**6. What is the role of Guard Intervals in WLAN transmission? How does a short Guard Interval improve efficiency?**

**Role of Guard Intervals in WLAN transmission:**

* In WLAN transmission, a guard interval is a small-time gap added between data symbols to avoid interference from delayed versions of the signal this issue is called inter-symbol interference (ISI). These delays often happen due to reflections when signals bounce off surfaces like walls or furniture. The guard interval gives these echoes time to die out before the next symbol starts, which helps the receiver clearly distinguish between them. Without it, overlapping signals could lead to errors in decoding the data.
* Guard intervals are especially important in environments where multipath propagation (signal reflection) is common. By absorbing that delay, the guard interval increases the reliability of the transmission.

**Short Guard Interval improve efficiency**

* When the guard interval is shorter, more time is available for actual data transmission, which boosts the overall efficiency and throughput of the network.
* For example, Wi-Fi 5 (802.11ac) also supports both 800 ns and 400 ns guard intervals. When devices are operating on a clean 5 GHz band with minimal signal reflections, switching to a 400 ns guard interval can boost data rates by roughly 10%. This becomes especially useful in open environments like offices or outdoor setups where there's less interference.
* However, it’s a trade-off. While a short guard interval gives better speed, it can also be more prone to errors in environments with lots of signal reflection. That’s why it's usually used in areas where interference is minimal or signal paths are relatively clear.