Revolutionizing Land Survey in the 5G era

Kim Muni, Republic of Korea

SUMMARY

5G is the next generation mobile communication which is under standardization work worldwide.
Data transfer speed will be 10 times much faster than 4G, which is being used nowadays, so hologram and virtual reality are expected to become commonplace in the next few years.
International Telecommunication Union (ITU) describes 5G as providing up to 20Gbps data transfer speed and at least 100Mbps everywhere.
Anyone can download a super high-definition(UHD) movie within 10 seconds.
The official name of it is "IMT-2020" and is aimed to be commercialized globally by 2020.
The reason why all ICT companies compete to develop 5G technology is
because 5G serves as the basis for everything in the coming IOT (internet of things) age.
ICT will be applied in all IOT industries.
The fourth phase of the Industrial Revolution, in which all industries will converge through ICT, is underway.
Land surveying is one of the fields that will surely benefit. If surveyors want to show the situation at the time of survey, they can use hologram or AR(agmented reality) the land owner who is not present at that time.
In that cases, lots of data should be sent and the data latency rate must also be lower.
The more the capacity is increased, the clearer the quality.
To this end, a very fast network is needed and 5G will make it possible.
In 5G, the feasible technique can be divided into first AR, VR and second IOT.
In places where surveyors have a hard time because of poor survey environment such as those surrounded by a mountain or sea, the construction site can be accessed and analyzed, using virtual reality and augmented reality.
Land owners can find the survey records, as well as work and discuss any questions with the surveyors in real time through AR,VR such as hologram.
5G communication technology can also make IOT technology possible, because it can handle a big amount of data.
Add Cadastral control points to the "Beacon", which is a representative of the IOT, and it will mean shorter time for surveyors to look for particular points. Moreover, whenever the land is covered with snow or dirt, or even if it disappears, the surveyors can still get the latest records in real time.
The purpose of this study is to describe the prospect of an advanced and revolutionized survey environment under the 5G environment.

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1. INTRODUCTION

<figure 1. 8 function of 5G performance defined by ITU-R, A Study on the Development of 5G Telecommunication Technology for Telecommunication Society in Korea.>
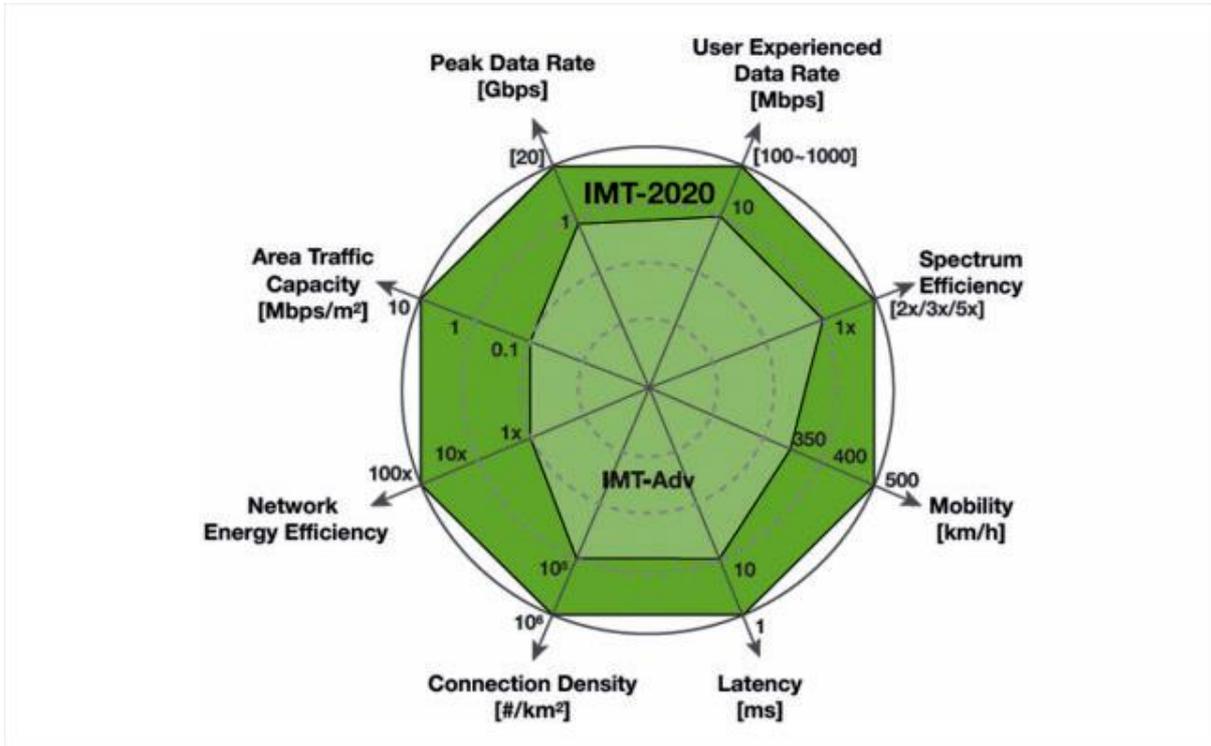
5G is the official name of the fifth generation mobile phones appearing next to 4G.

