3. Market and User Trends related to 5G

This chapter describes the result of survey on the current various services realized by ICT and analysis of the market and user trend for each service, and our consideration of the forecast of services as the introduction of 5G.

3.1. Shift from PCs to Devices such as Smartphones and Tablets and wearable terminals

Internet traffic initially began to increase as the number of PCs connected to the Internet increased. The emergence of reasonable flat-rate Internet connection services lead to rich content, such as video, which lead to further and further increase in Internet traffic.

The past few years, however, Internet traffic has increased with the dramatic rise of the use of smartphones, especially among young people. These devices, unlike PCs, allow people to be connected to the Internet 24 hours a day with something they hold in their hands. While delivering video and images to smartphones has contributed to the increase of Internet traffic, just as it did with PCs, the rise of social media has also led to an increase of Internet traffic. (See Fig. 3.1)

Smartphones have become indispensable for young people now that they are being used by those in their teens and twenties to strengthen their relationships with each other. This generation will bring this communication style with them as they enter the workforce by the 2030s. 5G, which is being introduced in 2020, will be fully implemented by then, meaning most people will have a 5G compatible smartphone in their possession.　When we consider the use scene for 5G, which will have a maximum possible speed of 10Gbps, we will need to consider that this generation will be the main users of these services. (ITU-R M.2083 states that 5G will require a minimum user experience data rate of 100Mbps)
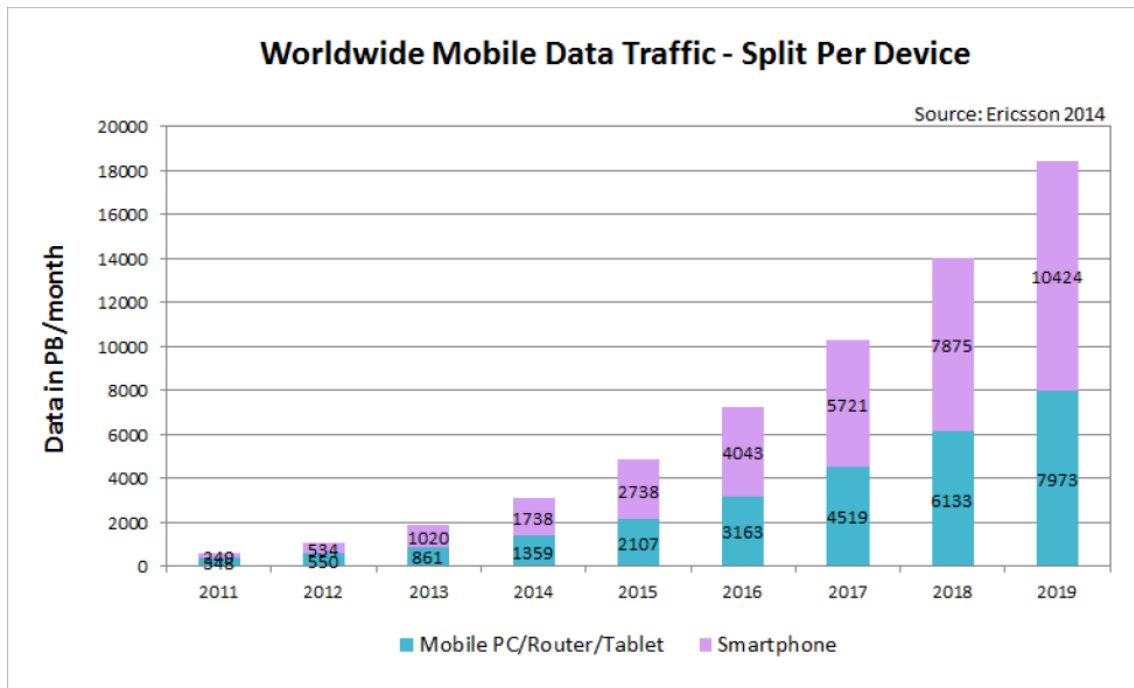
Fig.3.1 Worldwide Mobile Data Traffic – Split Per Device Source: Ericsson 2014

3.2. Increase in Location-Based Services

Both the private and public sectors are developing services that use GPS and digital maps, which have become important parts of today's society. These services are expected to continue to develop and evolve as they being to use high speed mobile and cloud based services enabled by 5G.

For example, current digital maps are modified to when new information is delivered to a device. The best example is Google Maps, whose smartphone application can not only be used while walking, but has also become popular as an alternative to a dedicated car navigation system. (See Fig. 3.2) In the future, it won't only be people who are using electronic maps, however, but also self-driving vehicles will be able to function when high speed data transmission allows for real-time information updates. When this becomes a reality, digital maps will be able to be dynamically updated, including information on traffic jams and road construction. The ultra-low latency of 5G will enable these maps to be dynamically updated in real-time.

