

Role of Guard Intervals in WLAN Transmission

Purpose:

Prevents inter-symbol interference (ISI) caused by multipath propagation, where signal reflections arrive at different times.

Mechanism:

Inserts a guard interval (typically 800 nanoseconds) between OFDM symbols as a buffer or cyclic prefix to separate delayed echoes from the next symbol.

Function in OFDM:

Ensures the receiver can decode each symbol accurately, even with multipath delays, maintaining data integrity across subcarriers.

Application:

Critical in Wi-Fi standards (802.11a/g/n/ac/ax) to handle reflections from walls, furniture, or other obstacles.

Short Guard Interval Improving Efficiency :

Reduces Overhead: Shortens the guard interval from 800 nanoseconds to 400 nanoseconds, decreasing the non-data time between symbols.

Increases Throughput: Allows more symbols to be transmitted per second, boosting data rates by approximately 10-11% (e.g., in 802.11n/ac) without changing bandwidth.

Optimizes Symbol Duration: Reduces the guard interval's proportion (e.g., from 20% to 10% of a 4-microsecond symbol), enhancing spectral efficiency.

Condition Dependency: Effective in low-multipath environments (e.g., open spaces), where delay spread is minimal, as detected by the receiver.

Dynamic Adjustment: Enables performance gains only when ISI risk is low; reverts to 800 ns in high-multipath settings (e.g., dense buildings) to avoid signal corruption.