WiFi Training Program 2025

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Question-11:

What are the types of PPDU? Explain the PPDU frame format across different Wi-Fi generations.

1. 802.11b

Frame format:

In preamble :

- **SYNC - 128 bits (Long) / 56 bits (Short)- Helps the receiver lock onto the signal and synchronize with the transmitter's timing.**
- **SFD- (Start Frame Delimiter)- 16 Bits- Marks the start of the actual frame (immediately follows SYNC).**

In Header:

- **Signal – 8bits -Indicates the data rate (e.g., 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps). Helps the receiver decode the following data properly.**
- **Service- 8 bits-Reserved for future use or specific options like scrambler initialization. Usually set to zero unless otherwise specified.**
- **Length- 8 bits- Specifies the length of the PSDU (MAC frame) in microseconds. This allows the receiver to know how long the transmission will last.**
- **CRC- 8 bits - A Cyclic Redundancy Check used to detect errors in the PLCP header. Ensures that header info was received correctly.**

PSDU-it is the actual user data carried in this frame.

2. 802.11a/g

In preamble:

- **STF (Short Training Field)- Used to synchronize timing and detect the presence of a signal. It helps the receiver lock onto the signal quickly.**
- **LTF (Long Training Field)- Used for channel estimation. Since OFDM divides the signal across many subcarriers, LTF helps the receiver understand how each subcarrier is affected by the channel, allowing it to compensate for interference, delay, and fading.**

In header:

- **Rate- Indicates the modulation scheme and coding rate (e.g., BPSK, QPSK, 16-QAM, etc.). The receiver uses this to determine how to demodulate the PSDU.**
- **Length- Specifies the duration of the upcoming data packet. This allows for proper timing and synchronization.**
- **Parity- A single-bit error detection code (odd parity) to verify the integrity of the SIGNAL field.**
- **Tail- A few bits set to zero that reset the convolutional decoder and ensure clean termination of the frame for error-free decoding.**

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3. 802.11n

In preamble:

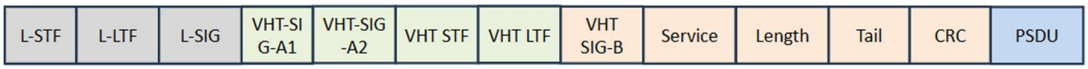
- **HT-SIG1- This is the first part of the HT-SIG (High Throughput Signal field).**
- **HT-STF(Short Training Field)- Helps improve MIMO channel estimation**
- **HT-LTF(Long Training Filed)- used for MIMO channel estimation and equalization.**

In header:

- **HT-SIG2- second part of HT-SIG contains additional information like STBC, GI.**
- **Service- 8 bits-Reserved for future use or specific options like scrambler initialization. Usually set to zero unless otherwise specified.**
- **Length- Specifies the duration of the upcoming data packet. This allows for proper timing and synchronization.**
- **Tail- A few bits set to zero that reset the convolutional decoder and ensure clean termination of the frame for error-free decoding.**
- **CRC- 8 bits - A Cyclic Redundancy Check used to detect errors in the PLCP header. Ensures that header info was received correctly.**

PSDU-it is the actual user data carried in this frame.

4. 802.11ac



Legacy Fields:

- **L-STF Legacy Short Training Field – Used for signal detection and AGC (Automatic Gain Control).**
- **L-LTF Legacy Long Training Field – Used for channel estimation.**
- **L-SIG Legacy Signal Field – Indicates legacy rate and length. Required for backward compatibility with older devices.**

In preamble:

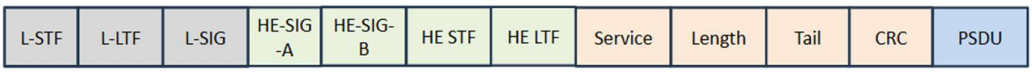
- **VHT-SIG-A1 & VHT-SIG-A2- These are VHT Signal Fields that carry control information such as: MCS (Modulation and Coding Scheme), Channel bandwidth (20/40/80/160 MHz), Number of spatial streams.**
- **VHT-STF (Short Training Field)- Synchronization (time & frequency)**
- **VHT-LTF (Long Training Field)- Channel estimation (for MIMO/MU-MIMO)**

In Header:

- **VHT-SIG-B- Conveys information about the length of the PSDU (Physical Service Data Unit).**
- **Service- 8 bits-Reserved for future use or specific options like scrambler initialization. Usually set to zero unless otherwise specified.**
- **Length- Specifies the duration of the upcoming data packet. This allows for proper timing and synchronization.**
- **Tail- A few bits set to zero that reset the convolutional decoder and ensure clean termination of the frame for error-free decoding.**
- **CRC- 8 bits - A Cyclic Redundancy Check used to detect errors in the PLCP header. Ensures that header info was received correctly.**

PSDU-it is the actual user data carried in this frame.

5. 802.11ax



Legacy Fields:

- **L-STF Legacy Short Training Field – Used for signal detection and AGC (Automatic Gain Control).**
- **L-LTF Legacy Long Training Field – Used for channel estimation.**
- **L-SIG Legacy Signal Field – Indicates legacy rate and length. Required for backward compatibility with older devices.**

In preamble:

- **HE-SIG-A-Contains basic transmission parameters (bandwidth, MCS, spatial streams, BSS color, etc.).**
- **HE-SIG-B-Carries user-specific info in MU-MIMO/OFDMA setups (e.g., RU allocation, user info).**
- **HE-STF-High-Efficiency Short Training Field – Helps achieve precise synchronization in high-density environments.**
- **HE-LTF-High-Efficiency Long Training Field – Supports channel estimation for MU-MIMO and OFDMA, customizable based on the number of spatial streams.**

In Header:

- **Service- 8 bits-Reserved for future use or specific options like scrambler initialization. Usually set to zero unless otherwise specified.**
- **Length- Specifies the duration of the upcoming data packet. This allows for proper timing and synchronization.**
- **Tail- A few bits set to zero that reset the convolutional decoder and ensure clean termination of the frame for error-free decoding.**
- **CRC- 8 bits - A Cyclic Redundancy Check used to detect errors in the PLCP header. Ensures that header info was received correctly.**

PSDU-it is the actual user data carried in this frame.