Municipalities also need hazard maps that can be updated in real-time to be used in times of disasters or evacuations. 5G will also assist in creating maps that will change in real time in response to disaster information, just like the dynamic maps self-driving vehicles will use.
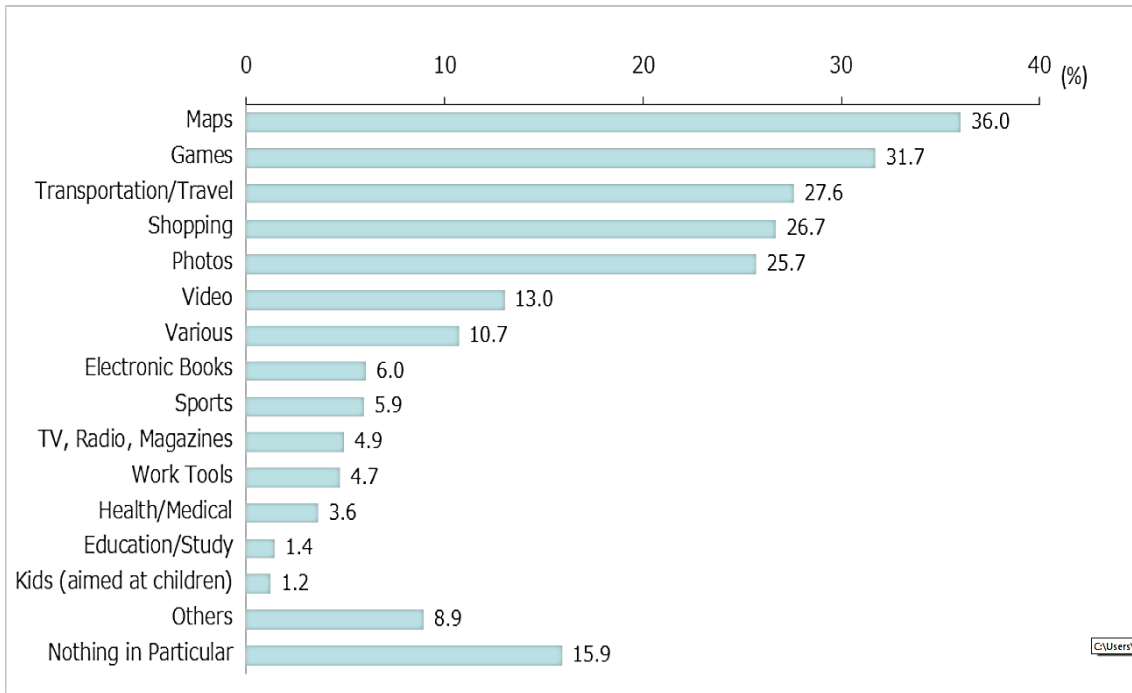
Fig.3.2 application usage

3.3 Large increase in the use of smart phones by senior citizens

Smartphones are currently most well known for being able to engage in social networking (SNS), the ability to change information in real time with people not in the same physical space as each other. As use of SNS has grown, it has turned into one of the main tools of people to people communications
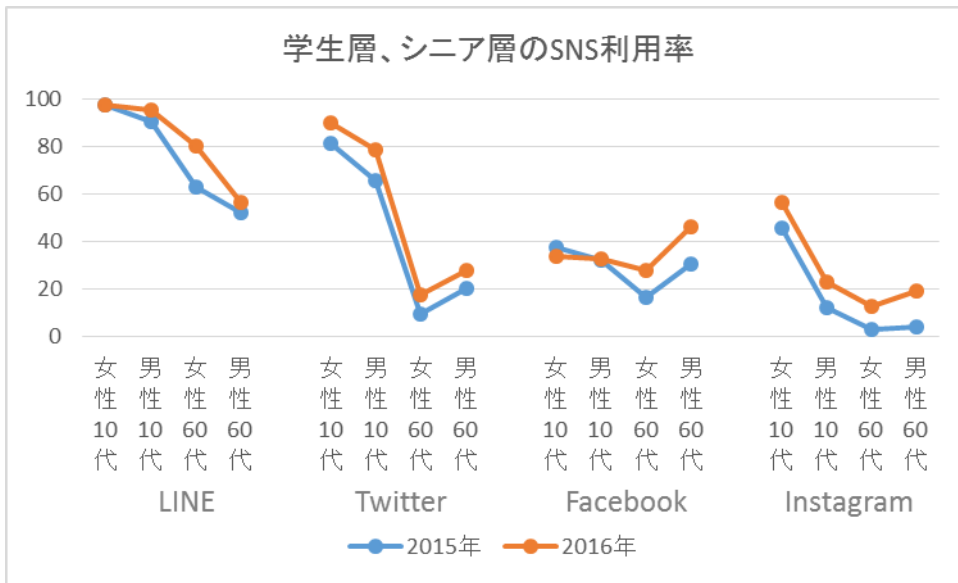
And while SNS is already heavily used by young people in their teens and twenties, but the utilization rate for seniors has been noticeably increasing in the past year. While many senior citizens are new to using smartphones, and have just scratched the surface when it comes to their use, but they also have a strong desire and enthusiasm to understand and master their use. SNS is not only about communicating with family and friends, but it is also used for exchanging ideas about one's hobby and sharing photos one has taken. Seniors will find many new ways to use SNS to meet their needs and many are more than ready to take up this new challenge.

