LEADERSHIP FOR IT SECURITY & PRIVACY ACROSS HHS

HHS CYBERSECURITY PROGRAM

OFFICE OF INFORMATION SECURITY

5G Security Implications for the Healthcare Enterprise

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Agenda

- Introduction/Overview
- Important technical concepts
- The history of the Gs
- 5G applications
- 5G for the healthcare industry
- Security threats/mitigations
- But wait, there's more!
- References
- Questions

Slides Key:

	Non-Technical: managerial, strategic and high-level (general audience)
	Technical: Tactical / IOCs; requiring in-depth knowledge (sysadmins, IRT)

Introduction/Overview

- Fifth generation cellular network technology (Officially called: 5G New Radio)
- Adopted by 3rd Generation Partnership Project (3GPP) - international org. responsible for 3G UMTS and 4G LTE
- Several improvements:
  - Approximately 10 to 100 times faster than typical current cellular connections; Faster than residential physical fiber optic cable; Can handle significantly greater number of devices simultaneously (IoT)
  - Significantly reduced latency: 20 milliseconds to 1 millisecond
  - Customized networks
- Potential issues:
  - High speed/capacity means shorter range of each cell tower, more must be deployed
  - Concerns over health issues
  - Eyesores in residential neighborhoods
- Alternative 5G NR technologies: Verizon’s 5G TF (fixed wireless internet); will transition to 5G NR
- Allows for operation on variety of frequencies, including recycled frequencies of decommissioned networks
  - 2G DCS, 3G ESM, PCS, etc…
- Not incremental or backward-compatible; does not overlap with 4G LTE or WiMax

Important technical concepts

- **Millimeter waves** – Higher spectrum band (typically 24 GHz to 100 GHz), tradeoff between very high transmission speeds but shorter broadcast range
- **Small Cells** – Cell towers and broadcast ranges much smaller than previous cellular networks; the radios can be hung up on street lamps, poles, rooftops or other areas
- **Massive MIMO (Massive multiple-input, multiple-output)** – Groups together antennas at the transmitter and receiver to provide better throughput and better spectrum efficiency
- **Beamforming** – A technology that allows for the directing of a 5G signal in a very specific direction, vice an omnidirectional transmission
- **Full Duplex** – Simply means that data can be transmitted in both directions at the same time

Image source: Wired

Traditional cell tower vs. small cell

Image source: Techspot

The history of the Gs

- Charting the Evolution of cellular network standard generations:

	1G	2G	3G	4G	5G
Period	1980 – 1990	1990 – 2000	2000 – 2010	2010 – (2020)	(2020 - 2030)
Bandwidth	150/900MHz	900MHz	100MHz	100MHz	1000x BW pr unit area
Frequency	Analog signal (30 KHz)	1.8GHz (digital)	1.6 – 2.0 GHz	2 – 8 GHz	3 – 300 GHz
Data rate	2kbps	64kbps	144kbps – 2Mbps	100Mbps – 1Gbps	1Gbps <
Characteristic	First wireless communicatio n	Digital	Digital broadband, increased speed	High speed, all IP	
Technology	Analog cellular	Digital cellular (GSM)	CDMA, UMTS, EDGE	LTE, WiFi	WWWW

Image courtesy of LinkedIn.com

The history of the Gs (continued)

- More characteristics of the generations:

