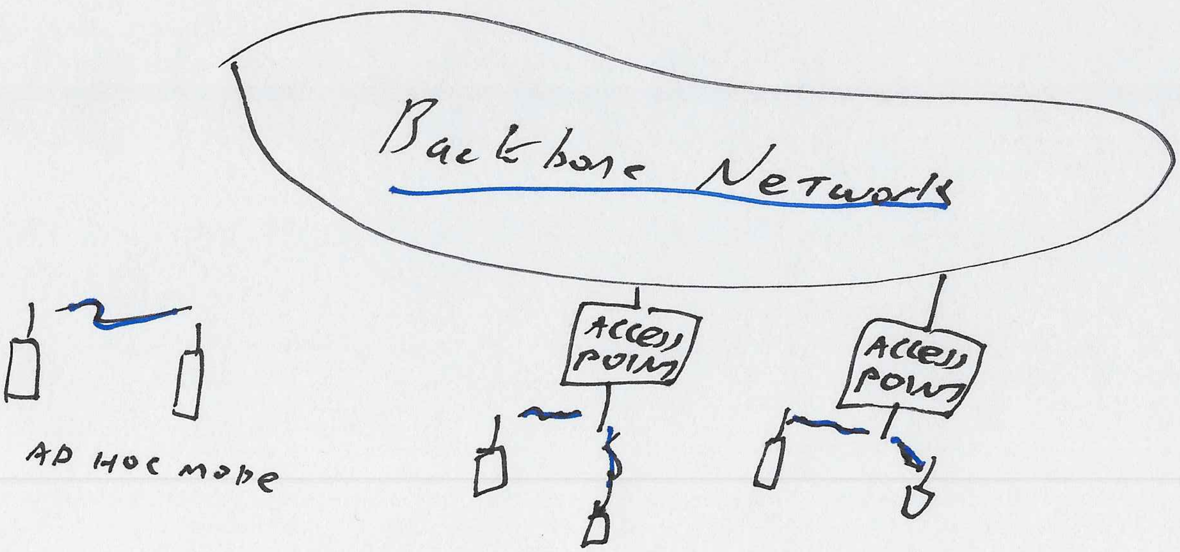
Wireless Network

- WiFi IEEE 802.15
- Blue Tooth IEEE 802.15
- LTE Advanced
- 5G

WiFi 802.11 original



- 1 or 2 Mbps
- Direct sequence or Freq hopping (79 freq in US)
- ISM band 2.400 - 2.4835 GHz
- WEP - 50% throughput reduction
- HIPERLAN (Europe)

ORIGINAL WIFI price /performance not ch.. appealing

FOUNDATIONAL VERSIONS

802.11b → 1999, made wifi popular

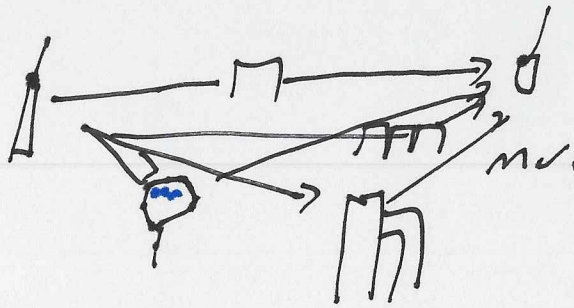
11Mbps at 100-150 feet

Direct sequence, Freq hopping or infrared

802.11a → Developed after "b" - UNI band (54 Mbps)

802.11g → 22Mbps, later 54 Mbps

802.11n →



Multipath

Mimo technology

Parallel path,

< 600 Mbps

more recent versions:

802.11ac → < 600 Mbps

MU-MIMO access point can xmit multiple streams to multiple users ~~at once~~ simultaneously

802.11ad → uses 60GHz

more loss/sig. attenuation

bandwidth & layer

802.11ax → real time multimedia (2019)

802.11af → use VHF old TV freq
→ freq < 1GHz
→ good signal properties

802.11ah → use unlicensed spectrum < 1GHz
→ long distance, low data rate (sensor net, smart grid, Internet of things)

Bluetooth (802.15)

- Personal Area Network

① Design Goal:

- System should function globally
- ad hoc networking
- support for data/voice
- Cheap, low power, small transceiver

② spec: 2.4 GHz ISM band
FREQ HOPPING (79 channels, 1600 hops/sec)
DATA RATE 1Mbps
RANGE 10m

③ Data Rates later versions up to 2, 50 Mbps using parallel 802.11 link

④ spin-offs:
802.15.4
ZIGBEE (sensor data)
802.15.4e

⑤ 802.15.6
Wireless Body Area Network (WBAN)
- for medicine, sports, gaming, entertainment

LTE – Long Term Evolution

① Air interface for cell phones

- LTE standard 2008
- LTE Advanced (4th Gen)

1st Gen	ANALOG
2nd Gen	DIGITAL
3rd/5 Gen	Higher Data Rates for application

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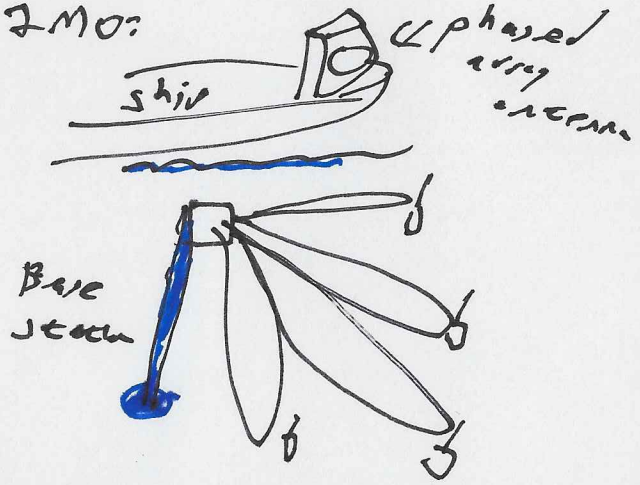
② LTE Advanced Features

Carrier Aggregation: can aggregate "component carriers" of 1.4, 3, 5, 10, 15, 20 MHz

Up to 5 to get upto 100 Mbps

③ MIMO:



④

- Special Diversity + Special Mux
- Relay,
- Self-Organizing Nets To reduce opex
- M2M: Machine to machine
- D2D: Device to device

Towards 5G

(2)

- Release 14 aims for up to 32 antennas
- Uses unlicensed BW as well as licensed BW.
- Carrier Aggregation Enhancements
- Machine Type Communication (MTC)
- Latency 1ms
- Vehicle Communication
  - V2V
  - V2P
  - V2I
  - V2X

(1) Dual track:

"evolution" to LTE Advanced

or

"radio access technology (RAT)"

no requirement for backwards compatibility

Bands above and below 6 GHz in release cone.