History of Mobile Telephony

Lecture 4.1

Mobile Computing

Slides by Dr. Tami Meredith

Mobile telephony generations

1G: 1979 to 1991, analog, data up to 2kbps, FDMA

2G: 1991 to ~2016, GSM, digital, up to 64kbps, SMS (text messaging), switch to TDMA

2.5G: 1997, GPRS, digital, 56-114kbps, WAP, MMS, email

3G: 2001+, UMTS, 384kbps to 42mbps, switch to CDMA

4G: 2013+, LTE, up to 300mbps

5G: Upcoming/Here?

GSM:
Global system for Mobile Communications

GSM is a set of standards developed by the European Telecommunications Standards Institute (ETSI) to describe technologies for second generation (2G) digital cellular networks.

GSM networks started to be shut down in 2016.

GPRS: General packet radio service

GPRS is a standard that complemented 2G networks by providing a channel for mobile data. Sometimes referred to as 2.5G, GPRS allows for limited Internet connectivity with data rates of 56-114kbps.

Due to this relatively slow data rate, most of the first widespread GPRS devices had WAP (Wireless Application Protocol) browsers which allowed them to view limited versions of webpages.

GPRS allows for implementation of MMS (Multimedia Messaging Service), which allows users to send pictures, short video clips, audio clips, and much longer messages than SMS is capable of.

UMTS:
Universal mobile telecommunications system

UTMS is a standard for mobile cellular communication which was developed by the 3GPP (3rd Generation Partnership Project) and is what is typically referred to as 3G. Throughout its various releases, UMTS has gotten progressively faster, starting with a maximum with HSPA+ (Evolved High Speed Packet Access), sometimes known as 3.9G.

LTE: Long term evolution

LTE is the current(ish) standard for wireless mobile data communication and is what is often known today as 4G. Like UMTS, it was developed by 3GPP and is designed to be an upgrade over existing 3G infrastructure. LTE features up to 300mbps download speeds and has much less latency, or lag than 3G.

5G: Fifth cellular generation

5G is the cellular communication generation of the “future”. As the fifth generation, this new portion of the radio frequency spectrum is expected to deliver huge benefits to latency and data speeds.

Autonomous vehicles, medical industries, sports, and more are all limited by 4G LTE and 5G opens a big opportunity for each of these and more.

As 5G trials have been carried out the cellular providers are realizing that high frequency **5G cannot reach inside of buildings**. This fault is one that is concerning but solvable by using a 5G compatible cellular signal booster or microcell.