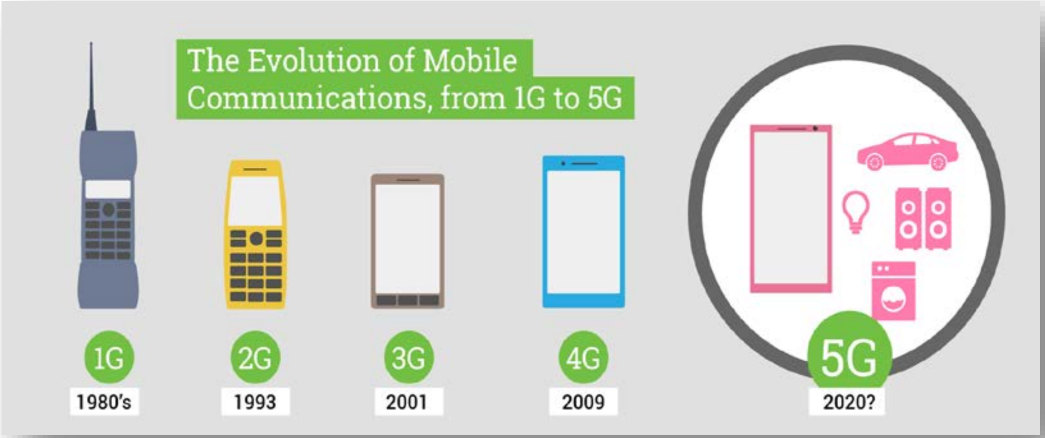


Image courtesy of Carritech Telecommunications

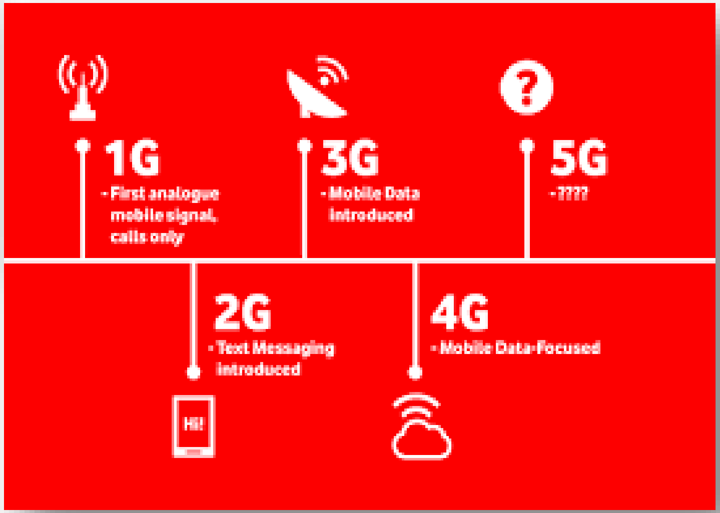


Image courtesy of Gearbest.com

- Hardware has evolved along with each of the standards
- Each generation brings with it new capabilities
  - 2G: Text messages
  - 3G: Mobile data

The history of the Gs (continued)

- Speed!