Anyone can download a high-definition movie within 10 seconds. Above all, with faster transfer speeds and less delay in communication, 5G era will make it possible for hundreds of billions of devices to be connected to a network, and for making the real IOT environment viable . The scope and scale of the internet will surprisingly expand if 5G technologies are utilized. Sensors will be able to get installed throughout cities and monitor the environment, air quality, quality of service, etc and the collected information will be instantly relayed to people. Also, a sensor that can detect fire, even if it is installed in the forest , will be able to alert the person in charge of an emergency situation immediately.

So, how does this technology affect the land survey environment?

The purpose of this paper is to explore the evolution of the next-generation 5G communication paradigm and how this can change the survey industry environment.

The data capacity of 5G which is the next mobile generation is about 1,000 times faster than 4G and 200 times faster than LTE mobile communication.

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In the future, there will be a growing variety of real-time multimedia services such as augmented reality, virtual reality, and real-time on-line gaming.

The provision of a low-latency 5G wireless communication service is essential to enable users to experience natural interaction.

The objective of this paper is to discuss the impact of the next generation of 5G technologies on the survey environment.

2. MAIN SUBJECT

2.1 Business related to 5G technologies in LX.

2.1.1 Terms and Definitions of AR, VR and IOT.

AR : Augmented reality allows the user to see virtual objects in the real world.
In other words, it is a type of virtual reality technology that combines objects in a real environment with virtual components generated by computer graphics techniques.

VR: Virtual reality is something that does not exist, but is actually a computer simulation of senses, such as vision or hearing, touch, to make users feel as if it were real.

IOT : Household appliances, electronic devices , remote meter reading, Smart Home, in various areas, can be networked to share information.

There are specific IOT research and development technologies under LX company, which is currently conducting research such as the following:

2.1.2 Beacon boundary mark.

<figure 2. LX report, A study on the management of boundary mark based on the IOT.>

Once boundary mark is installed through the cadastral survey, it should be managed by land owners.

However, it gets damaged or swept away frequently after installation.

This will result into financial burden due to duplication of survey application,since the boundary mark has disappeared. To improve this, LX is conducting a research project on the possibility of attaching a beacon sensor to a boundary mark.

The landowner can thus determine (or find) the location of the boundary mark attached to an IOT sensor using a smartphone app.

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Lots of sensor data transmitted in real time enables management and monitoring of the status of the transition point from the IOT boundary mark, storing various information on the LX's server, which in turn can be utilized for various surveys of big data analysis.

By improving the boundary mark using IOT, landowners can directly control the land boundary. It will reduce the incidents of having to repeat a survey application, so the national economic burden can be lowered by minimizing the loss of boundary marks, and land disputes.

2.1.3 National point number sign management.

<figure 3. LX report, A study on the management of boundary mark based on the IOT.>

The proposed system aims to unify the location indication system for areas where there are no police and fire organizations.

Marking the national location positioning system will make it possible to mark all areas including cities, mountains, seas, and farmlands.