In addition to SNS, new trends have been detected in senior citizens' increasing use of mobile systems. For example, usage of wireless functions of smartphones and tablets by senior citizen males, such as WiFi Bluetooth, and GPS, has been increasing at a faster

rate than other age groups. In addition, the use of smartphones for internet shopping has been increasing greatly. Additionally, male senior citizens show a higher interest in using future mobile applications, such as connecting mobile networks to smart houses and smart cars, when compared to younger generations.
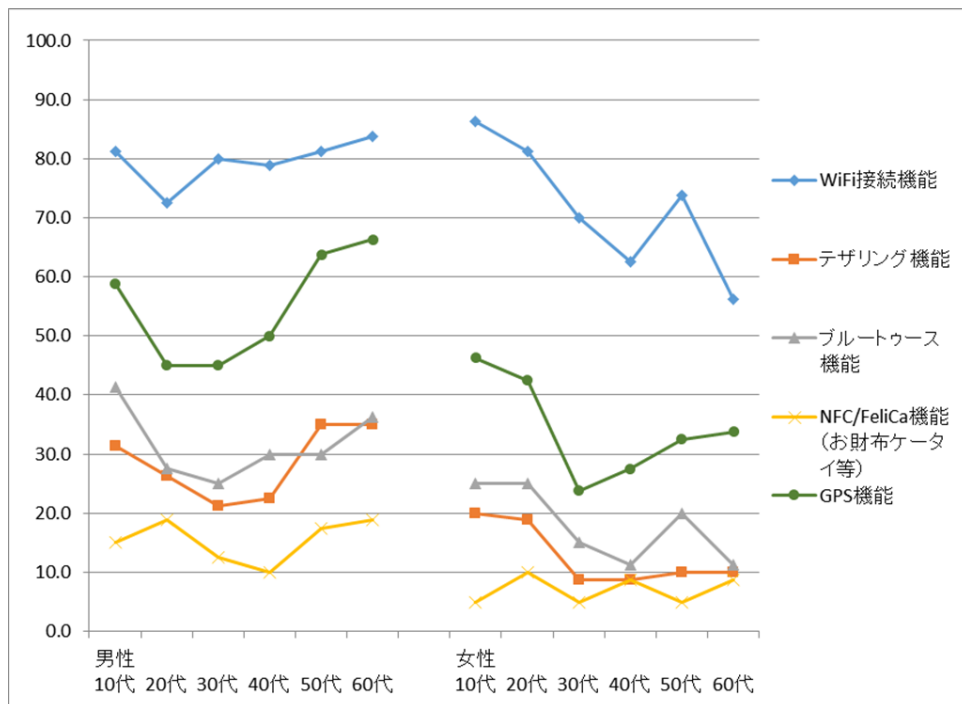
It can be said that this data completely overturns the image of senior citizens being passive in the face of new ICT services. We can look to Taiwan to see where mobile trends for senior citizens are going. It is well known that Taiwanese are active, cutting edge users of mobile. One big example is SNS usage, which is much large in Taiwan than in Japan. Senior citizens are also heavy users of SNS, and there are no real differences is mobile use by age group in Taiwan. Although seniors use LINE for day to day communication, it is not uncommon to have a variety of SNS apps installed on their devices to talk with acquaintances abroad. It is believed that Japan will be the same in the near future, with differences in the uses of mobile phones being dependent on age being erased as senior citizens begin using a variety of mobile services on a daily basis.

