

5G IS COMING: WHAT DOES IT MEAN ON THE USE OF MOBILE APPS FOR MEDICAL PURPOSES?

Chade Li, Yifan Zhao & Yinan Li

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Part 1

INTRODUCTION

- 5G is short for the Fifth Generation Mobile Network
- Compared with previous generations, 5G has much higher speed, lower latency and more extensiveness.



Introduction

1. Introduction

1.1 5G is Coming!

It seems that the evolution of the digital wireless communication system has been considered as one of the most iconic milestones of modern technology over the last two decades. The dramatically increasing use of cell phones and mobile applications has been spreading throughout and changing the world.

This report will introduce some most salient features of 5G, the mushroom use of the mobile applications and the Internet of Things (IoTs) and illustrate the impacts that 5G will have on the medical care industry.

1.2 5G and its Advantages

Similar to the previous four generations, the 5th Generation Mobile Network, or simply 5G, works as a digital cellular network, which requires the network tower to operate the data transmission management in different small areas like cells.

Compared with 5G and 4G/3LTE, its advantages are mainly reflected in three aspects: high speed, low latency and extensiveness.

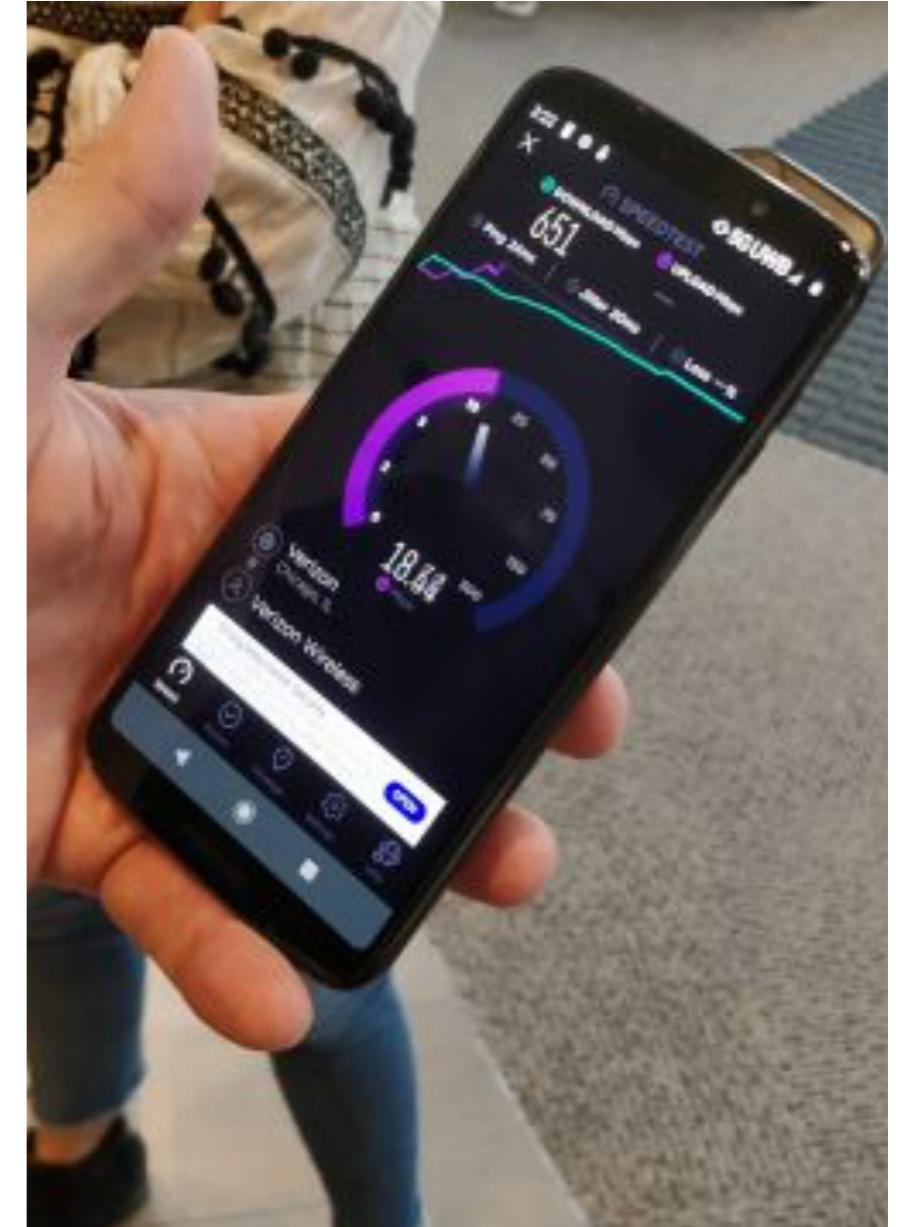


Figure 1. Motorola was the first in the world to sell a 5G phone. The Model is called Moto Z3 that is in fact a 4G handset paired with a new 5G Moto Mod. Adapted from "5G phones: These are the first next-gen handsets," by J. Rogerson, 2019. Retrieved from <https://www.techradar.com/news/5g-phones-what-are-the-first-5g-phones>

Introduction

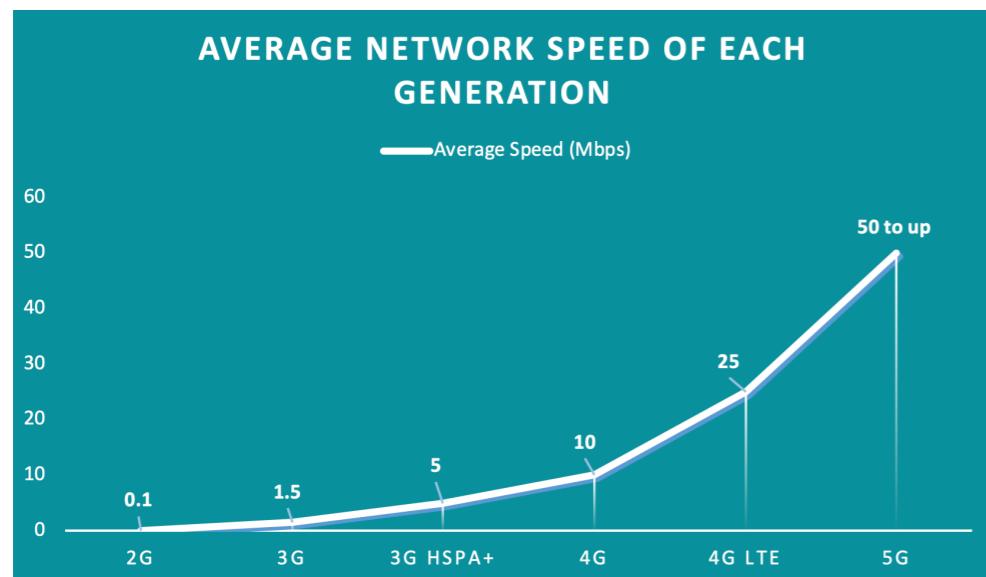


Figure 2. The average network speed from 1G to 5G. (Source: Ken's Tech Tips).

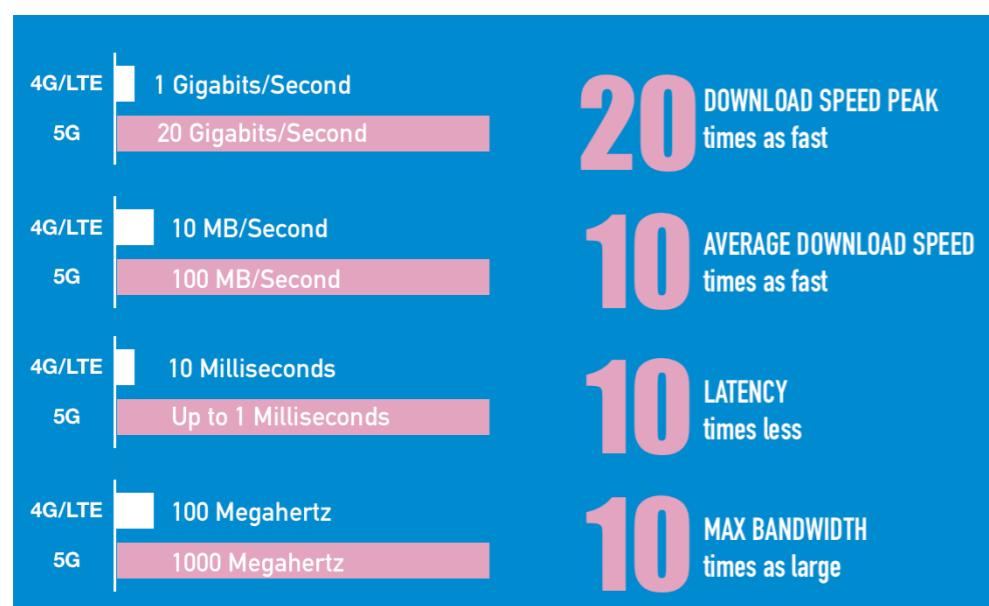


Figure 3. Speed and Latency Comparison between 5G and 4G LTE. (Source: Android Authorities).