5G: Bringing Cellular closer to the Internet

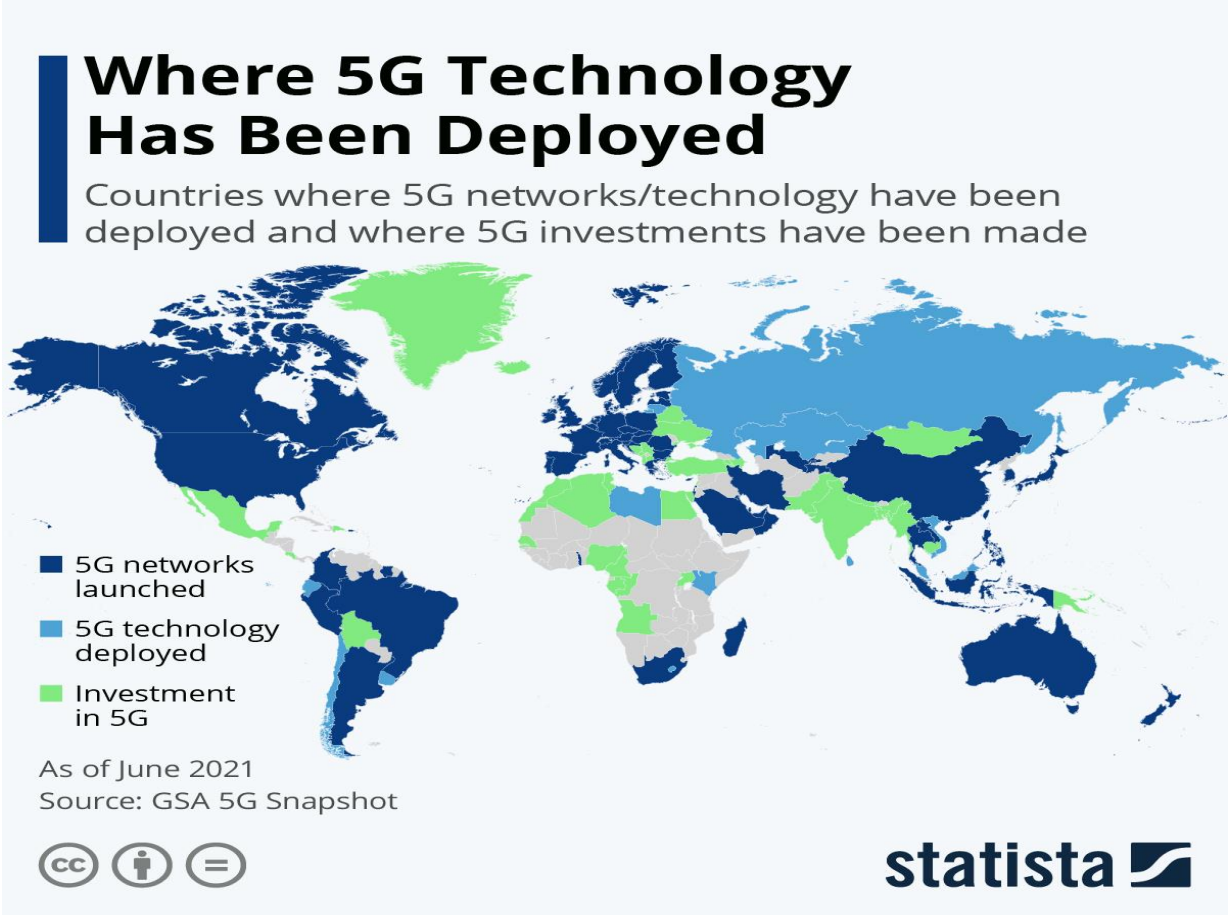
- Can support < 1M devices per km^2
- Deployment: https://en.wikipedia.org/wiki/List_of_5G_NR_networks
- Low Band (Millimeter-wave): Similar to 4G in throughput and range, not used by some carriers.
- Mid Band (Microwave): Range of several km, 100-900 Mbps, urban use.
- High Band: Limited range and object penetration issues. See next slide.

5G Technology

Cell types		Deployment environment	Max. number of users	Output power (mW)	Max. distance from base station
5G NR FR2	Femtocell	Homes, businesses	Home: 4–8 Businesses: 16–32	indoors: 10–100 outdoors: 200–1,000	tens of meters
	Pico cell	Public areas like shopping malls, airports, train stations, skyscrapers	64 to 128	indoors: 100–250 outdoors: 1,000–5,000	tens of meters
	Micro cell	Urban areas to fill coverage gaps	128 to 256	outdoors: 5,000−10,000	few hundreds of meters
	Metro cell	Urban areas to provide additional capacity	more than 250	outdoors: 10,000−20,000	hundreds of meters
Wi-Fi (for comparison)		Homes, businesses	depends	indoors: 20–100 outdoors: 200–1,000	few tens of meters

2021 Rollout

https://www.statista.com/chart/23194/5g-networks-deployment-world-map/



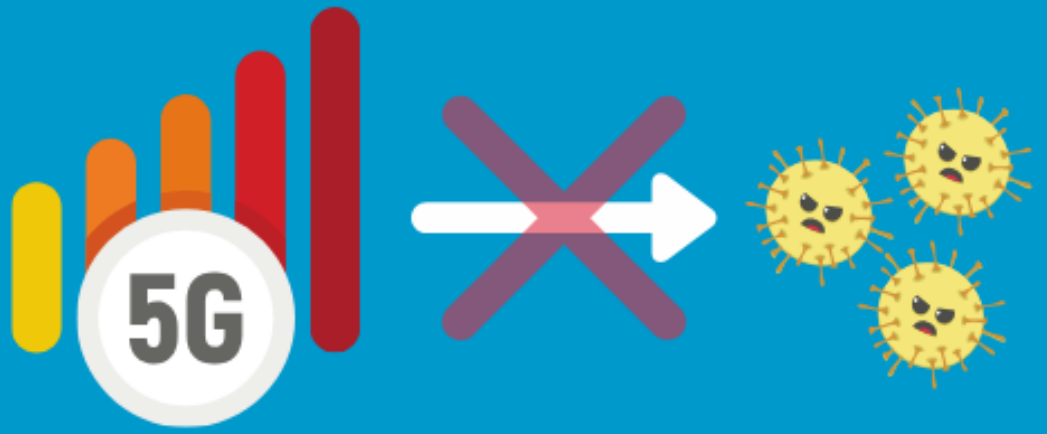
FACT:
5G mobile networks DO NOT spread COVID-19

