**Super-Framing Structure**

To achieve increased flexibility and robustness, beyond what is described in the standard time-slicing scheme outlined in EN 302 307-1 Annex-M, an additional enhanced waveform called "Super-Framing Structure" has been defined in EN 302 307-2 Annex-E. (See Figure 1.)

Based on the time-slicing scheme, several data packets called physical layer frames (PLFRAMEs) and their physical layer headers (PLHEADERs) are combined within a container called super-frame.

The super-frame comes with different formats adapted to fit flexibility, efficiency, and robustness requirements. In all formats the super-frame starts with one specific sequence out of a set of known patterns followed by the format indicator. Depending on the chosen format, a super-frame header may follow, providing information about the presence of pilots, protection level of PLHEADERs, and their first position within the super-frame. A super-frame trailer may develop. This format allows improved synchronization at low SNR situations, as for synchronization regular spaced signal elements are included.

Protection of the PLHEADERs and PLFRAMEs can be varied to make the super-frame structure suitable for high-efficiency applications as well as for operation under very low SNR conditions.

Optional super-frame aligned pilots increase the reliability of the super-frame tracking. (See Figure 2.) When required, high protection levels of PLHEADERs ensure PLHEADER tracking over a super-frame under severe channel conditions. The protection level of PLHEADERs is constant within one super-frame but variable over consecutive super-frames. The protection of the PLFRAMEs varies individually. Spreading out the PLFRAMEs is an option that helps to compensate for bursty impairments. Injection of very low (VL)-SNR pilots for individual PLFRAMEs increases the robustness of phase estimation. This altogether provides the most reliable tracking and adapted efficiency under different SNR conditions.

Different signaling patterns and orthogonal reference scrambling sequences for signaling elements and pilots provide high interference resilience among different carriers and allow for recognition of a specific super-frame, among others.

The super-frame structure provides a future-proof waveform that can support multiformat transmission, interference mitigation techniques, and beam switching operation.

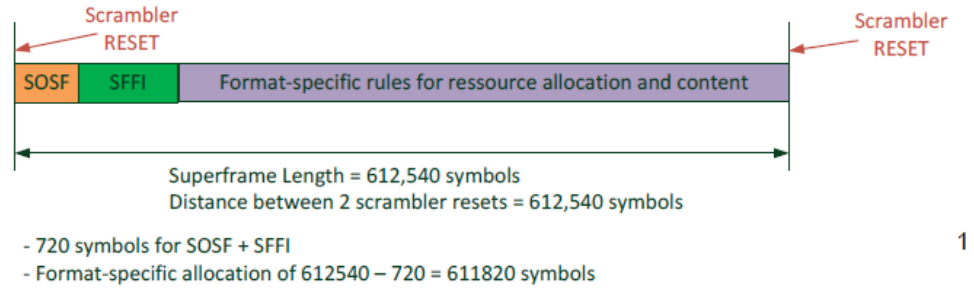


Figure 1. General super-frame definition

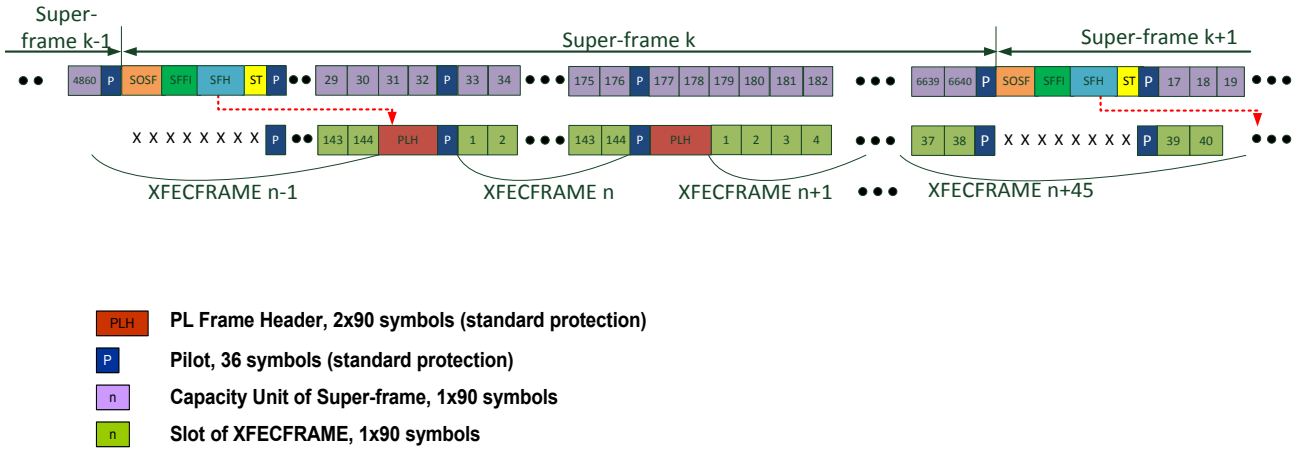


Figure 2. Super-frame format 4 with activated super-frame aligned pilots