MODULE 5 ASSIGNMENT

1. What are the key features of Wi-Fi 6, 6E, and 7 and how do they differ from previous standards like Wi-Fi 5 (802.11ac)?

Wi-Fi 6 (802.11ax):

• OFDMA for better efficiency and lower latency.

• MU-MIMO on uplink and downlink.

• Target Wake Time (TWT) for improved power efficiency.

• Higher performance in dense environments.

• WPA3 for better security.

Wi-Fi 6E:z

• Extends Wi-Fi 6 into the 6 GHz band.

• Up to 1,200 MHz of extra bandwidth.

• Less interference from legacy devices.

• More available channels → better performance.

Wi-Fi 7 (802.11be):

• Supports 320 MHz channels (double from Wi-Fi 6).

• 4K QAM for higher data rates.

• Multi-Link Operation (MLO) for better throughput and reliability.

• Reduced latency for AR/VR and real-time use cases.

2. Explain the role of OFDMA in Wi-Fi 6 and how it improves network efficiency.

• Divides a Wi-Fi channel into multiple smaller sub-channels (RUs).

• Allows simultaneous data transfer for multiple devices.

• Reduces latency by serving multiple users in one transmission.

• Enhances performance in congested environments.

• Improves spectrum utilization.

3**. Discuss the benefits of Target Wake Time (TWT) in Wi-Fi 6 for IoT devices**.

• Allows scheduling when devices wake to send/receive data.

• Minimizes power usage — ideal for battery-powered IoT.

• Reduces contention and network congestion.

• Extends battery life of devices.

• Supports scalable and energy-efficient networks.

4. Explain the significance of the 6 GHz frequency band in Wi-Fi 6E.

• Offers a clean, uncongested spectrum.

• Supports up to 59 new 20 MHz channels.

• Reduces interference from legacy devices.

• Enables wider channels (up to 160 MHz) for high throughput.

• Ideal for high-bandwidth applications like 4K/8K streaming and VR.

6. What are the major innovations introduced in Wi-Fi 7 (802.11be)?

• 320 MHz channel width.

• 4K QAM for up to 20-30% more throughput.

• Multi-Link Operation (MLO) across multiple bands.

• Enhanced Channel Sounding and beamforming.

• Lower latency and jitter for real-time applications.

7. Explain the concept of Multi-Link Operation (MLO) and its impact on throughput and latency.

• Allows simultaneous use of multiple links (e.g., 5 GHz + 6 GHz).

• Increases total throughput by combining bandwidth.

• Improves link reliability and load balancing

• Reduces latency and supports seamless data flow.

• Enhances performance for time-sensitive applications.

8. What is the purpose of 802.11k and v, and how does it aid in roaming?

802.11k:

• Devices receive neighbour reports for nearby APs.

• Speeds up scanning and selection of best AP.

802.11v:

• AP suggests optimal APs for roaming.

• Devices can transition more intelligently.

• Improves roaming experience and reduces disruptions.

9. Explain the concept of Fast BSS Transition (802.11r) and its benefit in mobile environments.

• Enables fast and secure handoff between APs.

• Reduces latency during roaming.

• Pre-authenticates client with nearby APs.

• Ideal for applications like VoIP, video conferencing.

• Supports smooth transitions without service interruption.

10. How do 802.11k/v/r work together to provide seamless roaming in enterprise networks?

• 802.11k: Helps client discover nearby APs.

• 802.11v: Assists in choosing the best AP based on signal and load.

• 802.11r: Speeds up authentication during handoff.

• Together, they:

o Enhance roaming decisions.

o Reduce delay and packet loss.

o Improve user experience in enterprise and large networks.