Based on this knowledge, how the next generation mobile network is envisioned for the near future needs to be changed. Up until now, the youth were seen as the prime movers of mobile phone progress. However, in the new mobile society, senior citizens need to also be included in the category of expected heavy users. This will have a profound effect on proposed mobile applications to be used on the next generation mobile network. Applications that meet the needs of senior citizens, starting with SNS and including but not limited to heath care services, fintech, smart cars, and robots that support seniors' daily lives, will increase in importance. In fact, the next generation mobile network's "killer content" may come out of one of these. Even for games and other content services, that senior citizens are also heavy users will have to be given more heavy consideration than what was conventionally thought until now.

学生層、シニア層のSNS利用率

SNS Usage by Students and Seniors

Teens　１０代

Q5-5. 今、あなたがお使いのスマートフォンやタブレット端末では、次に挙げる機能を利用することがありますか。
利用することがあるものをすべて挙げてください。（複数選択可）

Which of the following services do you currently use on your smartphone. Please choose
all of those which you use.
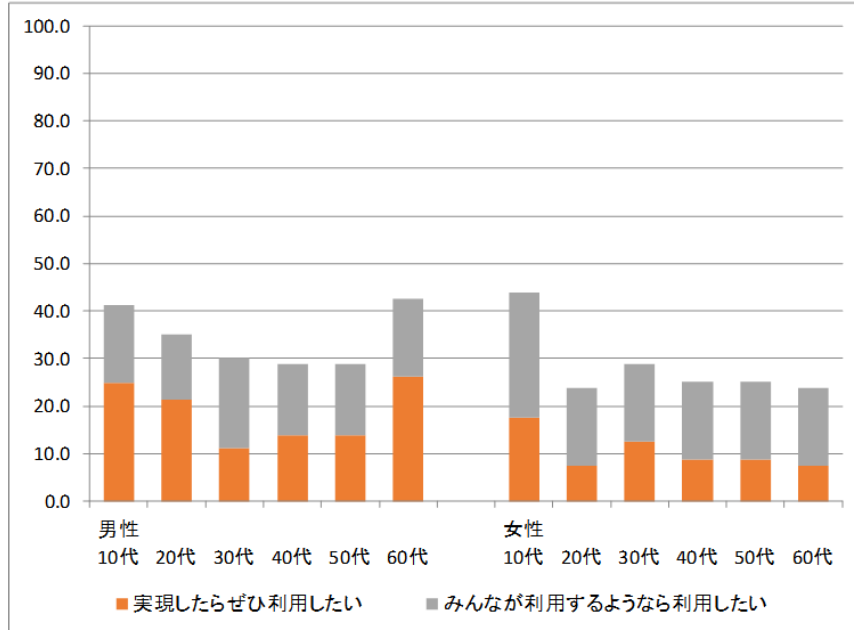Blue - WiFi
Orange - tethering
Grey - Bluetooth
Yellow - NFC/Felica (e-money)
Green – GPS

Intentions on use of the Next Generation Mobile Applications
Q8-2-O Smarthouses connected to wearables that monitor your health

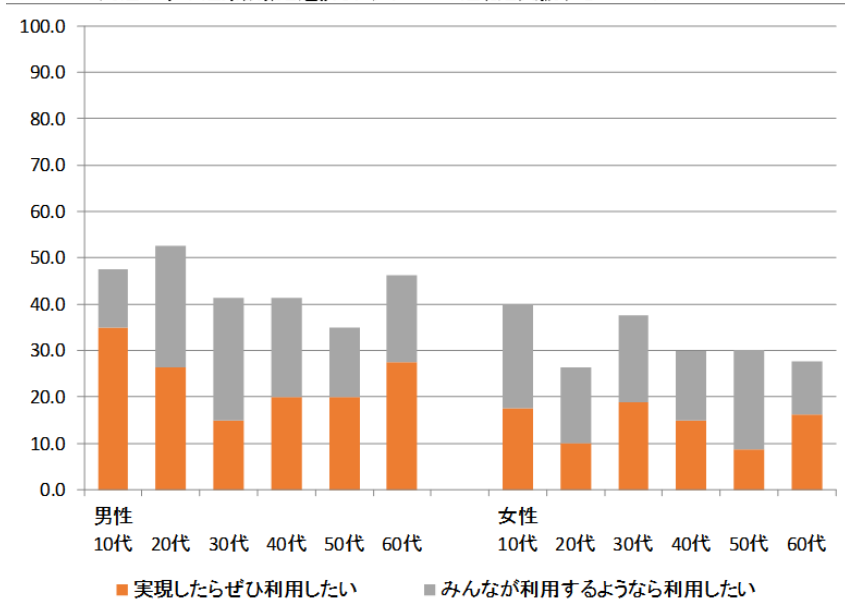Q8-2-9. ウェアラブル端末と連携して、いつも健康状態をモニタリングしてくれるスマートハウス