1.2.1 Ultra-high Speed

As it can be seen in by Ken's Tech Tips's (2018) and Android Authority's (2019) reports, the average network speed has raised by 300~500 times during the past decade (see Figure 2); furthermore, compared with 4G LTE that is being used most currently, 5G's download speed peak will increase by 20 times, and the average download speed 10 times.

1.2.2 Low Latency

The sound is transmitted through the air and the transmission time is about 140 milliseconds. It means that if this delay is placed on a moving car, a traffic accident could happen. The latency vision for 5G networks is in 1 millisecond or even lower (Android Authority, 2019) (see Figure 3). This excellent low latency will be a qualitative improvement for industrial automation and AI technology.

1.2.3 Large Capacity and Extensiveness

The broadband connection will allow for new industrial and media. Meanwhile, the clients of the Internet will benefit from 5G on their daily routines and recreational activities. The era of Big Data will enable the bright future of the IoTs and enlarge the capacity of information that can be efficiently harnessed by human beings.

Part 2

IOTS & MOBILE APPS

- An IoT refers to any “smart” physical object that stays connected to the Internet
- A “mobile app” now means any software that runs on a cell phone, a tablet or an IoT.

Internet of things

IOT



IoTs & Mobile Apps

2. Redefining “Mobile Apps”: The Rocketing Usage of IoTs

2.1 5G and the IoTs

It can be expected in the 5G Era that not only every human but most of the daily items on this planet will be connected to the Internet. These items are called IoTs, or the “Internet of Things”.

An IoT refers to any “smart” physical object that stays connected to the Internet giving a unique ID and address for each (Ranger, 2018). It is usually implemented with sensors and controllers, and the Internet connection enables them to communicate and make adjustments due to the user’s needs.

In fact, IoTs are not novelties things that come with 5G. Researches show that the number of IoTs has already exceeded the world population during 2008 (Swan, 2012) (see Figure 4). As per the constant data exchange among sensors, environments and control units, the amount of data is considerably huge. Therefore, higher transmission speed is needed to perform the IoTs precisely.

