

# LTE & WiFi

## Background

### LTE

licensed

- stands for 3GPP Long Term Evolution
- deployed since ~ 2009
- "4g", kind of
- up to 20 MHz of bandwidth
- between 600 MHz and 2.6 GHz (center frequency)
- max power (downlink) 40 watts

### WiFi

unlicensed

- 802.11 - spec "WiFi" - certification
- 802.11 - 1997 2.4 20
- 9 - 1999 5 20
- 5 - 1999 2.4 20
- 9 - 2003 2.4 20
- n - 2009 2.45 40
- ac - 2013 5 160
- max power - 1 watt

## MAC

### LTE

#### Services

- FDD - uplink and downlink use separate freqs;
  - except China
- Uplink and Downlink use Resource Blocks
  - combination of TDMA x FDMA
  - very efficient (optimal signals signalling overhead)
- What about a new device?
  - some resource blocks are left for Contention
    - This is a form of slotted-ALOHA

## MAC - continued

### WiFi

- Primary CSMA
  - tests the medium, and if it's not free waits a random amount of time up to a contention window amount
- optional RTS/CTS
  - may not be used much in practice??
- Polling for contention-free access
  - AP<sub>i</sub> will use CSMA to get a superframe, then will assign some of its allocation to other devices.

## FEC

### LTE

- Each transport block has a CRC of 24-bits
- Convolutional code
  - length 7
  - 3 polynomials
  - only for control blocks
- Turbo codes for data
  - Turbo codes are like convolutional, but with feedback
  - rate  $\times 3$  (as of Rel 8)

### WiFi

- uses convolutional codes and LDPC
- rates  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{3}{4}$ ,  $\frac{5}{6}$

## Modulations

- Both use OFDM
- Both use QAM
  - 802.11ac - up to 256 QAM
  - BPSSK, QPSSK, 16, 64, 256-QAM
- LTE-Advanced - up to 256 QAM
- Both Allow for MIMO techniques
  - up to 8x8
  - Beamforming and Spatial Multiplexing

## Misc.

LTE-U - LTE in existing unlicensed bands