National Project Mission 2016312761 여혁수

President, I think 5G technology is a critical key to lead our "Smart X" project to success. I have a very long word for you to introduce why 5G technology is required to achieve our project. Previously, I will briefly talk about what 5G is.

4G, the mobile communication which is prevalent in our country, is highly faster than 3G, which was much faster than 2G. Likewise, 5G also just means more speed than 4G, right? Not exactly.

4G vs 5G 성능

4G	구분	5G
1Gbps	최대 전송속도	20Gbps
10Mbps	이용자 체감 전송속도	100~1000Mbps
-	주파수 효율성	4G 대비 3배
10ms	처리 지연 속도	1ms
10만 대	최대 기기 연결수	100만 대
-	에너지 효율성	4G 대비 100배

*자료:국제전기통신연합

[1]Sure it is faster, much faster. When looking at value of full speed on the chart, the difference is 20 times. We can download a 2 hours movie in 4 seconds. But 5G technology also improved latency to 1ms. Short latency means fast response. We can see much softer action in online game with fast response. If we request some data, the start of sending will be ridiculously quick. Moreover, what is shown in real-time video conferencing will also be much smoother and cleaner because of short latency. I will talk later how the short latency will be used in "Smart X" project. And also 5G techonology has very wide frequency bandwidth. For example, at 700MHz, which is low frequency part of 5G, wave is suitable for large open areas such as deep rural areas because it has advantage to go farther away without disconnection. At more than 24 GHz, which is highest part of 5G, wave can be used for data intensive services. But it can be easily blocked by any tiny thing, so we can use in small area like car to car communication, and smart home communication. 5G has great advantage that is useful in various fields having wide frequency bandwidth.

From this part, I will talk about affects of 5G technology in "Smart X" project. First, 5G will play a big role in the construction of smart city. Smart city is a city that guarantees

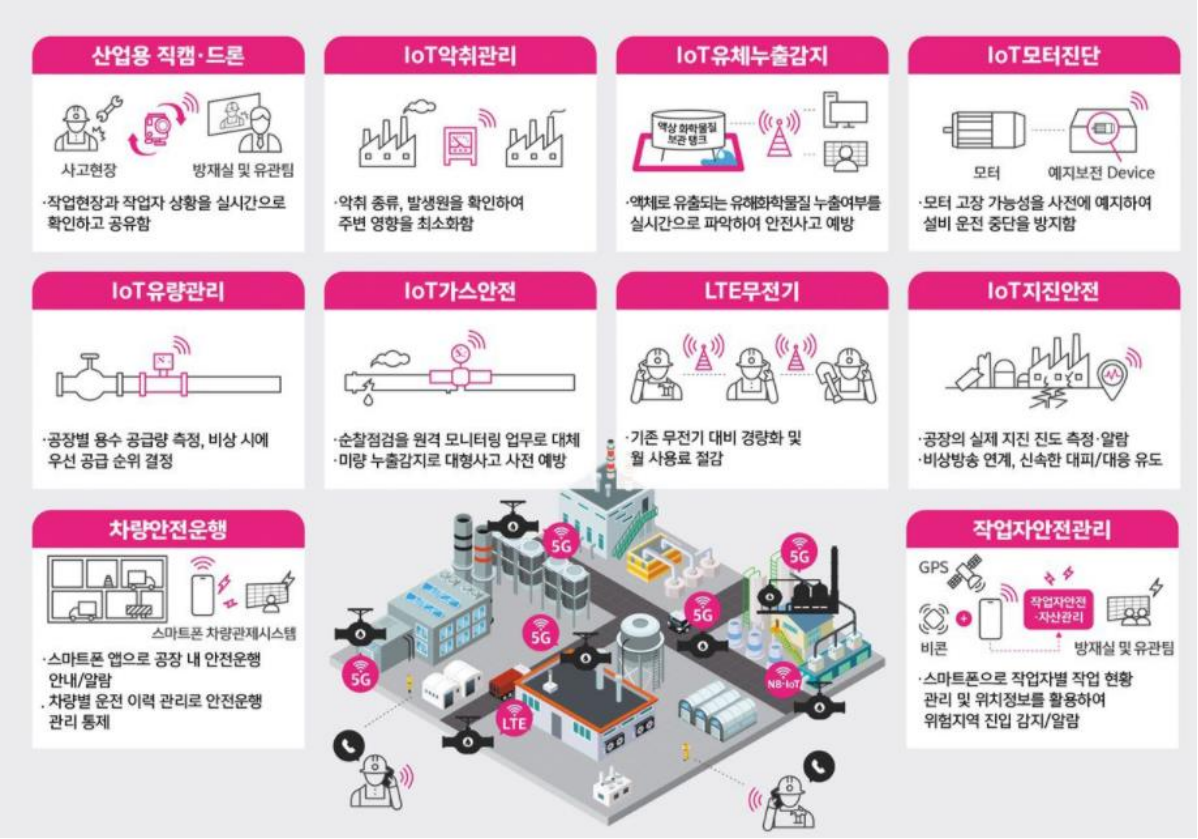
[1] 5G 시대 통신판 이렇게 바뀐다 "영화 다운로드 16초서 0.8초로, 360도 홀로그램 영상통화도", 매일경제, 2019-01-07, https://www.mk.co.kr/news/business/view/2019/01/13147/

