Problem.** [10] CO1 L4

Hidden and exposed terminal problems

- The hidden terminal problem refers to the collision of packets at a receiving node due to the simultaneous transmission of those nodes that are not within the direct transmission range of the sender but are within the transmission range of the receiver.
- Collision occurs when both nodes transmit packets at the same time without knowing about the transmission of each other.

S1 and S2 are hidden from each other & they transmit simultaneously to R1 which leads to collision

- 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

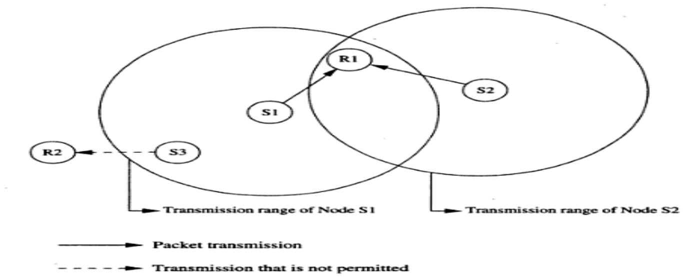


Figure 6.1. Hidden and exposed terminal problems.

5 (a) Explain Five Phase Reservation Protocol. [10] CO2 L4

It is a single-channel TDMA-based broadcast scheduling-protocol.

• The protocol is fully distributed i.e. multiple reservations can be simultaneously made throughout the network

Time is divided into 2 frames:1) Reservation frame (RF) & 2) Information frame (IF)

• Each RF has N reservation-slots (RS). Each IF has N information-slots (IS). Each RS has M reservation-cycles (RCs).

• In order to reserve an IS, a node needs to contend during the corresponding RS. Based on these contentions, a TDMA schedule is generated in the RF and is used in the subsequent IFs until the next RF.

• During the corresponding IS, a node would be in one of the 3 states:

1. Transmit (T) 2. Receive (R) 3. Blocked (B)

• The reservation takes place in following 5 phases:

1. Reservation Request Phase

• A source-node sends reservation-request (RR) packet to the destination node.

2. Collision Report Phase

• If a collision is detected by any node during the reservation-request phase, then that node broadcasts a collision-report (CR) packet

3. Reservation Confirmation Phase

• A source-node is said to have won the contention for a slot if it does not receive any CR messages in the previous phase.

• Then, the source-node transmits a reservation-confirmation (RC) message to the destination-node.

4. Reservation Acknowledgment Phase

• The destination-node acknowledges reception of the RC by sending back a reservation acknowledgment (RA) message to the source-node.

• The hidden nodes that receive this message defer their transmissions during the reserved slot.

5. Packing & Elimination (P/E) Phase

• Two types of packets are: 1) Packing packet (PP) & 2) Elimination packet

• A PP is sent by each node that is located within 2 hops from a TN, and that had made a reservation since the previous P/E phase.

• A node receiving a PP understands that there has been a recent success is slot reservation 3 hops away from it.

(PTO)

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6 (a)	**What is Ad-hoc wireless Internet.**	[05]	CO1	L2

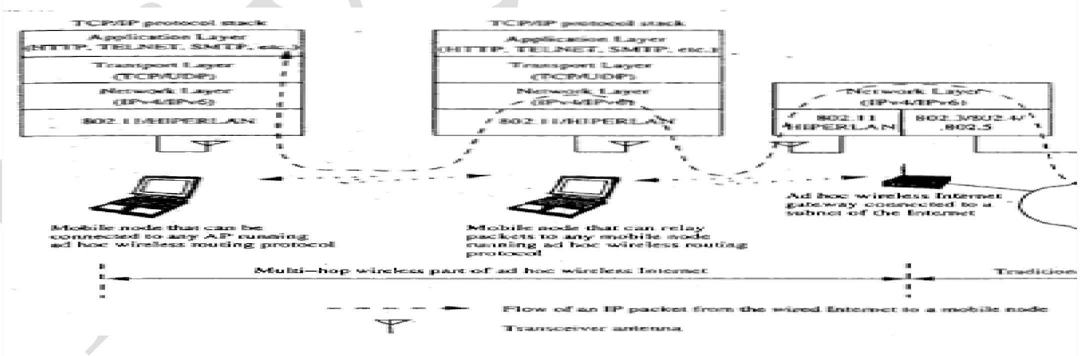
Ad hoc wireless internet extends the services of the internet to the end users over an ad hoc wireless network.

- Some of the applications of ad hoc wireless internet are :
  - ✓ Wireless mesh network.
  - ✓ Provisioning of temporary internet services to major conference venues.
  - ✓ Sports venues.
  - ✓ Temporary military settlements.
  - ✓ Battlefields &
  - ✓ Broadband internet services in rural regions.
- The major issues to be considered for a successful ad hoc wireless internet are the following :

❖ **Gateway :**

- They are the entry points to the wired internet.
- Generally owned & operated by a service provider.
- They perform following tasks ,

- Keeping track of end users. - Bandwidth management. - Load balancing. - Traffic shaping. - Packet filtering. - Width fairness & - Address, service & location discovery.



