Final Examination – Fall 2024

Name :- Anny Konika Das
ID :- 2120190011
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Dept :- CSE

1 no. ques. Ans

a) Ans: The Hidden Terminal problem occurs in wireless networks, particularly in Carrier Sense multiple Access with Collision Avoidance (CSMA/CA) protocoles. It refers to a situation where two devices (terminals) cannot detect each other's transmissions because they are out of range of each other but both can communicate with a third device. This can cause collisions when both terminals attempt to send data to the same device at the same time, unaware of each other's transmissions.

Explanation:

- Terminal A and Terminal C are within range of the Receiver (B) But they cannot hear each other because they are outside each other's transmission range.
- If A and C try to send data to B at the same time, their transmissions will collide at the receiver, causing data loss.
- Both A and C are unaware of each other's transmissions, leading to the Hidden Terminal Terminal problem.

Solution to the hidden Terminal problem:

There are several solutions to address the hidden terminal problem in wireless

networks :

1. Request to send / clear to send (RTS/CTS) mechanism:

- The RTS/CTS mechanism is commonly used to avoid collisions in wireless networks. It involves the following steps :

- Before transmitting data, the sender (A or C) sends a Request to sent (RTS) signal to the receiver(B

- The receiver (B) responds with a clear to send (CTS) signal, indicating that the sender is clear to transmit data.

- Other terminals in the network,

avoiding collisions.

Steps:

1. Terminal A sends an RTS message to Receiver B.
2. Receiver B responds with a CTS message.
3. Th Terminal C overhear the CTS and delays its transmission.
4. Terminal A sends data to Receiver B without interference from Terminal C.

2. Power control:

- power control mechanisms can help reduce the range at which terminals transmit, ensuring that they can only

communicate within their direct range, preventing interference with other terminals.

- Reducing the power can help minimize the occurrence of hidden terminal problems.

3. Carrier Sense multiple Access with collision Avoidance (CSMA/CA):

- CSMA/CA can be adapted with additional mechanisms like backoff algorithms, where terminals randomly wait before sending data to reduce the chance of simultaneous transmission.
- It is commonly used in conjunction with RTS/CTS.

4. Directional Antennas:

- Using directional antennas can

help reduce interference by focusing the signal in specific directions. This can reduce the number of hidden terminals that might cause interference.

b) Ans: wireless LAN Requirents –

1. High Data Transfer Rates:

- A Wireless LAN (WLAN) should support high rates to ensure fast and effient communication between devices. This includes supporting data rates of at least 100 Mbps or higher (e.g. WiFi 6).

2. Security and privacy:

- WLANs must have strong security mechanisms to protect data from unauthorized access or tampering. This includes supporting data rates of at least 100 Mbps or using encryption standards like WPA2 or WPA3, as well as secure authentication methods to prevent eavesdropping and ensure confidentiality.

3. Reliability and coverage:

- The network should ensure reliable connectivity with minimal interference or signal degradation. It should also have adequate coverage to support devices across the desired range, even in challenging environments (e.g., large office

spaces, outdoor areas).

These requirements ensure the efficient, secure and robust operation of a WLAN in various environments.

2 no. ques.-Ans.

a) Ans: In wireless communication systems, the handoff (or handover) region is the geographical area where a mobile device transitions from one base station's coverage area to another's. This process is crucial for maintaining an active call or data session as the device moves across networks.

Explanation:

1. Base station 1 (cell 1) and Base Station 2

(Cell 2) represent two adjacent cells in the wireless network, each with its own coverage area.

2. The handoff region is the overlap area where both cells' signals are strong enough to cover the mobile device. As the device moves through this region, it may need to switch from Base station 1 to Base station 2 to maintain a stable connection.

3. The handoff process occurs when the mobile device is handed off from one base station's coverage area to another without dropping the connection.

Key Points :-

- Seamless Transition: The goal of the handoff is to ensure a smoth transition between two cells, preventing dropped calls or interrupted data sessions.
- Signal strength: Handoff typically occurs based on signal strength, quality or other network factors like load balancing.

Advantages of Wireless LANs (WLANs):—

1. Mobility and flexibility:

- Wireless LANs provide users with the ability to move freely within the coverage area while staying connected. This is particularly beneficial in

environments like offices, hospitals or universities where mobility is key for productivity.

2. Cost - Efficient Installation and Expansion

- WLANs eliminate the need for extensive wiring, which reduces installation costs and complexity. Additionally, expanding the network by adding new devices or coverage areas is easier and less costly compared to wired networks.

3. Scalability :

- wireless LANs are easily scalable, meaning new users or devices can be added without significant changes to

the network infrastructure. This allows those things.