Viruses cannot travel on radio waves/mobile networks.

COVID-19 is spreading in many countries that do not have 5G mobile networks.

COVID-19 is spread through respiratory droplets when an infected person coughs, sneezes or speaks.

People can also be infected by touching a contaminated surface and then their eyes, mouth or nose.



World Health Organization

#Coronavirus #COVID19

8 April 2020

Multiplexing

Multiplexing refers to the technique of having several signals transmitted over a single channel, where a channel may be a wire, a fiber-optic cable, or in the case of cellular technologies, a section of radio frequency.

That is, multiplexing is how several different conversations can occur on the same frequency, at the same time.

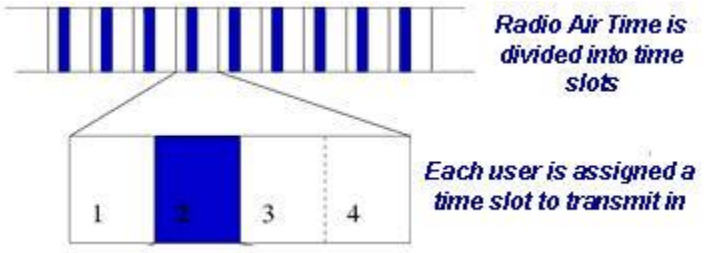
There are three main techniques: CDMA, FDMA, and TDMA.

Analogy: Having multiple conversations at the same time.

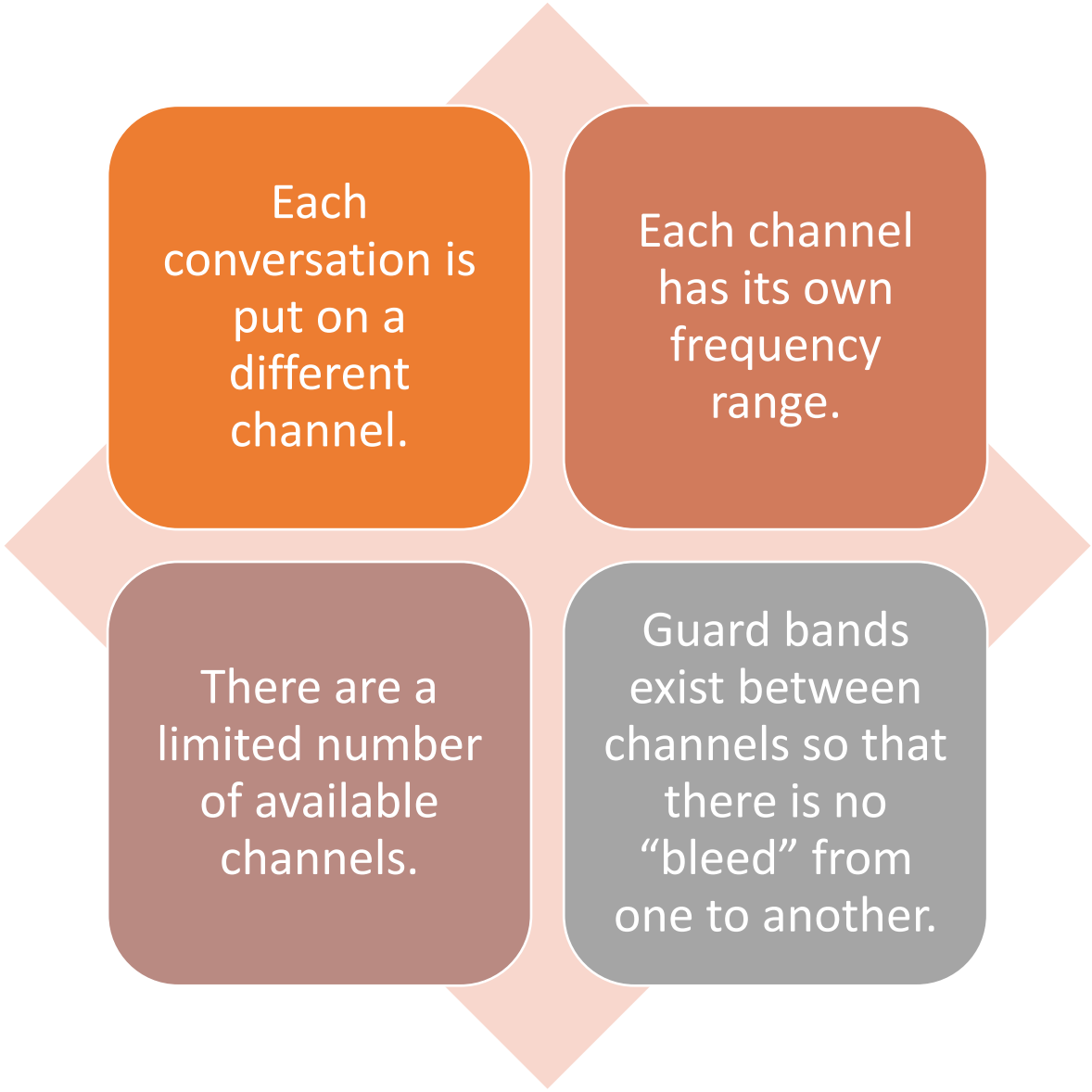
- Time Division: Everyone talks at a different time.
- Frequency Division: Everyone talks and hears a different frequency.
- Code Division: Everyone talks in a different language.