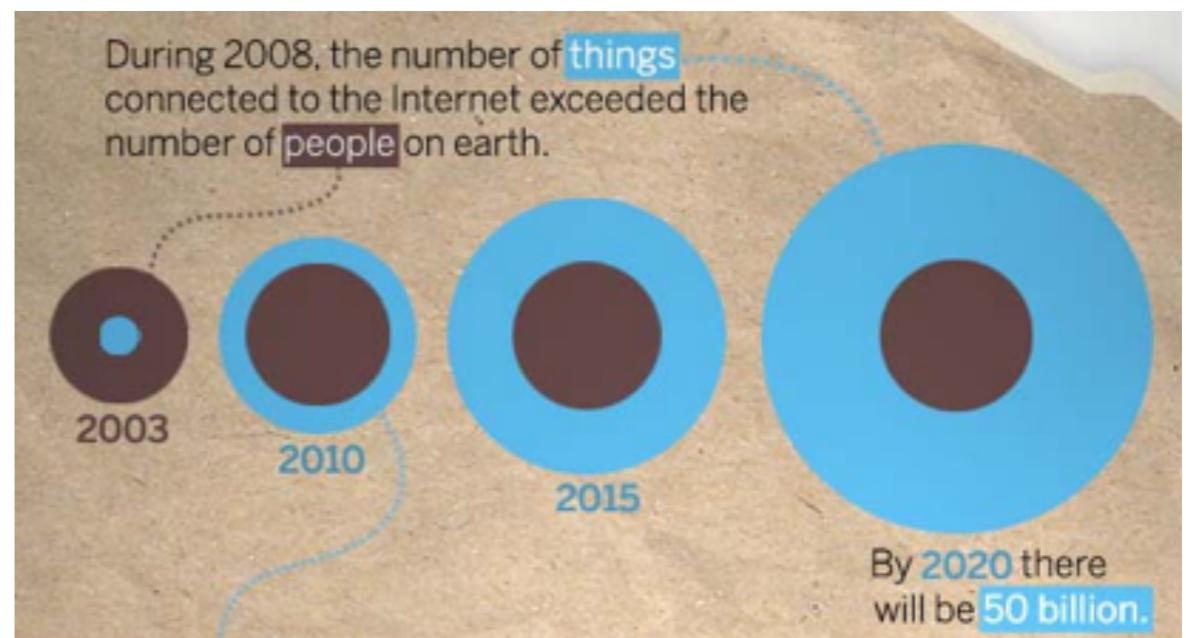


Figure 4. The accelerated growth of Internet-connected devices. Adapted from “Sensor mania! The Internet of Things, wearable computing, objective metrics, and the quantified self 2.0,” by M. Swan, 2012, *Journal of Sensor and Actuator Networks*, 1, p. 219.

Undoubtedly, 5G is the correct solution. The market of IoT has been growing even more rapidly as the development of 5G. 5G’s ultra-high speed will enrich the features and usages of the IoTs, and the IoTs stimulate the application of 5G in return. It is anticipated that the number of IoTs will reach more than 20 billion (Gartner, 2017) (see Figure 5) across business and consumer uses, and 50 billion among all categories (Swan, 2012) (see Figure 4).

IoTs & Mobile Apps

IoT Category / Year Number (million)	2016	2017	2018	2020
Consumer	3,963.0	5,244.3	7,036.3	12,863.0
Business: Cross-Industry	1,102.1	1,501.0	2,132.6	4,381.4
Business: Vertical-Specific	1,316.6	1,635.4	2,027.7	3,171.0
Grand Total	6,381.8	8,380.6	111,96.6	20,415.4

Figure 5. Table of installed IoT Units. Adapted from "Gartner Says 8.4 Billion Connected "Things" Will Be in Use in 2017, Up 31 Percent From 2016," by Gartner, 2017. Retrieved from <https://www.gartner.com/en/newsroom/press-releases/2017-02-07-gartner-says-8-billion-connected-things-will-be-in-use-in-2017-up-31-percent-from-2016>.

2.2 Mobile Apps/IoTs in Medical Care

We believe that the popularity of IoTs has redefined the term "mobile app". It refers to not only an application running on a mobile phone or a tablet but also software on an IoT.

It is not uncommon that some Mobile Apps are widely used in many healthcare institutions in North America. A glucose monitoring app can continuously monitor and

send data of the diabetic's blood sugar level, and connected contact lenses can help "detect symptoms of various eye disease" with "the combination of sensor" (Chowdhury, n.d., para. 14). Besides, as we will explain later, it should be highlighted that Virtual Reality (VR) technologies have been embedded in the healthcare industry, followed by two more areas, data management and remote diagnosis, that will be impacted by the 5G network.