Orange – would use it if it existed

Gray – Would use it if everyone else was using it

Smart Cars that assist the driver by being connected to surrounding cars and road facilities

Q8-2-12. 周辺の車や道路設備と通信しドライバーの運転を支援するスマートカー

Orange – would use it if it existed

Gray – Would use it if everyone else was using it

3.4. Introduction of the Sharing Economy

  With the advent of 4G technology, it has become normal for people to share content. Among young people, buying and borrowing of things directly from each other has become common as well. With 5G, services dedicating to sharing not only information but real objects will become the norm. The destructive new entrants to the taxi service market, Uber[4], allows for cars to be shared in a neighborhood in a way that is cheaper than taxis.   LINE also began a new service which allows people to discover nearby taxis through its system.   During the Tokyo 2020 Olympic and Paralympic Games, the ban on using private residences for lodging will be lifted so that they can be used as part of the hotel infrastructure.   Once 5G goes online, people will be able to search in real time for objects that other people can lend to them. For example, if someone needs to drive a car, they will be able to look for a car that is available and then borrow it for a specific period of time. (See Fig. 3.4)

  Now, people who are looking for information on something they want use individual auction sites.   With 5G and mobile edge computing technology, the base for this search becomes the edge cloud, allowing people to search the entire world for their needs. Mobile edge computing technology will be the representative service in this sharing age.
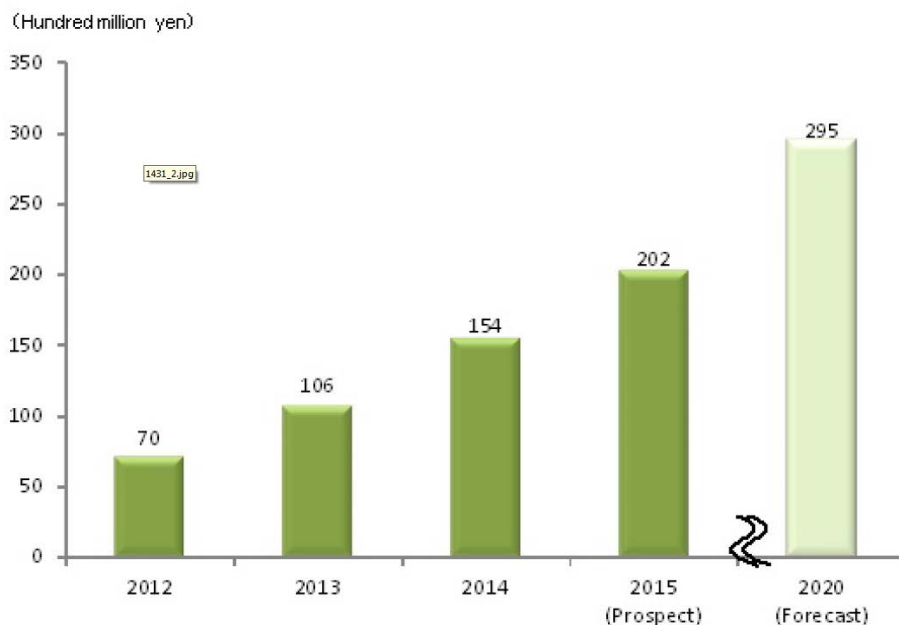

