

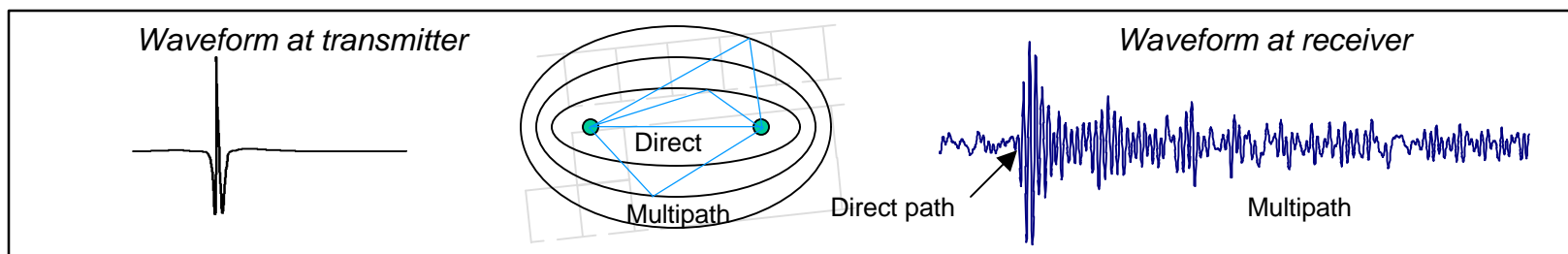


Ultra wideband (UWB) Radios for Precision Location

- A network infrastructure of fixed position UWB wireless local area network (WLAN) nodes provides the means for precise location and tracking of mobile nodes
- Precision time-difference-of-arrival (TDOA) timing is inherent in the UWB physical layer
 - TDOA is transparent to the WLAN communications
- Used for:
 - Tracking of assets and personnel for security and liability
 - Location-based authentication
 - Supply chain
 - Real-time resource allocation via knowledge of location
 - Data mining

