CDMA Code Properties

- Spreading codes should have special properties
  - 1) Autocorrelation as similar to an impulse as possible
    - One peak when a code is correlated against copies of itself
    - Multipath resilience
      - 00110011
      - 00110011
      - 00110011

- 2) Crosscorrelation as small as possible for pairs of codes
  - Want codes to be independent or orthogonal with respect to each other
  - Multiple user separation
    - One user’s transmission on its code results in a net reception of approximately 0 on other codes
  - code 1 01010101
  - code 2 00110011
Example CDMA “Reverse Link” (cell phone -> cell tower)

CDMA Example: IS-95

- Digital cellular system combines CDMA and FDMA
- Forward link (tower -> phone) different than reverse link
  - (Reverse link transmissions not synchronized)
- Uses 869-894 MHz (reverse) and 824-849 MHz (forward) bands
- Signal bandwidth 1.25 MHz, 0.27 MHz guard band
- Chip rate 1.2288 Mchips/s
- Orthogonal length-64 Walsh codes used for forward link (spreading factor of 64)
CDMA Transmit Samples

- Length-8 Walsh codes, 7 users, 1000 symbols
- Discrete valued samples [-7, +7]
- Odd values only

Baseband Transmit Spectrum

- $\text{abs}(\text{fft}(\text{waveform}))$
- 8000 frequency “bins” result in noisy approximation
- Remember the sampling frequency ($f_s$) is $2\pi$ in the digital frequency domain
Baseband Transmit Spectrum

- $\text{psd}(\text{waveform})$
- fewer frequency “bins”
- Note spectrum is zero at DC

2x Upsampled Transmit Spectrum

- Note null at DC now at $\pi$ (one half $f_s$) also
4x Upsampled Transmit Spectrum

- Null at DC now at $\pi/2$, $\pi$, and $3\pi/2$ (not shown)