Address mobility :

- This problem is worse here as the nodes operate over multiple wireless hops.
- Solution such as Mobile IP can provide temporary alternative.

❖ **Routing :**

- It is a major problem in ad hoc wireless internet, due to dynamic topological changes, the presence of gateways, multi-hop relaying, & the hybrid character of the network.

o Possible solution is to use separate routing protocol for the wireless part of ad hoc wireless internet.

❖ **Transport layer protocol :**

o Several factors are to be considered here, the major one being the state maintenance overhead at the gateway nodes.

❖ **Load balancing :**

o They are essential to distribute the load so as to avoid the situation where the gateway nodes become bottleneck nodes.

❖ **Pricing / Billing :**

o Since internet bandwidth is expensive, it becomes very important to introduce pricing/billing strategies for the ad hoc wireless internet.

❖ **Provisioning of security :**

o Security is a prime concern since the end users can utilize the ad hoc wireless internet infrastructure to make e-commerce transaction.

❖ **QoS support :**

 With the widespread use of voice over IP(VOIP) & growing multimedia applications over the internet, provisioning of QoS support in the ad hoc wireless internet becomes a very important issue.

❖ **Service, address & location discovery :**

o Service discovery refers to the activity of discovering or identifying the party which provides service or resource.

o Address discovery refers to the services such as those provided by Address Resolution Protocol (ARP) or Domain Name Service (DNS) operating within the wireless domain.

o Location discovery refers to different activities such as detecting the location of a particular mobile node in the network or detecting the geographical location of nodes.

(b) Write the difference between Cellular Network and Ad-hoc network. [05] CO1 L4

Cellular Networks	Ad Hoc Wi
Fixed infrastructure-based	Infrastructure-less
Single-hop wireless links	Multi-hop wireless
Guaranteed bandwidth (designed for voice traffic)	Shared radio chann (more suitable for
Centralized routing	Distributed routing
Circuit-switched (evolving toward packet switching)	Packet-switched (evolving toward e switching)
Seamless connectivity (low call drops during handoffs)	Frequent path brea due to mobility
High cost and time of deployment	Quick and cost-effe
Reuse of frequency spectrum through geographical channel reuse	Dynamic frequency based on carrier se
Easier to achieve time synchronization	Time synchronizati difficult and consu
Easier to employ bandwidth reservation	Bandwidth reserva medium access con
Application domains include mainly civilian and commercial sectors	Application domai emergency search a and collaborative c
High cost of network maintenance (backup power source, staffing, etc.)	Self-organization a properties are buil
Mobile hosts are of relatively low complexity	Mobile hosts requi (should have a tra routing/switching
Major goals of routing and call admission are to maximize the call acceptance ratio and minimize the call drop ratio	Main aim of routin with minimum ove quick reconfigurati
Widely deployed and currently in the third generation of evolution	Several issues are t for successful comr even though wides defense

7(a) Explain Soft Reservation Multiple Access with Priority Assignment (SRMA/PA), using Frame Structure. How is it different from Hop Reservation Multiple Access Protocol? [10] CO2 L4

Developed with the main objective of supporting integrated services of real-time and non-real-time application in ad hoc networks, at the same time maximizing the statistical multiplexing gain.

- Nodes use a collision-avoidance handshake mechanism and a soft reservation mechanism
- Unique frame structure
- Soft reservation capability for distributed ad dynamic slot scheduling
- Dynamic and distributed access priority assignment and update policies
- Time constrained back-off algorithm
- Time is divided into frames, with each frame consisting of a fixed number of slots
- Each slot is further divided into 6 different fields (figure) namely SYNC, soft reservation (SR), reservation request (RR), reservation confirm (RC), data sending (DS) and acknowledgement (ACK)

The SYNC field is used for synchronization purposes

- The SR, RR, RC, and ACK fields are used for transmitting and receiving the corresponding control packets
- The DS field is used for data transmission
- The SR packet serves as a busy tone
- It informs the nodes about the reservation of the slot
- SR packet also carries the access priority value assigned to the node that has reserved the slot
- When an idle node receives a data packet for transmission, the node waits for a free slot and transmits the RR packet in the RR field of that slot

A node determines whether or not a slot is free through the SR field of that slot This process is called *soft reservation.*

- Priority levels are initially assigned to nodes based on the service classes in a static manner
- It is required that priority of voice terminal pv(R) > priority of data terminal pd(R) such that delay-sensitive voice applications get preference over normal data applications
- A node that is currently transmitting is said to be in active state
- A node that is said to be in the idle state if it does not have any packet to be transmitted
- In the active state itself, nodes can be in one of the two states: access state and reserved state
- Access state is one in which the node is backlogged and is trying to reserve a slot for transmission
- The access priorities are assigned to nodes and updated in a distributed and dynamic manner
- This allows dynamic sharing of the shared channel