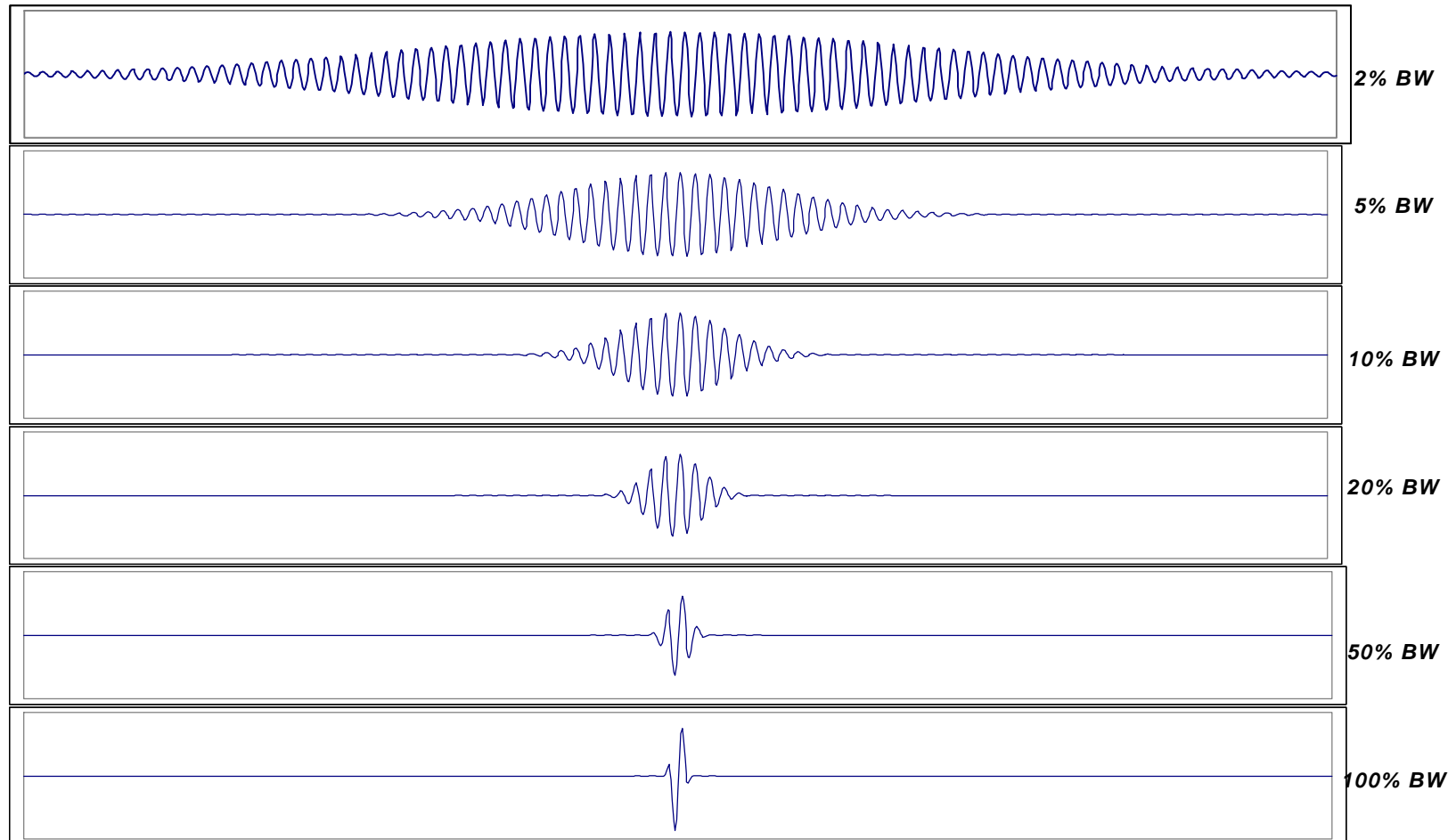
UWB Background

- Communications with precision ranging and positioning ability
- 2 GHz RF Bandwidth
- Data rates from 40 Mbps down to 2.5 kbps
- Code division channelization
- Multipath performance
 - Immunity to multipath nulls
 - Direct path can be distinguished from multipath