Fig.3.4 Transition and Forecast of Car Sharing Market Size
Source：YANO Research

3.5. Introduction of Artificial Intelligence and Robots

  It has become normal for smartphones to be controlled by voice commands such as OK Google and Hey Siri.   With the increasing ability of Artificial Intelligence (AI) applications, which reside in cloud services, simple conversations needed for information services and telephone help desks can be done by AI. Recently, several companies have started to use humanoid robots. These humanoid robots v will be able to be powered by AIs residing in the cloud as opposed a CPU inside the robot. It is expected that the low latency of 5G will connect AIs and robots, allowing them to communicate with human beings in real-time. It is also expected that, in addition to humanoid robots, specialized household robots to be used for cleaning and daily chores will also become parts of people's daily lives.   In terms of industrial machinery, there are now remote controlled drones and robots.   The ability for cloud based AI to pilot drones will greatly depend on a stable connection to a network, which will be provided by 5G's ultra-low latency. 5G's capabilities will be used greatly as the use of robots become as common as smartphones around the world. (See Fig. 3.5)
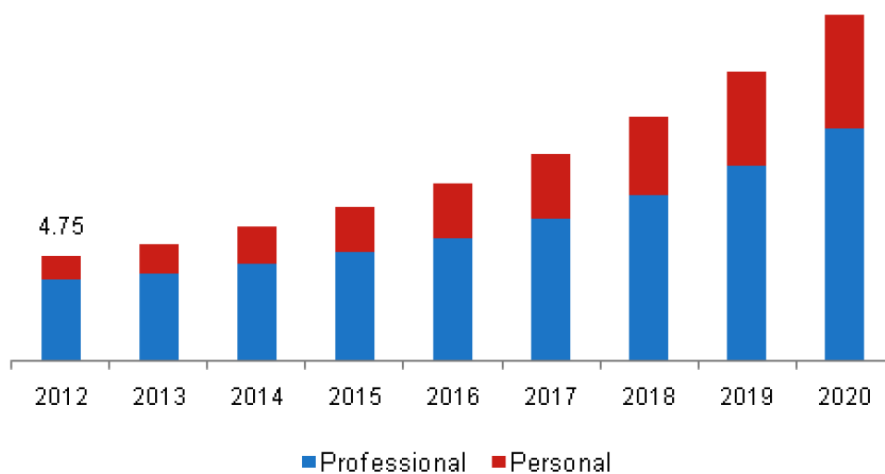

Fig.3.5 Global service robotics market by application (USD Billion), 2012 - 2020
Source : Grand View Research

3.6. Self-Driving Vehicles

  Automated driving can be divided into four levels. Level one is that the car has break assistance or cruise control functions to assist the human driver when necessary. Level four, on the other hand, is that the car is driving itself without any help of the human driver. As the levels increase, the need to be connected to a network increases as well. In the future, all cars will be connected to a network. Even automated driving at level one,

which does not seem to be necessary to be connected to a network to assist drivers, will benefit from being connected to a network which will allows for navigation systems to be dynamically updated and breaks operations to be updated with data about the car itself. Level two and level three automated systems, since they sometimes require the car to drive autonomously, will need to be connected to a network in order to understand local road information quickly and make judgments about the driver and the car in order to make proper decisions. Since these decisions can be made in the cloud, data needs to be quickly transmitted between the car and the cloud, meaning 5G's low latency will be an important factor. In the end, however, any delay in the connection between the base station and the car will not be a concern, since the connection between the data center where information will be processed and the car is expected to be an end to end delay guaranteed network.

5G can be used to implement automated driving services in levels one to three. In order to have fully automated level four driving cars, 5G will be used for people who don't drive. For example, a level four automated driving car can be ordered with a smartphone. These vehicles, examples include driverless taxis or elderly care pick up service vehicles, will bring the customer to their destination. While enjoying the drive to their destination, the customer is then freed from operating the car and can enjoy the free time provided to them on their trip. (See Fig. 3.6) From 2020 when automated cars will be allowed on expressways, the organizations that manage expressways may provide automated car users with entertainment such as films to enjoy during their trips, a car moving on an expressway, in order for a 4K movie to be delivered, will use 5G handover services.   In these ways, the commute time inside automated cars will also utilize 5G services.
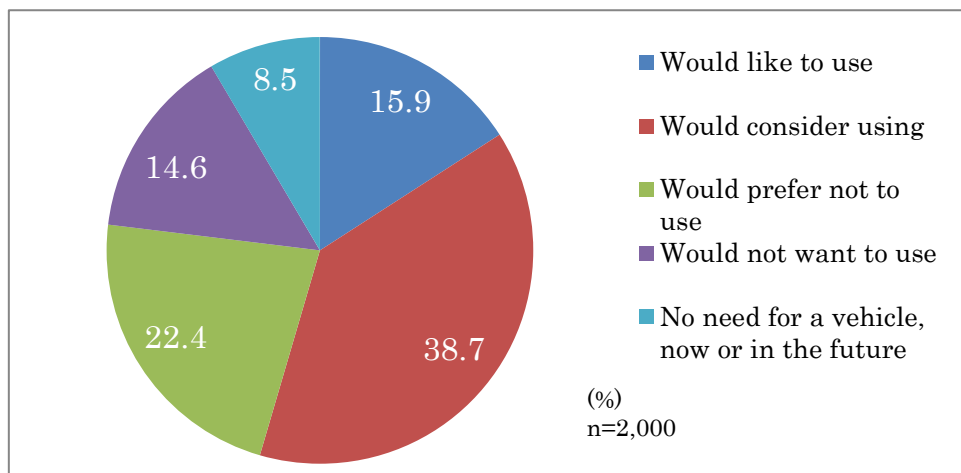