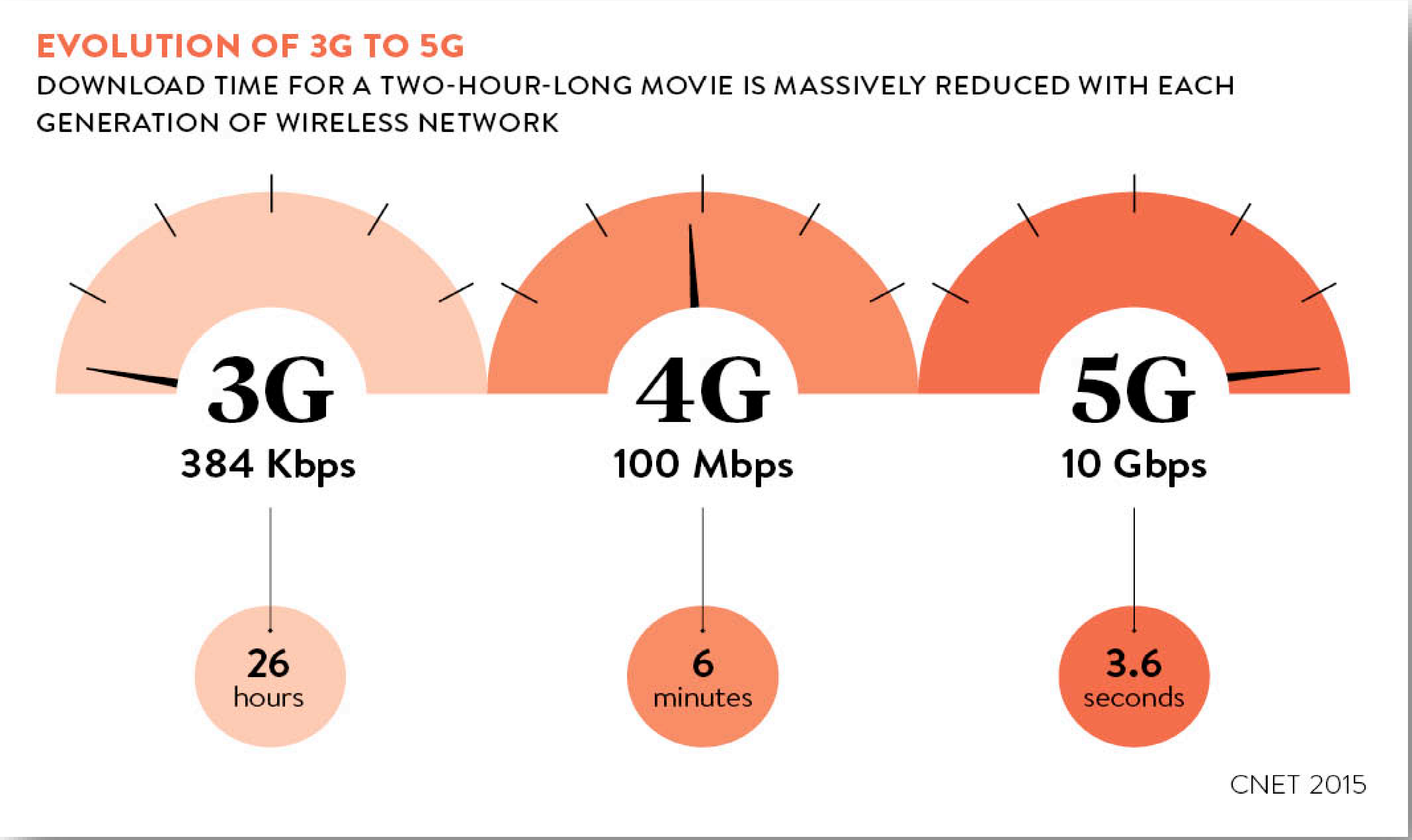
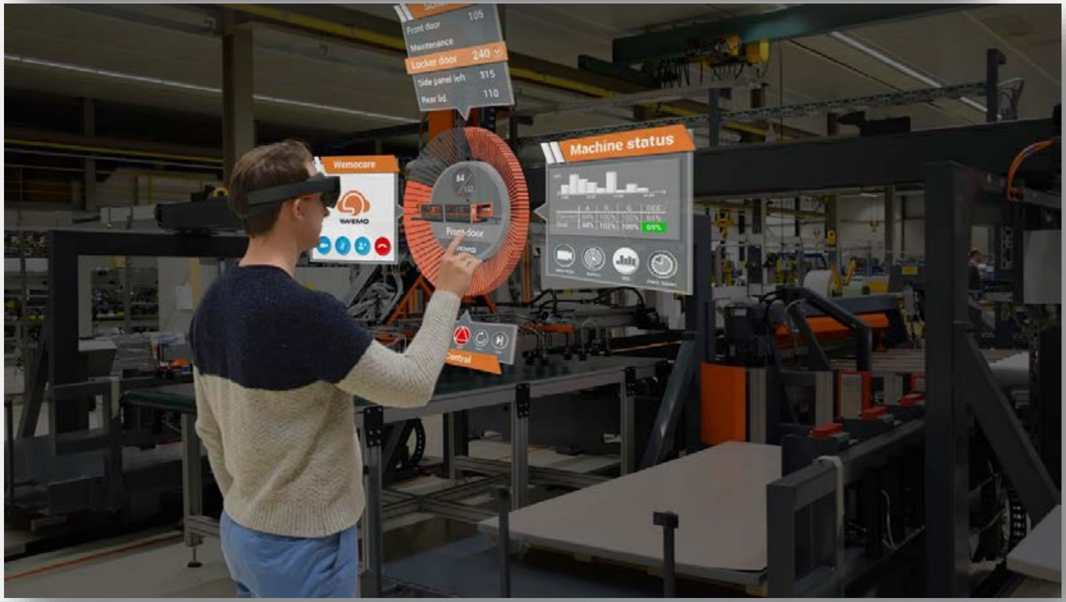


Image courtesy of Raconteur.net

5G applications

- Not available to many yet, but when it is…
  - Self-driving cars
    - Autonomous, intelligent, need to constantly send/receive data for safety and navigation purposes
  - Augmented reality
    - Enhanced real-world; interactive overlays
  - Virtual reality
    - Entire world constructed virtually; need to constantly send/receive data for interaction and navigation
  - Increased Internet of Things (IoT)
    - Physical devices and everyday objects with sensors



