The Evolution of Wireless

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Mobile Devices

• Voice Signals Only
• Analogue Cellular Phones
• NMT, AMPS

• Voice & Data Signals
• Digital Fidelity Cellular Phones
• GSM, CDMA, TDMA

• Enhance 2G
• Higher Data Rates
• GPRS, EDGE

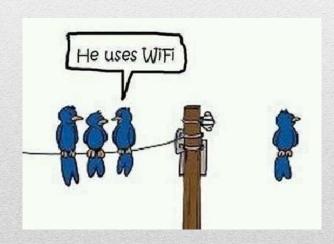
• Voice, Data & Video Signals
• Video Telephony / Internet Surfing
• 3G, W-CDMA, UMTS

• Enhanced 3G / Interoperability Protocol
• High Speed & IP-based
• 4G, Mobile IP

Mobile Networks

- Mobile networks are built on a specific frequency band bought from the government
 - Same thing that radio and TV stations run on

 WiFi is considered a "free" frequency that anyone can use in very close range



Difference from WiFi

- Mobile carriers have their own distinct frequency band range that they purchased from the FCC
- Number of spectrums owned specifies how good of a coverage you get
- Each frequency support a certain bit rate

$$C = B \log_2 \left(1 + \frac{S}{N} \right)$$

Shannon's Limit

- 1G: 1979 1990 (Analog)
- 2G: 1990 2001 (Digital)
 - 2.5G (Bridge to 3G)
- 3G: 2001 Present (Broadband)
- 4G: 2010 Present (LTE)

Timeline

- AMPS (Advanced Mobile Phone System) Network
 - Voice-Only networking operating on the 800MHz band
- NMT (Nordic Mobile Telephone) was the first fully automatic cellular phone system
- Permanently shut down in 1999, anyone with a radio scanner could listen to your call and susceptible to noise
- Had ~ 2 million subscribers at its peak

1G-Analog

- Fixes to network congestion and security from 1G
- GSM (Global System for Mobile)
 - Radio frequency band ranging from 900MHz to 1800MHz
- Initially TDMA (Time Division Multiple Access)
 - Synchronized static timeslot allocation
- Later used CDMA (Code Division Multiple Access)
 - Orthogonal signals sent by all customers
- SMS (Short Message Service), AKA text messages ©

2G - Digital

- Unofficial stepping stone term for 2G with elements of 3G enhancing its performance
- EDGE (Enhanced Data rates for GSM Evolution)
 - Increased rate of 2G network resulting in faster speeds
- GPRS (General Packet Radio Service)
 - Packet oriented mobile data service
- Digital encryption and caller ID added as well

2.5G - Bridge to 3G

- UMTS (Universal Mobile Telecommunications System)
 - Core network architecture on 2100mHz spectrum
- WCDMA (Wideband CDMA)
 - Significant algorithm and mathematical improvements in

signal transmission, allowing more efficient transmissions

• Interactive gaming, TV services, and internet streaming

3G - Broadband

- Enhanced 3G through a series of upgrades to UMTS
 - significantly faster speeds (~ 10 times faster than 3G)
 - lower latency
 - reduced network congestion
- EPC (Evolved Packet Core) IP-based architecture
 - Simpler architecture results in lower operating costs
 - Backwards compatible with 3G technologies

4G - Long Term Evolution

EVOLUTION CONTRACTOR OF THE



1G

1ST GENERATION wireless network

- Basic voice service
- Analog-based protocols



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2ND GENERATION wireless network

- Designed for voice
- Improved coverage and capacity
- First digital standards (GSM, CDMA)



3G

3RD GENERATION wireless network

- Designed for voice with some data consideration (multimedia, text, internet)
- First mobile broadband





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4TH GENERATION wireless network

- Designed primarily for data
- IP-based protocols (LTE)
- True mobile broadband







SPEED

in kilobits per second

2.4 kbps

64 kbps

2,000 kbps

 $100,000\,\mathrm{kbps}$