

New Cadastral Surveying Process Based On Wibro Communication

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Key words: Totalstation, Smart Station, RTK-GPS, Many-to-Many, Wibro, Zig-bee

SUMMARY

The usage of information technology for cadastral surveying should be improved to the most effective method. As the result of this study, the current process may be shortened considerably to create new profit when the new communication technology is applied. Therefore, for such profit creation, the process improvement solution for the field of cadastral application of communication system used with total station, GPS operation software, Network-GPS, Ntrip, Wibro and Zig-bee, among the applicable solutions for cadastral surveying field with the recently used latest communication technology. In conclusion, the conceptual process establishment and task processing for current cadastral surveying working processor may be simplified as applying the information technology.

Especially, as most of current cadastral surveys are consisted of the total station, GPS, and the CAD-type software which controls and measures them, they apply the primary information technology, and depend on the 3 voices of observer, leader and computer operator for shape editing and Geo-Coding processing. As the wireless internet based Wibro communication is applied for this working processor, the mutual processing could be applied with wireless internet. As the software was developed for the cadastral surveying processor improvement, the geo-coding was improved and the working phases of field cadastral surveying work, and above all, various reasons for difference could be decreased.

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1. Introduction

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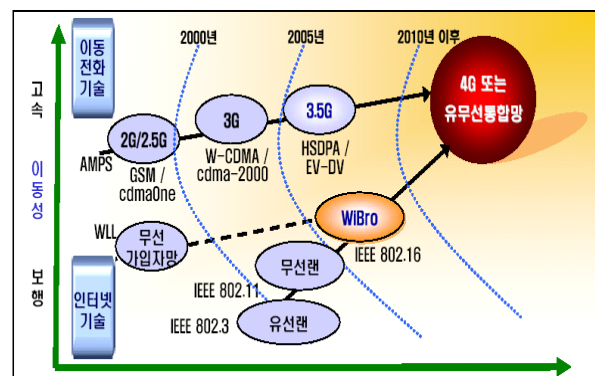


Fig. 1 Wireless member's network

could be applied with wireless internet. As the software was developed for the cadastral surveying processor improvement, the geo-coding was improved and the working phases of field cadastral surveying work, and above all, various reasons for difference could be decreased.

2. Application of new communication to the surveying technology

Currently, the internet, mobile communication and GPS have been a part of usual. Especially, the application of GPS has changed the fundamental philosophy of surveying work for classical surveying method as well as the accuracy. Therefore, such an improvement means the type of work with time zone rather than the setting up of existing geometric position, which means the surveying system around teamwork is changed into the pattern of establishing the personal surveying performance. The

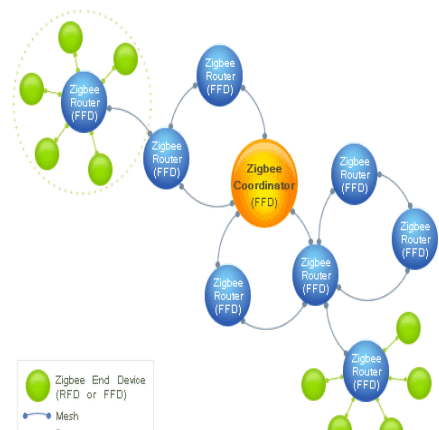


Fig. 2 Wiress Networks

WiBro technology which was developed in Korea as the first time in the world has been selected as the international standard for **3rd generation mobile communication**(3G) and the applicability of WiBro technology. Especially, in the Radio-communication Assemblies of International Telecommunication Union held in Geneva, Switzerland, the WiBro technology(official name: OFDMA TDD WMAN) was selected as the standard of 3G(IMT-2000). This WiBro communication, which is the abbreviated word of Wireless + Broadband Internet, is used as **Mobile WiMAX** internationally and is the wireless communication service which is available with wide range internet connection(upward 5.2Mbps, downlink 25Mbps). As many countries are competing hard for the initiative of post-3G mobile communication technology, the post-WiBro technology is next generation mobile communication such as 4G, etc. Since the WiBro is the technology which already applies the core technology including OFDMA, MIMO, smart antenna, etc, it is considered to be evolved as 4G technology naturally. Especially the selection as 3G standard for WiBro made the circumstance for the mobile communication business around the world which are preparing for the 3G service with that to introduce the WiBro as well as **HSDPA**, CDMA 1x EVDO, etc. in the 3G frequency band. As the WiBro technology has been recognized with its priority of efficiency than its competitive technology, HSDPA, it is expected that the companies which are selecting the HSDPA for 3G service would introduce the WiBro decisively. And this is considered to act as the opportunity to preoccupy the early WiBro market for domestic companies which have led the WiBro commercialization as prolonged to the WiBro introduction over the world.