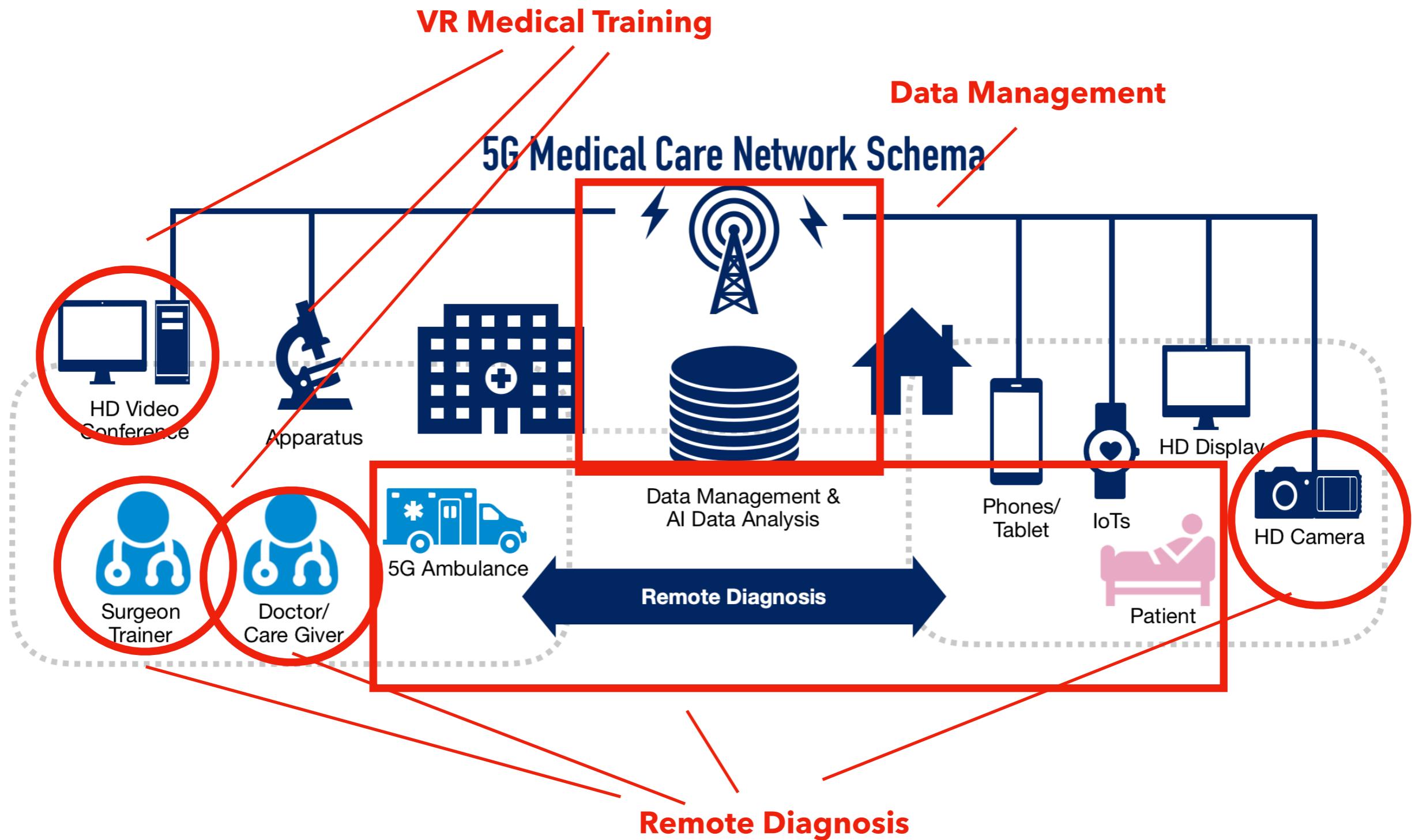
Part 3

HOW 5G INFLUENCES

- 5G tends to be a rapid need of medical care practice and research
- We believe that 5G will dramatically shape and/or impact data management, remote diagnosis and VR medical e-training in the industry.



How 5G Influences



How 5G Influences

3. Impacts and Inspirations: What 5G Means on Medical Care

5G is becoming a game changer in many fields. One of the industries that will be significantly influenced by 5G is the medical care industry. There is a rapid need for precise and advanced technology to support medical care practical skills, such as measurements, surgeons and nursing, as well as medical research (Cohen, 2019).

In this part, we will mainly discuss and predict how data management, remote diagnosis and VR medical e-training will be shaped and/or impacted in the future.

3.1 Data Management

3.1.1 Managing and Sharing Multi-dimensional Data

Unlike the most regular smartwatches that only records heart rate and sleep quality, professional applications in the healthcare industry need to deal with a much larger amount of data files. According to AT&T (n.d.), image machines using technologies such as Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET) generate gigabytes of information per patient per study. If the network is low on bandwidth or encounters latency, it will take a long time for the diagnostic result to be added in the patient's case profile and sent to a specialist for review.



Figure 6. A new PET-MR scanner at Edmonton's Cross Cancer Clinic. Adapted from "PET MR," by R. Neil, 2018. Retrieved from <https://www.ualberta.ca/medicine/departments/oncology/department-news/2018/may/pet-mr>

How 5G Influences

Fortunately, 5G Network will significantly boost the transmission speed and reliability. AT&T (n.d.) reports that the PET scanner technician (CIO of Austin Cancer Center, Jason Lindgren) "used to have to send the files after hours" (para. 3), but "now as soon as the patient leaves the scanner, the study is already on its way" (para. 3).

