## IEEE 802.11a OFDM System Design Parameters

### 1. OFDM System Parameters

* **Bandwidth:** 20 MHz
* **Subcarrier spacing (Δf):** 312.5 kHz (20 MHz / 64)
* **Total number of subcarriers:** 64
* **IFFT/FFT size:** 64 points
* **Number of data subcarriers:** 48
* **Number of pilot subcarriers:** 4
* **Unused subcarriers:** 12 (reserved as guard carriers)
* **Location of unused subcarriers:** 6 at each band edge and 1 at the center (DC).  
   → Total: 13 positions without data (48 data + 4 pilots + 12 guards = 64).
* **Sampling rate:** 20 Msps
* **OFDM symbol duration (without cyclic prefix):** 3.2 µs
* **Cyclic Prefix (CP):** 0.8 µs (16 samples)
* **Total OFDM symbol duration:** 4.0 µs (3.2 + 0.8)
* **OFDM symbol length (samples):** 80 (64 + 16)

### 2. Unused Subcarriers

**Reasons for unused subcarriers:**

* To avoid **out-of-band interference**.
* To eliminate the **DC subcarrier** (frequency offset = 0) and reduce I/Q imbalance errors.
* To simplify transmitter and receiver **filter design**.

**Location:**

* 6 guard subcarriers at each spectrum edge.
* 1 DC subcarrier at the center.
* In total, 12 are effectively unused.

### 3. Symbol Duration and Rates

* **Useful symbol period (T<sub>U</sub>):** 3.2 µs
* **Guard interval / cyclic prefix (T<sub>GI</sub>):** 0.8 µs
* **Total symbol duration (T<sub>SYM</sub>):** 4.0 µs
* **Sampling rate:** 20 Msps
* **Symbol length (samples):** 80 samples (64 + 16)

### 4. Frame Prefix Sequence (Preamble)

Each IEEE 802.11a/g/p frame begins with a **preamble sequence** consisting of:

* **10 short training symbols**, each 16 samples long (total of 160 samples ≈ 8 µs).
* **2.5 long training symbols**, each 64 samples long (≈ 8 µs additional).

**Functions of the preamble:**

* Frame start detection.
* Frequency and phase estimation.
* Precise symbol alignment.

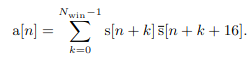
**From Section 2.2 of the article:**  
 “Each IEEE 802.11a/g/p frame starts with a short preamble sequence, which consists of a pattern that spans 16 samples and repeats ten times.”

### 5. Stream Tags (Section 2.1)

* **Stream tags** are used to mark:
  + The **start of an OFDM frame**.
  + The **encoding scheme and frame length**.

### 6. Blocks Calculating Autocorrelation and Power (Section 2.2)

**Autocorrelation:**



**Average power:**