4. Reduced cable clutter:

- WLANs eliminate the need for physical cables, reducing cables clutter and the need for complex wiring systems.

b) Ans: Technologies of WAN (Mobile Cellular Network):-

1. 1G (First Generation):

- Technology: Analog mobile
- Key Features: (AMPS)

2. 2G (second Generation):

- Technology: Digital cellular

- Key Features : GSM , CDMA

3. 3G (Thind Generation):

- Technology : High - speed mobile

- key Features : UMTS And CDMA2000

4. 4G (Fourth Generation:

- Technology : High - speed mobile with IP. based services.

- key Features : LTE

These technology represent the evolution of mobile networks with improvements in speed, capacity and Servic.

3. no - ques. Ans

a) Ans: To determine the market penetration of the service provider, we need to follow these steps:

Given:

- Population = 4 X 60 = 240 people
- Number of cells = 700
- Number of Channels per cell = 15
- Total number of channels = 700 x 15
  = 10,500 Channels.
- Grade of Service (GOS) = 7% 0.07
- Each user generates 1 call / hour with a call duration of 1.5 minutes.

#Step 1: Calculate the total traffic in Erlangs.

- Call rate (calls per user per hour)

= 1 call/hour.

- Call duration = 1.5 minutes = $\frac{1.5}{60}$ hours

= 0.025 hours.

Traffic per user in Erlangs:

T_{user} = Call rate X call duration

= 1 X 0.025 = 0.025 Erlangs

Now, the total traffic for the entire population:

T_{total} = Population X T_{user} = 240 X 0.025

= 6 Erlangs

#Step 2: Calculate the total offered traffic in Erlangs (from the network).

- The total number of channels = 10500
- The Erlang capacity of the network is

determined by the Grade of Service (GoS)

Erlang B formula

$$B(C, A) = \frac{\frac{A^C}{C!}}{\sum_{K=0}^{C} \frac{A^K}{K!}}$$

- Step 3 : Calutater Market penetration

$$\text{Market Penetration} = \frac{T_{total}}{\text{Total Available Traffic capacity}} \times 100$$

$$= \frac{6}{8000} \times 100 = 0.075\%$$

Conclusion:

The market penetration of the Service provider is 0.075%. This means

b) Ans: Multipath propagation occurs when radio signals from a transmitter reach via multiple paths due to refractions and diffractions from obstacles such as buildings, trees and other structures.

Effects of Multipath propagation

1. Interference (constructive and Destructive): The signals traveling via different paths can either reinforce each other or cancel each other out.

2. Fading: It occurs when the combined signal strength is weak or varies drastically due to the interference between the multiple signal paths.

- Interference: multiple signals can create interference.

Impact on Communication systems:

- Reduced Data Throughput
- Increased Error Rates

Mitigation Technology for Multipath propagation:

1. Diversity Techniques
2. Equalization
3. Adaptive Techniques
4. MIMO

Multipath propagation is a common

problem is wireless communication systems, leading to interference, signal fading and distortion.

4. no ques. Ans

a) Ans: To find blocking probability (B) for a system with combined traffic for 3 channels, we can use the Erlang B formula.

$$B(C,A) = \frac{\frac{A^C}{C!}}{\sum_{K=0}^{C} \frac{A^K}{K!}}$$

Step 1: ~~calculate the total offered traffic~~, A:

Where:

* $B(C, A)$ is the blocking probability.

*) C is the number of channels.

*) A is the total offered traffic (in Erlangs).

*) A_1 is the traffic for new originating calls.

*) A_2 is the traffic for handover calls.

Given:

*) Number of channels, $C = 3$.

*) Offered traffic for originating calls, $A_1 = 3$ Erlangs.

*) Offered traffic for handover calls, $A_2 = 4$ Erlangs.

Step-1: Calculate the total offered traffic, A:

$$A = A_1 + A_2 = 3 + 4 = 7 \text{ Erlangs.}$$

Step-2: Apply the Erlang B Formula:

Now we will use the Erlang B formula with $C = 3$ channels and $A = 7$ Erlangs.

$$B(3,7) = \frac{\frac{7^3}{3!}}{\sum_{k=0}^{3} \frac{7^k}{k!}}$$

first, calculate the components:

$$\frac{7^3}{3!} = \frac{343}{6} = 57.1667$$

Now calculate the sum in the denominator:

$$\sum_{k=0}^{3} \frac{7^k}{k!} = \frac{7^0}{0!} + \frac{7^1}{1!} + \frac{7^2}{2!} + \frac{7^3}{3!}$$

$$= 1 + 7 + \frac{49}{2} + \frac{343}{6}$$

$$= 1 + 7 + 24.5 + 57.1667 = 89.6667$$

Now calculate the blocking probability $B(3,7)$:

$$B(3,7) = \frac{57.1667}{89.6667} \approx 0.637$$

Conclusion:

The blocking probability (B) for the system with 3 channels, given the offered traffic of 3 Erlangs for originating call and 4 Erlangs for handover calls, is approximately 0.637 or 63.7%. The End' pg-21