a comfortable and convenient life for citizens by introducing various technologies to solve problems encountered in daily life such as transportation, environment, housing, and facilities. For a part of transportation, the intelligent transportation system(ITS) is a representative technology that can be developed by using 5G. ITS controls roads and traffic by automating the operation and management of the transportation system. As a result of implementing ITS, the traffic light signal can be changed actively depending on the various situations, and drivers and pedestrians will be able to move more efficiently. In order to implement the system, a new radio antenna that provides wireless communication from the road infrastructure to each vehicle is required. Not only the transportation system, but also cars can develop to self-driving cars. Vehicle communication technology V2X(Vehicle to everything)[2] makes this possible. It is a techonology that shares traffic information by connecting all objects and people such as traffic lights, surrounding vehicles, pedestrians, and road conditions with vehicle. With so many things connected in real time, information must be processed and updated really quickly in order for the car to react very quickly to any sudden situation. For this, 5G is essential. You can still think we're using a 4G network that's fast enough, but it's about 20 times faster than 5G at full speed. In addition, it has a quick response speed of 1ms, so it can be said to be an indispensable technology for self-driving cars that require fast response speed.

Another example is the environment. Services that can only be operated by connecting with large number of sensors, such as water quality & quantity management service, and air pollution prediction service, become possible through 5G. Because as mentioned in the chart from the section which I explained the difference from 4G, the number of devices that can be connected per base station is 1 million, showing a difference of 10 times compared to 4G.

Next, 5G can also contribute to the development of smart factory. In fact, smart factory is a project that has evolved steadily even before 5g. For example, LG Uplus is currently applying IoT motor diagnostics to prevent unexpected production disruption, and automating the status of parts to replace parts at the right time, thereby reducing maintenance costs.

[2] 5G와 스마트시티, 단번에 이해하기!, 디지털콘텐츠기업 성장지원센터, 2020-05-26, https://smartcontentcenter.tistory.com/948



Besides this, as you can see in the image[3] above, there are many technologies about smart factory such as odor management, and gas leak detection, and so on. However, the impact of 5g on the smart factory will be different from before. An official from LG Houses said, "We plan to use the collected data to the PMS (Process Safety Management) area, which improves the safety of field workers in the future." One of the PMS is to help workers quickly respond to emergency situations such as safety accidents and fires by grasping the location of workers in the factory in real time. This part also seems to be considering small latency as an essential part. Of course, it is not impossible to implement with 4G, but the smaller the delay in data transmission, the more secure workers are. No one will say no to the fact that the safety of the workers is the first thing to consider in operation of the factory. Together with 5g, it could lead to an accident-free factory.

Next, smart healthcare can also be developed with 5g technology. Let's look at medical systems that are part of the field of smart healthcare. The fast speed and low latency of the 5g network can increase the success rate of difficult surgery. Diagnostic pathology of existing Korean hospitals included sending tissues collected from patients during surgery

[3] 5G 입은 스마트팩토리… "자동분석으로 유지보수 비용 확 줄여", 조선일보, 2020-07-25, https://www.chosun.com/site/data/html_dir/2020/07/24/2020072402829.html

to pathologists in adjacent rooms, which took about 20 minutes and field analysis was also challenging.[4] Now, doctors will be able to take advantage of the high speed and low transmission delay of 5G networks to provide efficient and fast access to pathological data obtained during surgery, as well as access to relevant data and files from anywhere in the world, improving medical services. Getting information about the patient quickly is very important in determining the patient's condition during the procedure. Only by accurately judging the patient's condition can the correct surgical method be selected, which will lead to the success of the surgery. If it helps with a life-and-death surgery, more people can be saved. Also, with 5G, remote surgery is possible. Doctors watch the operation in real time and operate the surgical device remotely. With 4G networks, the latency between input and output can sometimes take up to 2 seconds, so remote surgery is a very sophisticated operation and virtually impossible. On the other hand, since 5G can reduce the latency to 1ms, remote surgery can become possible if the latency of 5G can be stably reduced. Of course, in order to commercialize this, it is necessary to do a lot of testing and show a success rate equal to or better than that of present surgery. Recently, the first laparoscopic surgery was performed using 5G at the Skolkovo Innovation Center in Moscow. In surgery to insert a fiber optic instrument through the abdominal wall, they succeeded in removing cancer tumors using a laparoscopic and 4K camera connected to a 5G network. Therefore, remote surgery can be seen as a feasible work.