Since much larger data is being exchanged in medical institutions, it is far more efficient for paramedics to manage patient data and medical resource data. The new technology will build a data warehouse, in which considerable amounts of statistics and imagery will be recorded, stored and connected to all the clinics and hospitals from different geographical locations. If the patient data become more multi-dimensional and accessible, it will be much easier for doctors and paramedics to get to know a patient's condition within a short time.

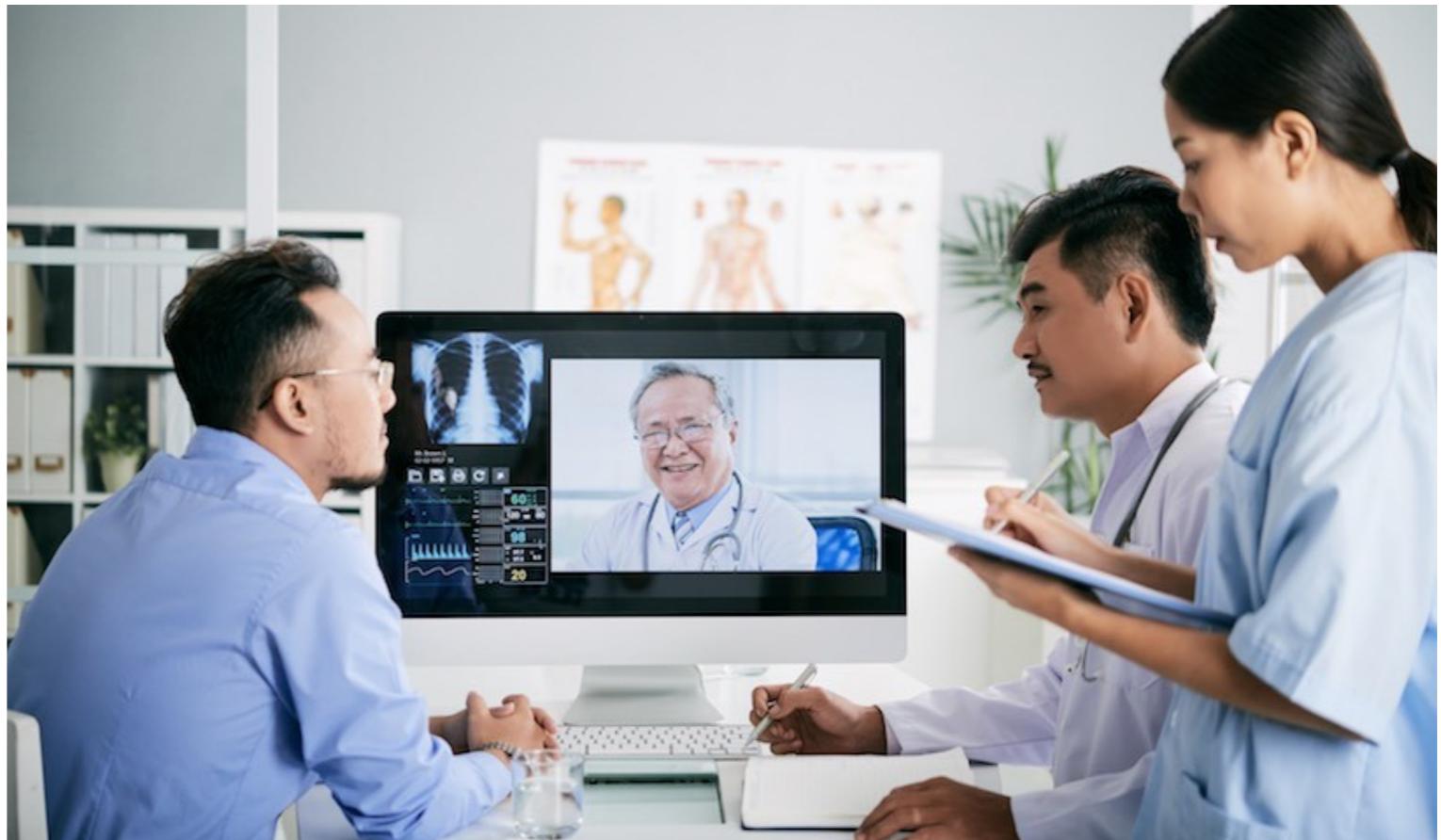


Figure 7. A specialist is assessing the imagery online. Adapted from "5 ways 5G will transform healthcare: Improving patient experience with personalized, preventative care," by AT&T, n.d.. Retrieved from <https://www.business.att.com/learn/updates/how-5g-will-transform-the-healthcare-industry.html>

“ Now as soon as the patient leaves the scanner, the study is already on its way.