- In order to avoid collisions, a binary exponential back-off algorithm is used for non-real time connections and a modified binary exponential back-off algorithm is used for real time connections
- In case of a voice terminal node, the node tries to take control of the slot already reserved by a data terminal if it finds it priority level to be higher than that of the data terminal

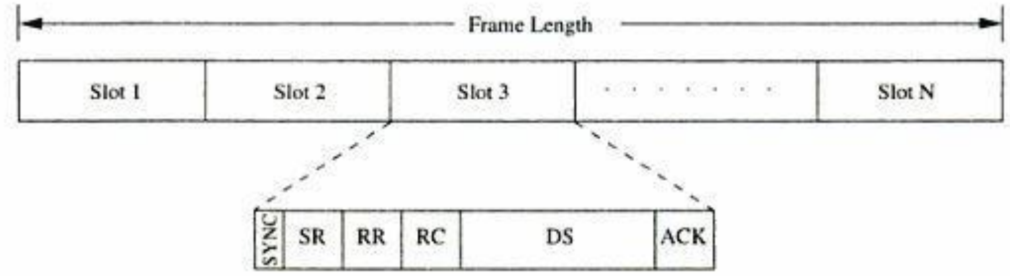


Figure 6.19. Frame structure in SRMA/PA.

8(a)	**Explain Collision Avoidance Time Allocation Protocol (CATA) in detail**	[10]	CO2	L4

A multichannel MAC protocol which is based on half-duplex, very slow frequency-hopping spread spectrum (FHSS) radios

- Uses a reservation and handshake mechanism to enable a pair of communicating nodes to reserve a frequency hop, thereby guaranteeing collision-free data transmission.

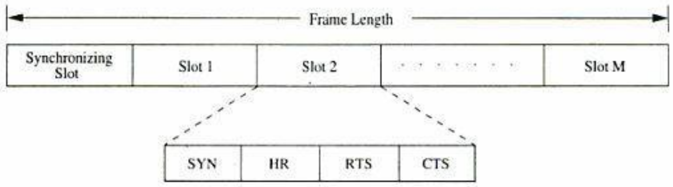


Figure 6.17. Frame format in HRMA.

There are L frequency channels available

- HRMA uses one frequency channel, denoted by f0 as a dedicated synchronising channel
- The nodes exchange synchronisation information on f0
- The remaining L-1 frequencies are divided into M=(L-1)/2 frequency pairs
- fi is used for transmitting and receiving hop-reservation packets, RTS, CTS and data packets
- fi* is used for sending and receiving acknowledgement (ACK) packets
- The data packets transmitted can be of any size.
- Data transmission can take place through a single packet or a train of packets.
- In HRMA, time is slotted and each slot is assigned a separate frequency hop
- Each time slot is divided into four periods, namely, synchronising period, HR period, RTS period, and CTS period
- Each period meant for transmitting or receiving the synchronising packet, FR packet, RTS packet, and CTS packet respectively.
- During the synchronising period of each slot, all idle nodes hop to the synchronising frequency f0 and exchange synchronisation information

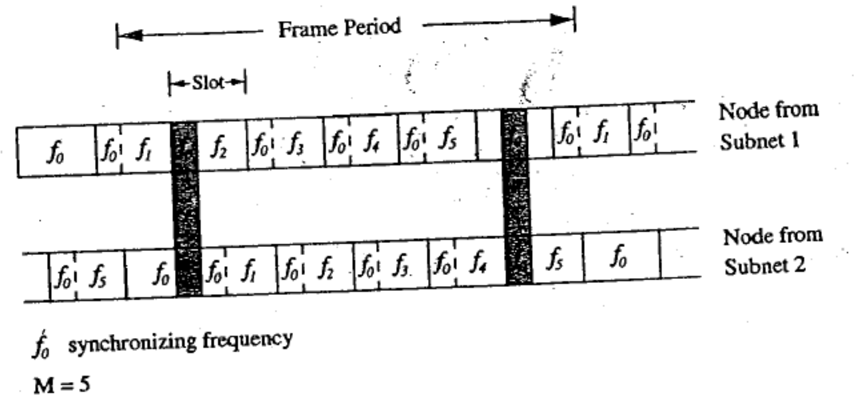


Figure Merging of subnets.

When a new node enters the network, it remains on the synchronising frequency f0 for a long enough period of time so as to gather synchronisation information such as the hopping pattern and the timing of the system

- If it receives no information, it assumes that it is the only node in the network, broadcasts its own synchronisation information and forms a one-node system
- Figure above depicts the worst-case frequency overlap scenario
- When a node receives data to be transmitted, it first listens to the HR period of the immediately following slot
- If it finds the channel to be free during the SR period, it transmits an RTS packet to the destination during the RTS period of the slot and waits for the CTS packet
- On receiving the RTS, the destination node transmits the CTS packet during the CTS period of the same slot and waits for the data packet
- If the source node receives the CTS packet correctly, it implies that the source and receiver nodes have successfully reserved the current hop
- After transmitting each data packet, the source node hops onto this acknowledgement frequency.
- The receiver sends an ACK packet back to the source.