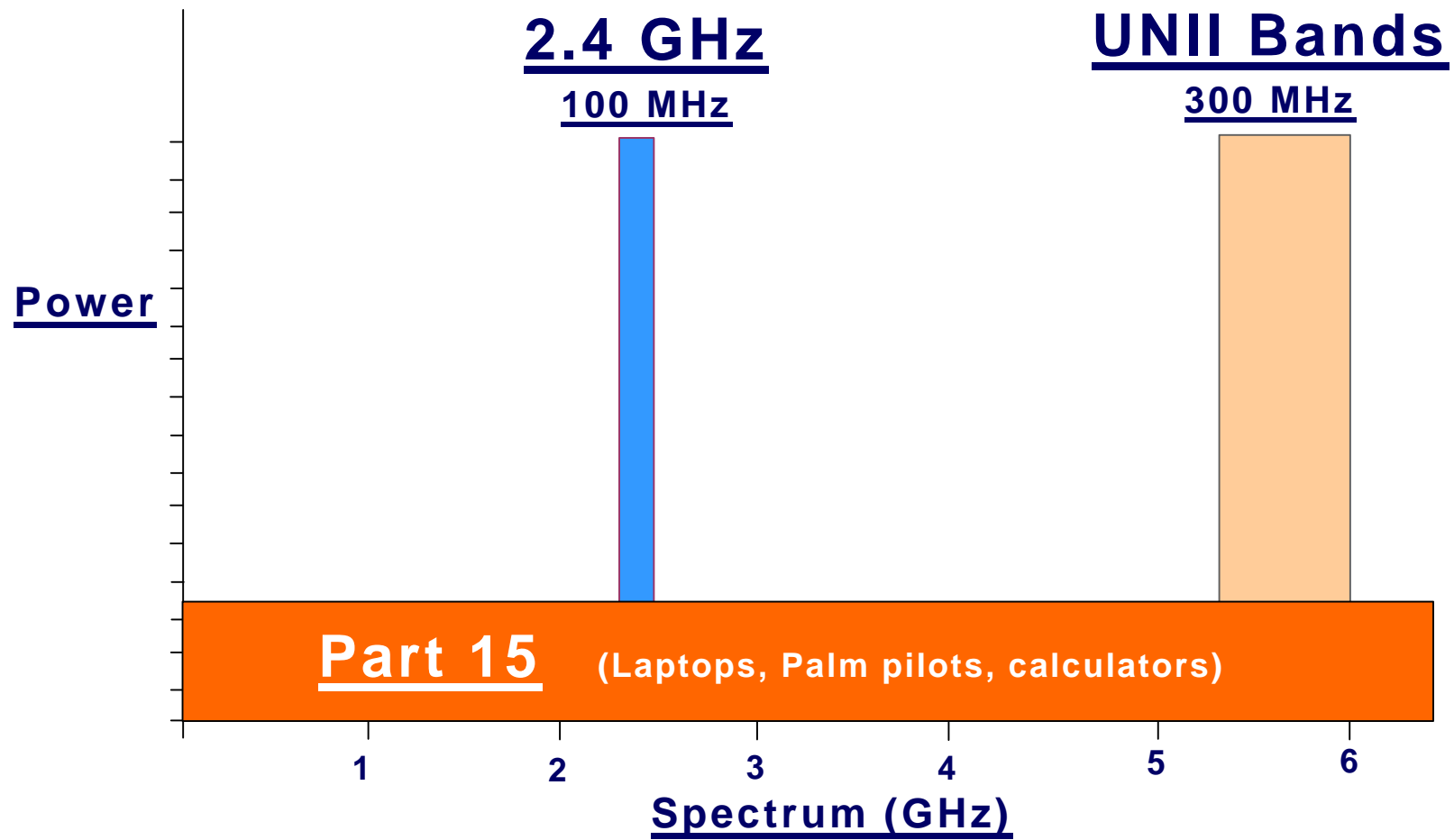




Bandwidth Concepts -- From Narrowband to Ultra Wideband

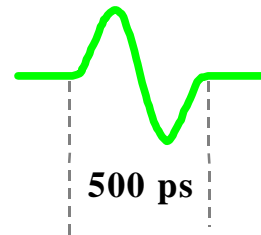


Unlicensed Spectrum

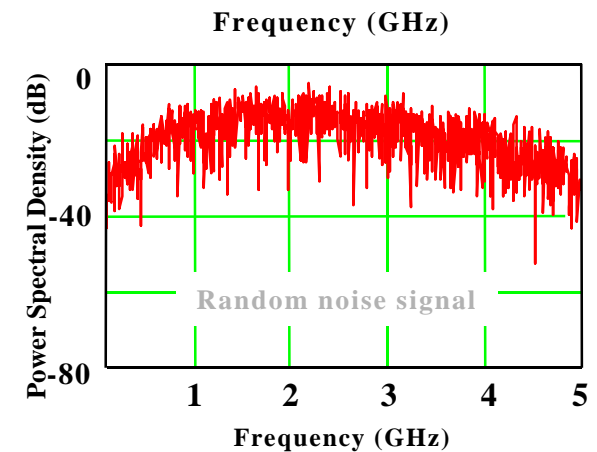
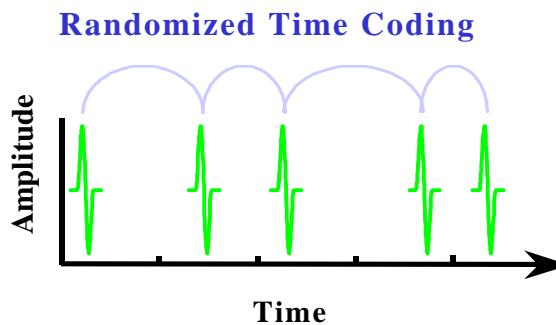


Time Modulated Ultra-Wideband

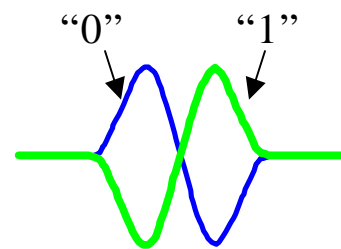
- Not a sinewave, but millions of pulses per second



- Time coded to make noise-like
 - Channelization
 - Anti-jam
 - Smooths spectrum

