

Annex Future Business and Services

Following sections, using market trends and future capabilities, introduce the perspectives of future business and services, with illustrations, eight business models and services.

With 5G technology will bring about the creation of many new mobile services. However, 5G by itself will not determine whether a service is used. Other factors include the national policies where an operator is located, individual operator business models, the cost of using 5G devices and infrastructure. In addition, industries like education and health care that will utilize 5G will also be limited by laws and regulations on their use. In this chapter, however, we will not take into account these uncertainties. Instead, we will discuss the special features and key abilities of 5G architecture and how they can be used in business and services.

The defining capabilities of 5G capabilities include a peak data rate of more than 10 Gbps, mobility of 500 km/h, and latency of less than 1ms, an individual cell that can connect to 10,000 devices, 1000 times the capacity of 4G. Additionally, 5G mobile will see a drastic reduction in the use of electrical power. Before discussing the specific services and business these capabilities will bring about, we will first describe the typical use scenes.

- ① Surgery done in medical helicopters -- with a high peak data rate and an ultra-low latency, even in disaster users will be able to connect to 5G networks.
- ② Watching high definition films while moving at high speeds -- even while moving at high speeds, people will be able to download high definition films
- ③ A new age in agriculture with micro robots -- rather than using large devices that need to consume a lot of power, these devices will use a limited amount of power which can be used over a long period of time.
- ④ Athletes practicing using live hi-definition 3D systems – with a massive number of connections set up on a race track will allow uploads from the stadium interior, which, combined with the ultra-low latency of the network, means athletes can participate in a virtual race on the track.

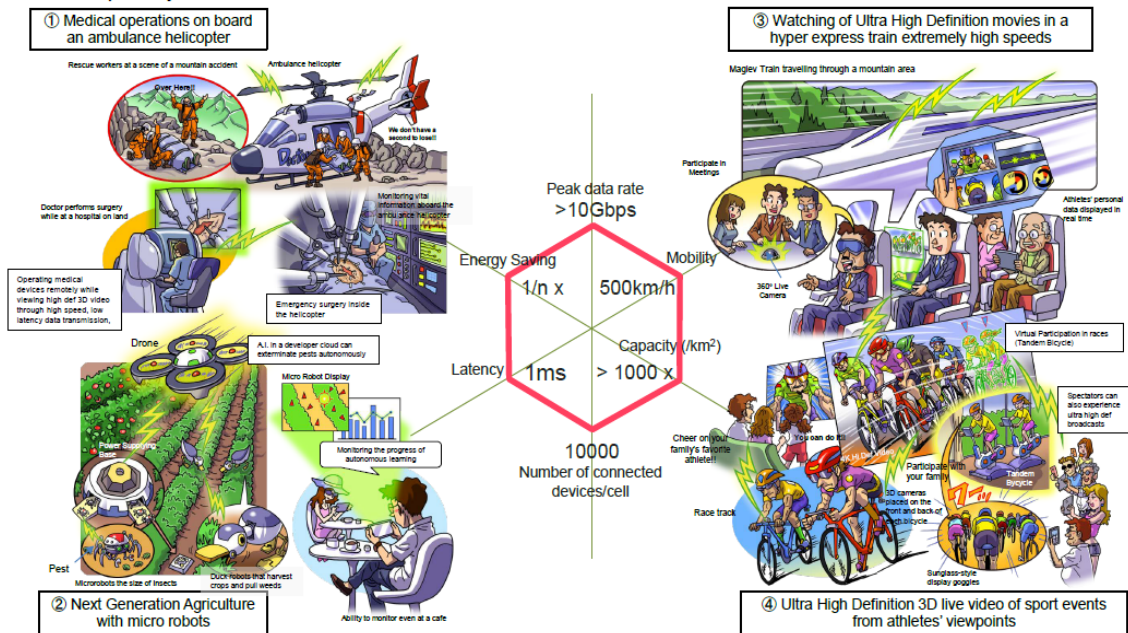


Fig.13.1 5G capability

[Further expectations to ‘5G’ services]

1. Location Based-Services using Small Cell Technology

Current 4G smartphones have spread with the use of location-based services using GPS, such as Google Maps. One issue with these applications is the inability to access GPS while inside or around a large building. Although people are not able to access GPS inside a shopping mall, an airport, a stadium, office buildings, with the use of 5G small cell technology deployed in areas where there is a large gathering of people, devices will be able to recognize users within range of the closest small cell. That small cell base station will be used as function of location-based services. Current smartphones continual use of GPS also means the phone is wasting a large amount of power. 5G will be able to utilize small cells, providing a good location service even without the use of GPS.