Due to the characteristics of national point number, it is difficult to manage the sign of national point number because it is distributed sporadically and the access is not easy.

For example, when the sign on the hiking trail is destroyed or lost, it can be difficult to ascertain the facts without the voluntary reports of hikers.

So, it is likely to be left unattended because it is no longer useful. However, this would prove to be disastrous. In case of emergency, the position of the structure should be controlled precisely because it is an important information.

In general, boundary marks are in square shapes. But, having them in cylindrical shapes inserted into the post sign, would be a better design. With the said design, the central system can record the status of the boundary marks in real time

So, administrators will be able to send their staff to reinstall or take any appropriate action, in the case of any damages.

2.1.4 Busan port real time measurement system.

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<figure 4. Real Time Measurement and Height Measurements of Busan Port Bridge
IOT service.>
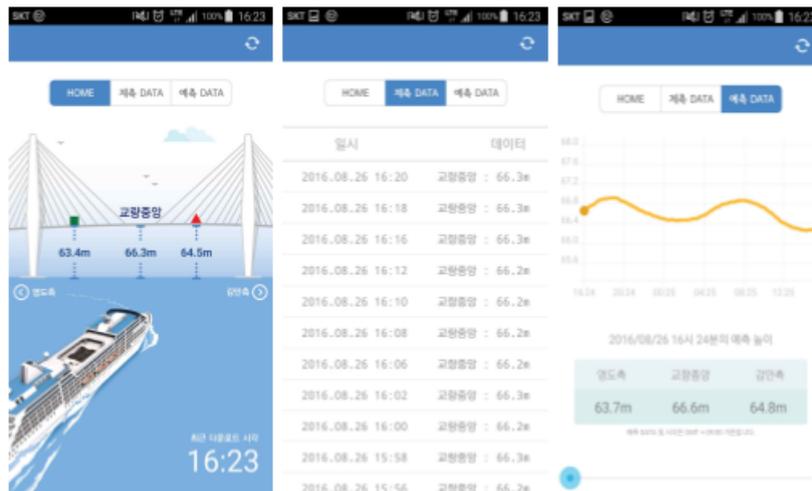
Once real-time sea levels are measured, the information will be updated on the a cloud system. This will greatly help the ship's entry and departure control centers and its captain in their decision-making.
By adjusting the height of Busan Harbor Bridge, LX will be able to significantly contribute to the cruise tours in Busan which in turn can improve the local economy.

2.2 The influence of 5G in land survey

Let's look at the flow of the unified network configured for the field and the office, surveyor with 5G technology.

<figure 5. Unified system.>
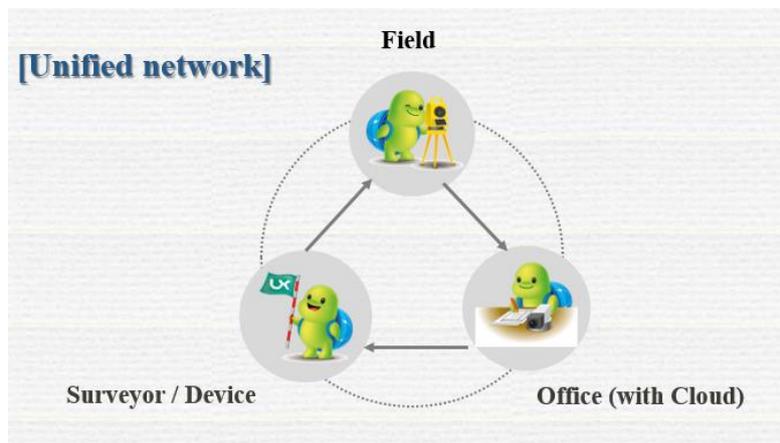
2.2.1 Field

The various features which can be implemented in 5G are as follows:

First, an autonomous vehicle guides the surveyors to the fastest and most precise route to the intended destination ,enabling them to arrive at the site on time. It is possible to collect various spatial information available on the road to the site such as the status of deterioration and repair of streetlights and telephone poles, the condition of areas to be surveyed, etc.

After arriving at the site, locate the cadastral control point which has a beacon via the smartphone app. 5G communication technology increases the amount of data available, so it makes IOT possible.