TDMA: Time division multiple access

TDMA is a variant of the greater technology called time-division multiplexing. TDMA involves taking a frequency channel and dividing it into tiny time segments. Each of these segments is then assigned to a user and then all the users transmit one after the other in their own allocated slots. TDMA is the multiplexing method of choice for 2G networks.



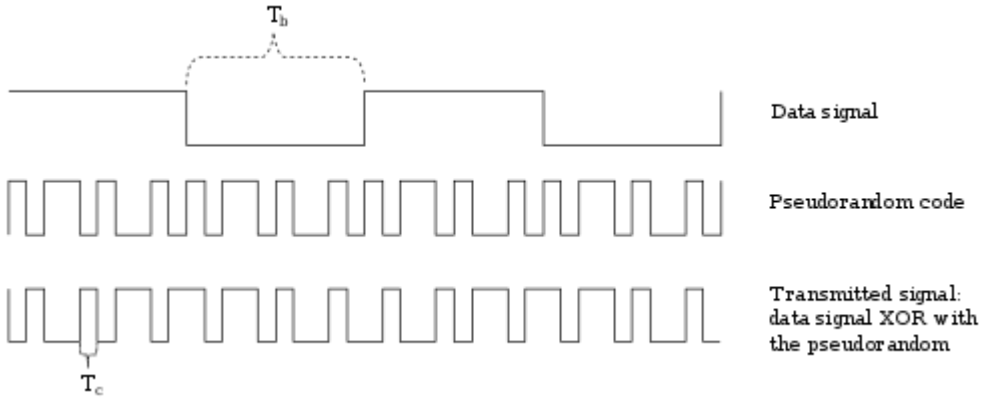
FDMA: Frequency division multiple access



CDMA: Code division multiple access

CDMA is a type of multiplexing that allows several devices to transmit information over a single transmission channel by giving each device a unique pseudorandom code.

CDMA is implemented in mobile phone communication standards such as cdmaOne, CDMA2000 (the 3G evolution of cdmaOne) and WCDMA (the 3G standard used by GSM carriers). However, individually, these standards shouldn't be individually described as CDMA in its entirety, but rather as different implementations of it.




My Cell Phone History
DF688
R280
T60d
T300
T237
P900
T637
K700i
W600i
SLVR L7
W810i
P910a
T226
SLVR L2
BlackJack
iPhone
K850i
W610i
iPhone 3G
K550i
C702
BlackJack II
iPhone
iPhone 3G


12:00PM
BlackBerry


Simon
1973
1993
2004
2007
2021