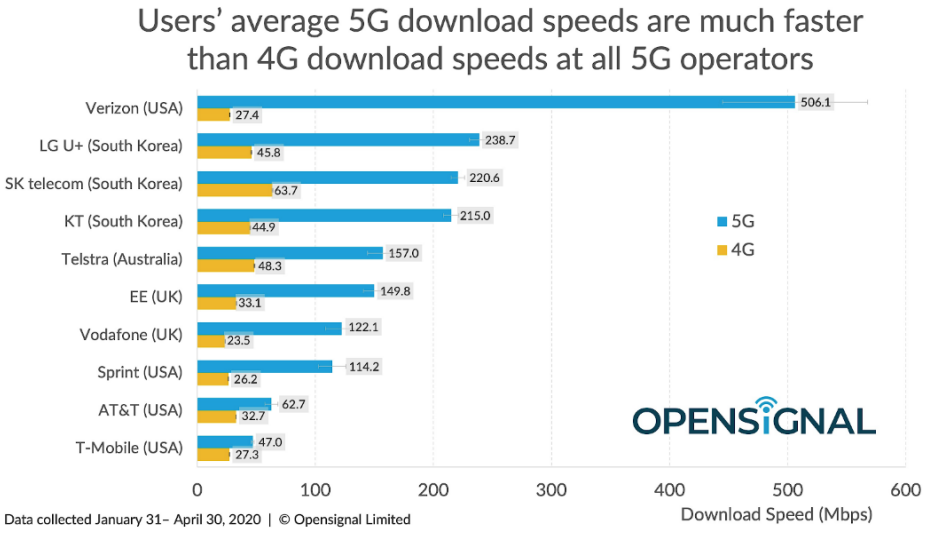
Finally, 5g can play a big role in smart military projects as well. By being able to receive data from nearly 1 million devices per base station with an excellent data transmission rate of 5g, we can provide data such as video, voice, images on the battlefield. In a American military magazine report[5] says, "This data-rich environment will fuel powerful algorithms that will allow commanders to better understand, shape, and adapt to complex and contested physical and information environments." Commanders can understand situations during war more accurately. And also says, "The warfighter will be empowered with far richer access to data at the tactical edge, so that even small units can achieve strategic effects." There are many good points like this but I also think that the cost to build the 5G based system will be enormous. Because the high frequency 5G is

[4] 5G, 의료 분야에 혁신을 가져온다, BIOTIMES, 2020-02-05, http://www.biotimes.co.kr/news/articleView.html?idxno=2418

[5] What 5G means to the military, MilitaryAerospaceElectronics, 2020-12-02, https://www.militaryaerospace.com/rf-analog/article/14188341/military-5g-communications

vulnerable to obstacles. Persistent Systems' Robenhymer[6] says, "5G frequency bands do not penetrate walls very well, or rain or foliage very well." It will take quite a lot of money because the towers will need to be built more tightly in order to be connected without being disturbed by many obstacles. Also, even if spending a lot of money, the stability of the connection can still be shaken depending on the weather. So I'm not sure that proceeding project of specifically this smart military project.

Until now I introduce 5G technology and the affect of 5G in our "Smart X" projects. I strongly recommend to invest in upgrading 5G. Because there are many advantages about people' safety and conveniences if upgrading 5G. Above all, we can make no-accident-traffic, no-accident-factory with 5G. But I think we need a lot of time to develop 5G technology to high level.



[7]As you see in the graph, the average 5G speed varies dramatically across these ten leading 5G operators. Even leading operators, which have been doing research for several years already, did not reach at top level yet. In order to fully implement the beautiful technologies I mentioned, such as self-driving cars and PMS, we need to implement high-level 5G communication through long research. Thank you for reading.

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[6] What 5G means to the military, MilitaryAerospaceElectronics, 2020-12-02, requote

[7] Quantifying the global 5G experience across ten operators, OPENSIGNAL, 2020-05-20, https://www.opensignal.com/2020/05/20/quantifying-the-global-5g-experience-across-ten-operators