Fig.3.6 Intention to use autonomous vehicles

3.7. Internet of Things (including industry, wearables, and agriculture)

The Internet of Things (IoT) will be one of the foundations of the 5G, but a large amount of objects will not be directly connected to mobile networks via 5G, but they will be connected by a mix of radio services. For example, NB-LTE (Narrow Band LTE), introduced with 3G, can provide 5G IoT-like services. Active Tags, BLE (Bluetooth Low Energy), and Wi-Fi will all provide access points for other IoT services. Germany has proposed an Industry 4.0 with an ICT that is engineered for industry. This does not mean only factories, but for a whole global supply chain, from procuring raw materials to completing finished goods, all tracked in real time. In this situation, the location of goods, whether on container ships, trucks, or trains, and where they are going will be known using the power of 5G. Active and passive RFID tags will be placed on both raw materials and finished goods, with access points on individual pallets and containers, all connected by 5G.

As for individuals who use Bluetooth keyboards and headsets, as well as smart watches and other devices that have the ability to track vital data, these will be connected to 5G through smartphones. These wearable devices will be connected to 5G smartphones and will be working in tandem with Bluetooth devices in order to collect and store data in the cloud, which can be used with cloud based applications. (See Fig. 3.7)

Currently in the agricultural industry, which is driven mostly by manual labor, ICT has been used to mainly expand the number of sales channels. That can now be expanded in order to increase productivity, by setting up field sensors to track variables such as the composition of the soil, moisture and rain levels, and solar radiation. In addition to keeping track to this data for planting, this information can be used when selling products, thereby adding more value to the crops. 5G will not be left out of these IoT devices, as well as it will be used to connect the various field sensors together.

There are many uses for IoT, but there are major differences in how people use IoT versus how people use smartphones and mobile phones. IoT systems should have a longer life for two aspects. First aspect is that IoT system should have longer life as the wireless systems. ICT often changes, and 5G will eventually change when the next generation comes along. However objects connected to the IoT by 5G services do not follow this lifecycle. They will have backward compatibility from 5G back to 4G, and will be able to connect to the next generation mobile system, as well. Another aspect is that objects connected to the IoT should consume very low energy to work in the environment that IoT will be deployed. IoT objects may be deployed in places that

cannot access a stable power supply of 100v/200v, and so they will need to run on battery power.　In this instance, 5G modules will have to be minimized in order to conserve power.
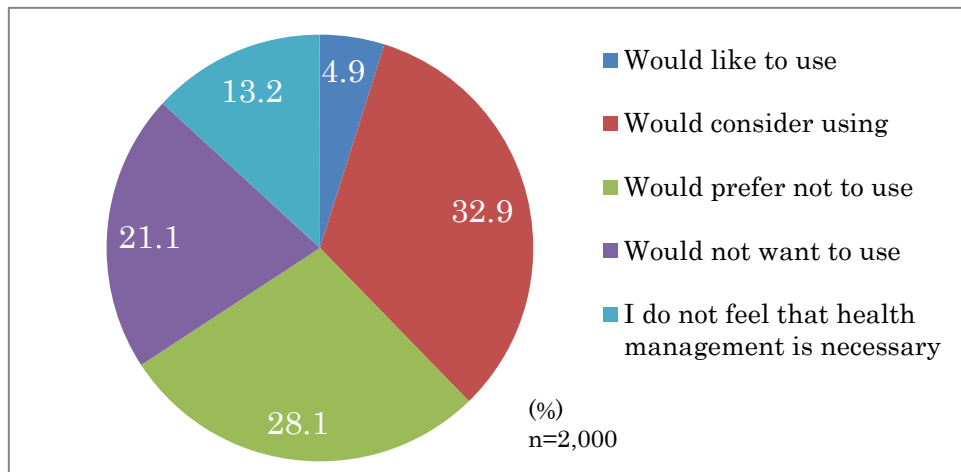

Fig.3.7 Intention to use health management services that rely on wearable devices

3.8. Changes in the Work Style

Holding video meetings and connecting to people via email is now possible with the Internet, so the need to live in urban areas has decreased. Additionally, there is no need for office managers to assign individual desks for each person. As mobile networks are established, this kind of work environment will increase, leading to large changes within companies.