**Jason Lindgren,
CIO of Austin Cancer Center.**

How 5G Influences

3.1.2 AI Data Analytics

Furthermore, a stimulating step has been taken in Israel that the country is becoming a testing ground for artificial intelligence (AI) data analyses in healthcare (Lieber, 2019). The news indicates that with the help of AI, the IoTs may

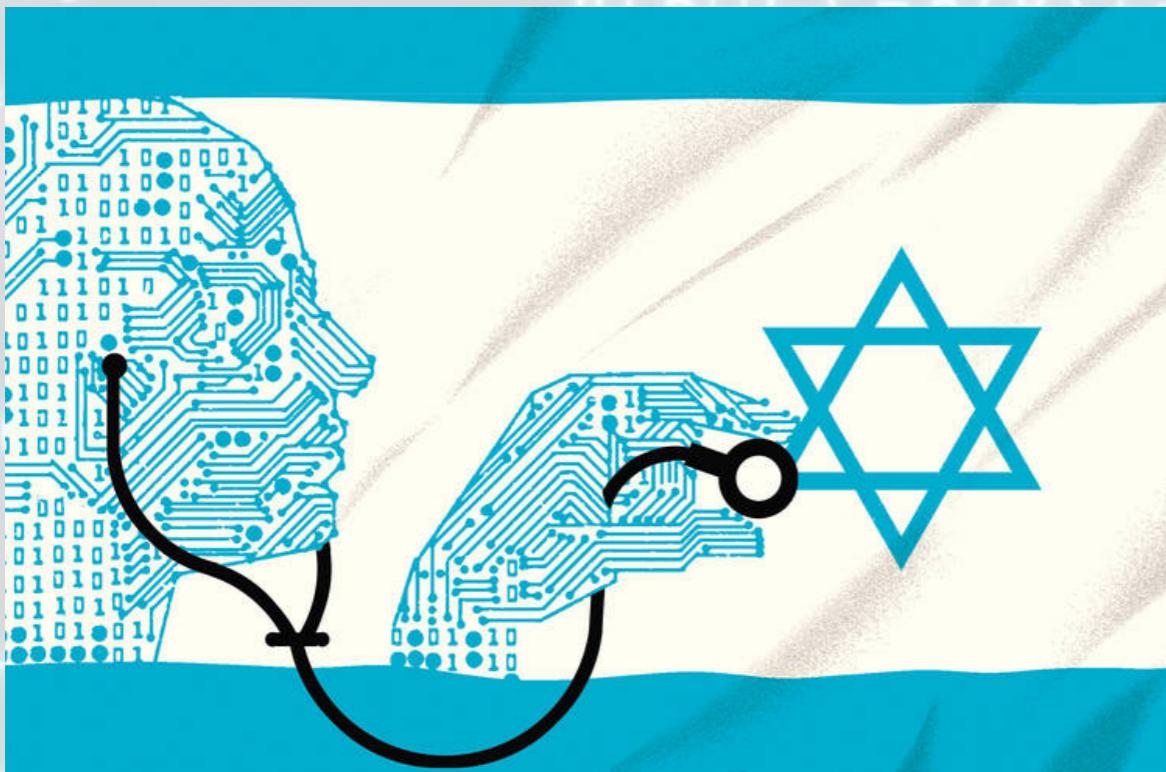


Figure 8. The poster shows that Israel is becoming a testing ground for the power of artificial intelligence to improve health care. Adapted from "Israel prepares to unleash AI on health care," by D. Lieber, 2019. Wall Street Journal, September 2019. Retrieved from <https://www.wsj.com/articles/israel-prepares-to-unleash-ai-on-health-care-11568599261?redirect=amp>

serve as a data analyst and help doctors and caregivers make decisions.

The reason why this can be achieved is that the data transmission benefits machine learning, which is one of the core categories in AI. The smart device contains a collection of analysis modules, each of which analyzes one particular aspect of a dump and helps diagnose one particular type of problem. The ultra-high speed of 5G provides massive amounts of data, which means there will be many more opportunities for the devices to study, get smarter and ultimately work for human beings.