5G, unlike its predecessor 4G with its macro cells, will be able to deliver fast broadband with ultra-low latency utilizing multiple small cells, bringing with it the possibility of many new business even opportunities. Users will be able to opt in to use small cells of mobile operator utilizing these capabilities. Mobile operators will be able to remove personal information for those users who opt in to provide location-based services. Small cells will also be able to participate in digital beam forming. With this feature, users will be able to receive information about their location near the closet small cell. Utilizing these capabilities, service providers will be able to offer users

timely services at the user's specific location.

2. Services Connecting to Local Wireless Networks

5G smartphones, which are always on close at hand, will have many use scenes, but not only with the network provided by the mobile operator's frequencies, but also with local wireless networks using Wi-Fi and Bluetooth.

White goods such as vacuum cleaners and washing machines can be connected to networks. For example, now when people purchase these goods the software cannot be upgraded during the objects life. However, this may be possible in the future. Beyond this, many household functions done by internal CPUs can be transferred to the cloud on networks. For example, in the future robot vacuum machines can sense the state of the house and transfer that information into the cloud, and can download the proper algorithm to do the necessary cleaning. Washing machines and refrigerators already have many sensors, but being able to connect them to a household network and then send that data to the maker, with the power of big data in real time, can help determine whether the object is nearing a breakdown or needs necessary maintenance. In addition, using the cloud can bring down the need for using the goods own CPU, decreasing the cost of the actual product.

Consumer electronics, in order to connect to these kinds of networks, need to be able to connect to the internet using household Wi-Fi as well as through 5G smartphones in order to easily connect to the internet. It might be difficult for people, such as senior citizens, to be able to accomplish this easily. With 5G, however, users will not need to purchase separate routers to connect to the internet. For example, when they buy a smart phone and make a contract with the operator, the smart phone will register a family name for electrical appliances with the mobile operator. Household ~~goods~~, devices, when purchased, will then be registered with the family name. When brought back to one's household, the internet connection will look for the smartphone, and the smartphone will automatically connect to other devices that are already in the household. In addition, the connected goods announce their state for other goods to connect to the smart phone through the connected goods.

3. Eco-mode Services

All resources, including frequencies, are finite. All 5G users cannot use the network at the same time with a high level of efficiency. Like users who put their phone in

manner mode so they don't bother people around them by having their phone vibrate when they get a telephone call, people can only use the bandwidth they need, keeping care to think about the other users around them, with their 5G smartphone's eco-mode. The eco-mode, a low rate connection service whose periodic connection interval by 5G base stations is long, needs to be prepared. When the consumer needs more bandwidth, a pay as you go packet system can be used with 5G's broadband and low latency capacities. During a large scale emergency all users can be required to use the eco-mode to conserve bandwidth. While in eco mode, people can be connected to 5G location-based services and those in disaster areas can be provided with information immediately all at the same time. In addition, victims find their loved ones as well through being provided information services by government and other aid agencies with priority.

4. Mobile Operator Business Model Revolution

Traffic flowing on networks has rapidly increased while the average revenue per user has declined. As mobile operators deploy nationwide 5G networks, the high cost of the initial equipment will require a high level of capital investment. User will expect that they will be able to access more content at lower service fees. 5G, to be able to cope with huge equipment costs, in addition to sharing base stations, there are various business models to work that can be implemented.

- ① Private small base stations. -- One model is that local stores can increase users by establishing Wi-Fi access points. Similar to 5G, they will want to build small base stations. Mobile operators in areas where 5G will be established later can build small base stations like local community antenna for television. In addition, individual users who are fiber optic subscribers can also install small base stations in order to resell their system to mobile operators.
- ② 5G CDN. -- In 5G, base stations will connect to edge cloud servers. End users will access the edge cloud. OTT contents will be far from the edge cloud, so they will need to access Content Delivery Networks. Mobile operators with 5G base stations and edge cloud will also have the opportunity to get into the content delivery network business.
- ③ Use of Personal Information in Big Data -- Information Age culture, beginning with SNS, has many merits, one of which is the sharing of personal information. Mobile operators may provide free 5G service for end users who

share their personal information, for example locations they visit. This information can be collected and analyzed with big data. The results can be used to providing new business opportunities for everyone.

