

The Evolution of Wireless

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Mobile Devices

1G

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

2G

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

2.5G

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

3G

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

4G

- 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 OF THE G



1G	2G	3G	4G
			
1ST GENERATION <i>wireless network</i>	2ND GENERATION <i>wireless network</i>	3RD GENERATION <i>wireless network</i>	4TH GENERATION <i>wireless network</i>
<ul style="list-style-type: none">• Basic voice service• Analog-based protocols	<ul style="list-style-type: none">• Designed for voice• Improved coverage and capacity• First digital standards (GSM, CDMA)	<ul style="list-style-type: none">• Designed for voice with some data consideration (multimedia, text, internet)• First mobile broadband	<ul style="list-style-type: none">• Designed primarily for data• IP-based protocols (LTE)• True mobile broadband
			
THE NEED FOR SPEED <small>in kilobits per second</small>			
2.4 <i>kbps</i>	64 <i>kbps</i>	2,000 <i>kbps</i>	100,000 <i>kbps</i>