Add Cadastral control points to the "Beacon", which is a representative of the IOT, and it will mean shorter time for surveyors who are looking for particular points. Moreover, whenever the land is covered with snow or dirt, or even when it disappears, the surveyors can still get the latest records in real time and maximize the efficiency of the work environment.. And it will reduce the manpower required for finding cadastral control points during an investigation in the field.

Big data is secured through the Cadastral control point and boundary mark with a beacon, can be used in analyzing spatial information as well as in surveying records of time-series analysis and environmental consulting. Errors in construction and anything which may result to financial damage will thus be prevented.

After surveying, landowners can manage the boundary marks through smart phone independently, and can determine information regarding temperature, humidity. The loss of any information can also be checked in real time.

2.2.2 office

Having a cloud system, the office can simultaneously and efficiently manage monitoring systems, allowing an easy and systematic management of all information that can be obtained at the site, such as floating population, weather, temperature, movement of car, and survey field location etc. This allows surveyors to provide necessary warning alarm, data storage, and data analysis.

2.2.3 surveyor

Furthermore, both the surveying instrument and the surveyor can receive the same information in real time.
Land owners can obtain land information with high percentage of accuracy, even before a survey is completed.
Moreover, any revisions of the survey report can be made soon, owing to the landowner's prompt feedback.

2.3 SWOT analysis.

2.3.1 Strength

-Our technological imagination can be real.

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-Surveyors do not have to be physically present in dangerous field environment.
-Every kind of disaster can be predicted and disaster prevention will be improved through survey. (for example : regional flood safety)
- Survey can be administered precisely even in so-called inaccessible areas.
- Survey results can be corrected, and stored systematically.
- Efficient information transfer is possible between surveying machines.
- Regardless of external factors (weather, season etc), it is available to update new information continuously.
- It is possible to produce survey information which are low-cost, precise, and retrievable.
- can help in making decisions concerning future investment based on stored information.
-It will be able to meet the needs of the land owners' high demand for up-to-date and accurate information.

2.3.2 Weakness.

- The number of days needed for research,as well as the development costs and human resources required, are unpredictable.
- Workforce may be reduced due to the development of high-tech equipment, causing unemployment problem.
- Lower utilization after development, due to some limitations such as battery problems.
- The reduction of business opportunities of public institutions such as LX owing to its availability to the private sectors.
-The constraints and limitations of technology especially in communication networks.

2.3.3 Opportunities

- Shortening time for surveying.
- Expanding the survey capability of one person (i.e. just One person can do a survey , without the help of others.)
- Increased satisfaction of land owners after surveying.
- Land owners can increase their understanding of the field conditions and the result of surveying.
- It is possible to produce survey information that will form the basis of national policy and decision-making.
- Increasing the prediction of risks on the field.
- It is able to produce high-precision digital maps and it can help in the operation of self-driving car.

2.3.4 Threats

- Lack of infrastructure to utilize AR,VR and increased waste of money and management.
- Required cooperation among related agencies.
- Need to develop technology-related laws.
- Inability to gain global competitiveness due to an apparent failure in developing human resources.
- Malicious hacker.

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3. CONCLUSION

Through this study, we explored how the survey environment industry could change in the context of the 5G next-generation communications network.

In conclusion, let us keep in mind the following points.

First, to keep up with the Fourth Wave of Industrial Revolution, the nation needs to systematically respond with a vision to the development of a new technology ecosystem, and to enhance and maintain a platform ecosystem in which public and private institutions, and their corporate partners can freely share and utilize data and services.

Second, we need to focus on building a professional knowledge system based on practical knowledge rather than on theoretical one.

Third, since standardization is essential to enhancing the interoperability of each subject, it is imperative to systematically approach the safety and security of IOT.

Finally,we have to come up with specific countermeasures along with the introduction of flexible regulations.

Now, indeed,is the time to prepare for the future technology and society of survey industry.

We have to be ready for the future generation of new technologies centering on 5G.

With the potential to be combined with many new technologies, it is expected that tangible results will be produced in relation to surveying.

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