5. Automatic Mobile operator Selection

Until today, people have been able to recognize the strength of nearby radio waves by a display on their phone. For the end user, the ideal situation is to be able to automatically choose a signal from the best operator. In the past, it was expected that a similar system to Least Cost Routing (LCR) , which was introduced with land line phones, would be introduced with mobile phones. LCR chooses the cheapest connection with an operator, but now what is most desirable is that the user chooses the best connection based on the user's throughput. For example, a heavy blog creator would choose the best throughput for uploading data but rather downloading data. Parameters that users would be able to use to choose from would include cost, throughput, and upload and download speeds.

6. Capability on Demand

The special technology of 5G includes capabilities of broadband, high density of connections, high connection speeds, low latency, and low usage of power. There are many opportunities for new business opportunities but they don't all come from these capabilities. For example, lower speed applications get lower power consumption as result. It is expected that 5G capability will be controlled by the end user on demand. The end user, with their smart phone control panel, will have a 6 pointed radar chart, from which the user can change and configure the capabilities of their phone. If the user wants a high security level, the user's phone will not use a local Wi-Fi network. 5G's communication infrastructure functions as software defined networking (SDN), so not only the telecommunication operator but the user can control their own network, allowing for the end user to have "Capability on Demand" resulting in extreme flexibility when compared to current mobile phone networks.

The end user will not have to choose their optimum capability every time for themselves, instead application developers using the device and 5G SDK/APIs can create different applications. For example, a stock purchasing financial application, when the application is active, can decide to utilize a very low level latency capability. On the other hand, to support someone running a full marathon, a sports app may only

turn on the GPS and not use other power consuming capabilities in order to save energy.

These functions can also be used for IoT service industries. Businesses using 5G to connect electrical appliances or other household devices can ensure minimum bandwidth to save costs, only changing capabilities when an update is needed. This is a jump in sophistication from the current 4G MVNO business oriented interface.

7. Other Application Services

5G mobile's technological specifications include capabilities of broadband, high density, multiple connections, low latency, and low energy output. While many services can be offered to consumers using these capabilities, not all of these capabilities need to be used for every service. A service menu that restricts some of these capabilities is needed.

Looking from the perspective of the regular user the most important issue is costs. The same types of services that 3G provides will cost only 1/2 or 1/3. 5G's high efficiency will be a selling point and early adapters will be satisfied, but for the regular users, the late majority, will want to be able to choose from an inexpensive list of services. It is expected that 5G will provide inexpensive services, including the current prices of 3G but with the currently unavailable features that 5G broadband will provide.

Agricultural field sensors as well as sensors calculating the inventory of vending machines do not need to access high speed broadband networks. Narrowband connections will be sufficient. Pay as you go fees will be inexpensive and transmission modules will use the smallest amount of electricity that is necessary for such service. Communication intervals for reporting can be allowed to take more time than other situations, especially considering cases such as rainy weather or high temperatures. Field sensors will recognize the situation and startup for only for the certain amount of time needed to report the information and then will shut down.

Real estate customers will choose the service that provides various security and anti-theft measures. These services would potentially include location and time reporting functions, end-to-end encryption and above-mentioned field sensor functions.

For self-driving cars, automated driving levels 2 to 4 can be processed in the cloud, so the latency of the connected network is very important. But that means not only the latency of the connection needs to be guaranteed but the latency within the network needs to be guaranteed. Latency within 4G networks can't be guaranteed, but this

service will need to be provided in order to provide automated driving services.

Another service that can be provided is high definition video connections to 5G small cells using beam forming tracking for users who watch a lot of rich video content.

This chapter describes some changes to the communication operator's business model, they may provide services that include edge cloud data processing functions and 5G. All IoT use scenes require low spec CPUs in devices for cost reduction. In these use scenes, not only will data transmission need to be guaranteed, but also the 5G network's ability to support a specific IoT device's data processing power will be needed, as well.