5G for the healthcare industry

- **"Healthcare will benefit from 5G technology from countless aspects; it is basically the field that might experience the most changes." -** The Medical Futurist:
- Increased bandwidth improves the transferring of large medical imagery data files
- "…at the Austin Cancer Center, the PET scanner generates extremely large files — up to 1 gigabyte of information per patient per study. When someone needs a remote consultation, it could be difficult to send over such a huge file quickly with the currently existing networks. In the future, that might change for the better and lead to more frequent remote consultations." **-** The Medical Futurist

Image courtesy of Medium.com

5G for the healthcare industry (continued)

- Wearables/Internet of Medical Things (IoMT):
  - Transmit often real-time data to doctors about the user's health (remote patient monitoring)
  - According to Anthem, 86 percent of doctors say they increase patient engagement with their own health
  - Predicted to decrease hospital costs by 16 percent in the next five years
- 5G technology could enable health IoT networks to operate in a stable, fast and highly reliable way.

Image courtesy of athenagt.com

5G for the healthcare industry (continued)

- Telemedicine
  - According to a study by Market Research Future, the telemedicine market is expected to grow at a compound annual growth rate of 16.5 percent from 2017 to 2023
  - 5G technology is expected to enable telemedicine due to the low latency it offers
  - Furthermore, 5G is expected to make telesurgery possible, due to the low latency that it offers as well as its enhancements to robotics, which would then aid surgery

Image courtesy of Medical Futurist

5G for the healthcare industry (continued)

- Other ways 5G will positively impact healthcare:
  - In the future, language translators will be able to video conference with the patient and doctor using models at the network edge with low latency.
  - Robotics autonomously or semi-autonomously performing medical procedures
  - Better leveraging of Artificial Intelligence tools
  - Better access to more specialists for collaboration

Image courtesy of Modern Healthcare

Security threats/mitigations

- In many ways, security threats for 5G-enabled healthcare technologies overlap with IoT threats:
  - Need to secure medical devices (authentication)

  - Need to secure data on medical devices (end-to-end encryption)

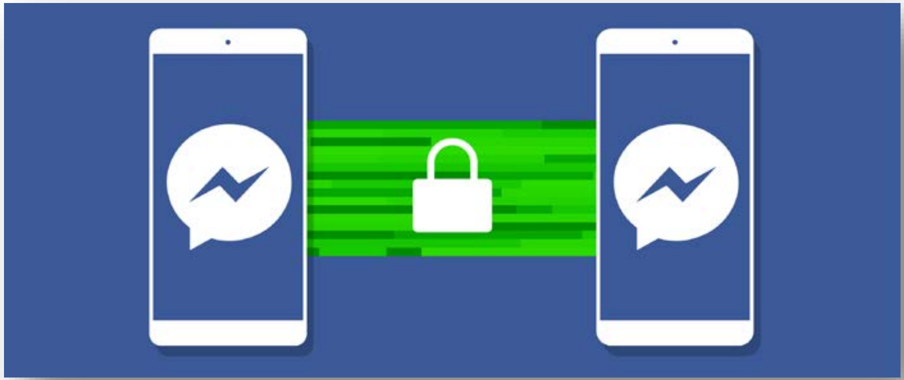


Image courtesy of TechCrunch

  - Need to monitor and segment networks

Security threats/mitigations (continued)

- Additional threats to 5G:
  - Expanded attack surface, weakest link theory (IoT)
    - Supply chain validation
    - Further segmentation can mitigate
    - Secure network architecture
- Disruption becomes an even greater threat
  - Dependency on ow latency = vulnerable to disruption
    - Telesurgery
    - Procedures performed by robots
  - Solutions:
    - Redundancy is critical
    - DDoS protection (zombies ~> botnets)
- Customized 5G networks
  - The one-size fits all approach to security will not work
  - Individual risk assessments become a necessary component of implementing security

But wait, there's more!

- 6G!
  - Academy of Finland funding "6Genesis" - an eight-year research program to conceptualize 6G
  - Summit began in March 2019
  - What is it and why will the world need it?
  - Likely to be significant improvements in:
    - VR
    - AR
    - AI
    - latency
    - speed
    - ???

Reference Materials

References

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Questions

Questions

Upcoming Briefs

- Island Hopping
- Physical Access Control

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