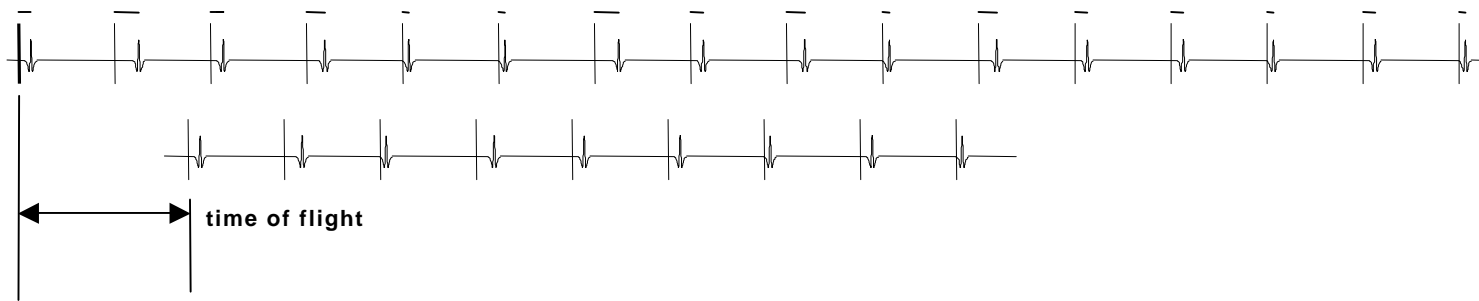


- Pulse polarity modulation



UWB Timing Components

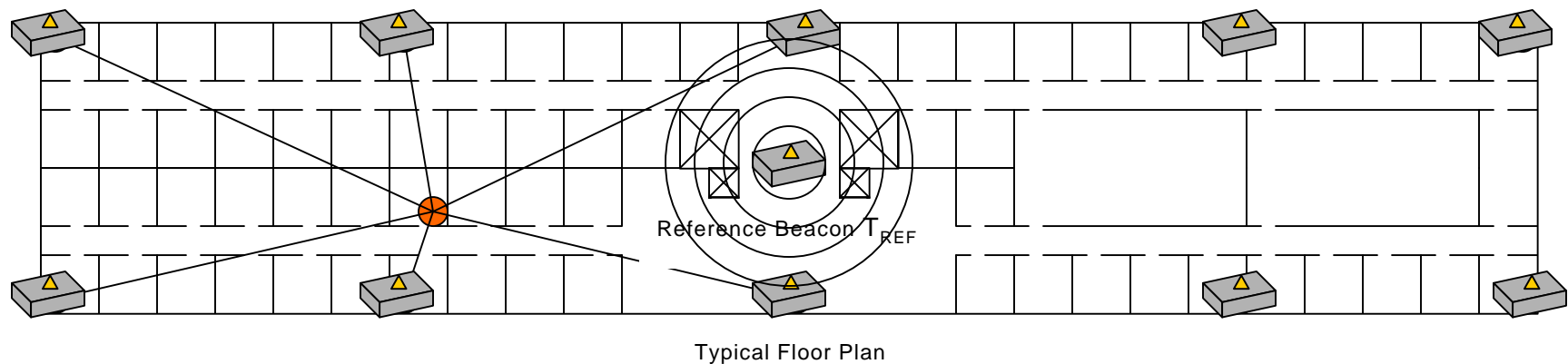
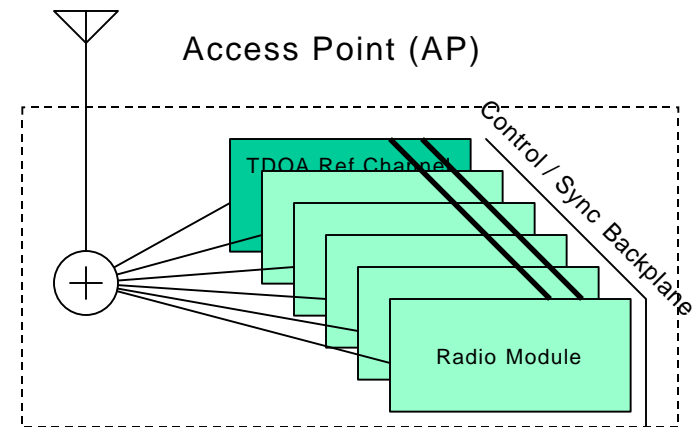
Code timing relative to fixed reference marks



- The time of flight is precisely measured by the phase shift of the code
- The receiver locks to the coded sequence of the transmitter within an accuracy of less than 100 picoseconds (equivalent to about 1.2 inches)
- In practice, all pulses are spread by multipath
 - Only the direct path matters for ranging
 - Leading edge (direct path) is measured for time of flight

Synchronization Among Access Points for Time Difference Of Arrival

- One radio module in each AP receives the beacon channel
- All radio modules in the AP are code synchronized to the beacon receiver
- Leading edge position of received waveform is measured at each AP relative to T_{REF}



Scatterplots of X, Y and Z Positioning

- Same series of points is plotted in all three graphs
- Dimensions in millimeters