In an aging society, many people will need to assist their elders, meaning many people may be required to leave a job to take care of someone at home. The lack of day care facilities for children will also force many parents to reluctantly leave their full time jobs to take care of their children. However, highly skilled workers will be able to use 5G networks to work from home and thus return to their jobs in these situations. In addition, although now it is normal to work at one job for one company, it will become normal to be able to work for several companies using the tools provided by 5G.　These tools can be used to help reverse the trends in Japan towards a society with a low birth rate and an aging population which now exist today. (See Fig. 3.8)

As mobile workplaces using 5G spread, people will no longer need to be at work early in the morning. People will be released from their commutes, using that time to work and relax. This will also affect other industries infrastructure, as well. Since rush hour commuters will decrease, railway company costs for maintaining capital infrastructure will decrease.　Not only railway companies, but roads and office and other large scale

infrastructure systems will be used less than before. With populations continuing to decrease outside of large cities, a new Japan can be built using mobile networks that avoids this increasing centralization of people in cities.
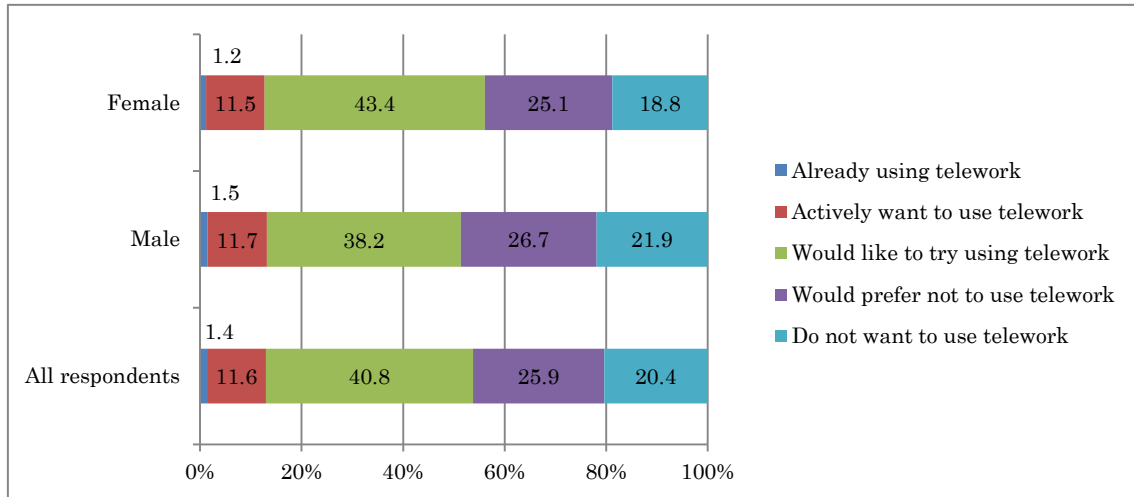

Fig.3.8 Intention to use telework among employed people (by gender)

3.9. Acceleration of Fintech Services

Finance and technology companies are working together to provide new financial services for both individuals and companies. These services include those for payments, remittances, asset management, investments and lending. On the technology side, AI technology such as distributed financial transactions using blockchain technology and AIs using deep learning are moving ahead. Blockchain technology will not only dramatically decrease the infrastructure costs for financial institutions but also create opportunities for new, unknown services and players to appear.

Once 5G is established, mobile payments and mobile remittances will be a part of everyday life as the use of paper money will continue to decrease. 5G infrastructure, build to withstand any disaster, will be able to continue to function, and with these services will allow donation money to be collected and sent directly to disaster areas, benefiting those communities in need. Additionally, AIs which are analyzing equity investments can be contacted any time, acting as investment advisors, on mobile devices and any changes in the investment environment can quickly be relayed to the investor and adjustments made accordingly in real time. This advice can be acted on in real time, with 5G's low latency, though an individual's device, providing positive benefits to individuals.

3.10. Penetration of Peer to Peer Service

From 2001 one major change in the high speed broadband internet was the quick rise of peer to peer file sharing software, like BitTorrent or Winny, and with it a corresponding rise in broadband traffic. More recently, virtual currencies using blockchain technology like bitcoin have not only impacted financial services, but also the greater field of IoT devices, smart contracts, copyright issues concerning digital rights management, and authentication processes.

Blockchain technology is an extension of peer to peer technology, consisting of nodes that use a consensus system in order for each node to act on its own. For example, one use case is the deployment of a large amount of IoT sensors. Each sensor is connected to the client server by a contract agreement, but each node can act independently, increasing efficiency while decreasing overall system costs. These multiple nodes can work together, becoming the building blocks for a stable 5G network, creating a situation where the computer and network are not separate but are acting together as one.

Note

[1]   Facebook

A social networking service on the managed internet provided by Facebook, Inc.

[2]   Instagram

A free online mobile photo-sharing, video-sharing, and social networking service developed Facebook.

[3]   LINE

A social networking service provided by LINE Corporation.

[4]   Uber

A car allocating website and application provided by Uber Technologies Inc.