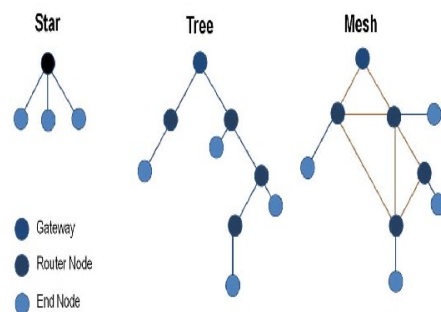


Fig. 3 Mesh Network

As the X-bee is one of the wireless standard which set up the wireless network for operating the light□ Securities for household or offices, the small electricity consumption of connection equipments is its feature. The electricity consumption of X-bee equipments is so small that it may be used with 2 AA alkaline batteries. The X-bee system is the post-technology of 'HomeRF' which has been removed in this January officially, and is conjugated with 'HomeRF light' and 802.15.4 technology. It uses the 802.11b or 2.4G GHz frequency range as same as wireless telephone, microwave oven, etc, and it may connect 255 equipments for each network. It may transmit the data with the speed of 250Kbps within the radius of 30m. Though its standard has not been confirmed yet, the companies for cellular phone and parts, which focus on the low energy consumption and low cost, have led the development. As the Zig-bee is the Data Communication Protocol and RF is the alias of wireless equipment and focuses on the simplicity rather than the complicated technology such as high-quality voice communication or multimedia. On the other hand, the wireless data research group prospected that the demand for X-bee-related products would be raised to the level of 6.2 million units (US\$ 1.3 billion) in 2007 from .41 million units (US\$ 1.3 billion) in this year. X-bee is competed with the other wireless network standards such as bluetooth, Wi-Fi,

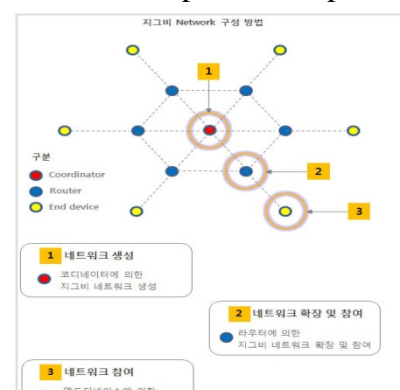


Fig. 4 Zig-bee Network

UWB, etc. Zig-bee is similar to bluetooth, but the greatest merit is its low electricity consumption which may maintain the battery for more than 1 year and the feature which it does not use high bandwidth. Accordingly, it is dominantly considered as proper for home use than industrial use. Especially, the X-bee is prospected to be useful for light, temperature, air control and security system, and differently from other home network technology, the X-bee may be used just with registration for membership. But what is inferior is its expensive price than bluetooth and slower speed than UWB. The Zig-Bee is the Data Communication Protocol which is operated in the band of 868/915MHz & 2.4GHz on the 802.15.4(LR-WPAN:Low Rate-Wireless Personal Area Network) PHY/MAC base. The meaning of Zig-Bee is the compound word of Zig-Zag and Bee, and it was designed from the scene that the honeybee informs the location of flowers and direction with the pattern of Zig-Zag. The 868/915MHz band uses the BPSK modulation method and has the transmission speed of 20kbps/40kbps each. And the 2.4GHz band which is the ISM band uses the O-QPSK modulation and CSMA-CA channel access method and has the transmission speed of 250kbps. The Zig-Bee is the wireless communication technology which provides the low electricity, micro mini size, low price, and convenience of usage, and it makes the wireless sensor network of large scale available when the Zig-bee telegraphy is connected to sensor. The fields to be used are expected to be the home network & home automation, factory and building automation and health care market, etc.

2.1 Internet-based total surveying system

The existing surveying system is executed as the total system and GPS are independently operated, and it needs the tasks in office such as coordinates modulation and diagram editing procedures for surveyed performance. But as the internet environment has been extended, the system organization for simultaneous share of surveyed performance has been available without spatial restriction. In other words, the text message transmission, 1:1 text conversation and bilateral video call are available as using the mobile phone. Therefore, the surveyed result may be processed in both of field and office at the same time for surveying and data processing. That is, what is monitored in the field may be processed with CAD task in office. Therefore, it is the system which the leader simply contacts to the field and the subsequent CAD processing is executed in the office environment. This system has been tried with X-system developed by Sokkia Co.,ltd. of Japan, and still it shows low availability.

2.2 Linkage of GPS and TPS

GPS has the merit of being free from the spatial restriction and not being needed with assurance of the field of vision with mutual machine orientation. Therefore, the survey is available as moving freely. But with the inaccuracy of performance with the openness and multi-path, it keeps the difficulties for survey in the urban or forest areas. Futhermore, in the case of total station,

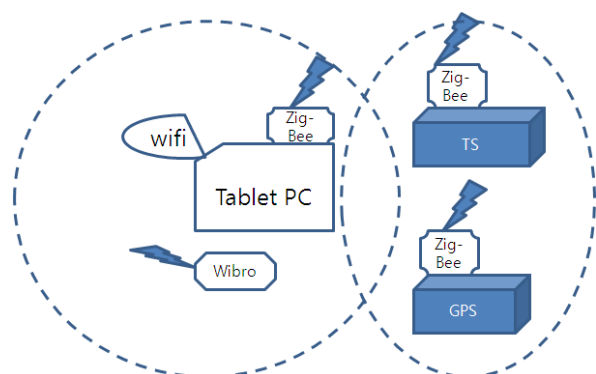


Fig. 5 GPS and TS wiress communication

though it has the high reliability for survey, it requires complicated working process as the spatial mutual communication is needed. Therefore, developing a new system using these merits as integrating two systems is considered. In the case of Smart Station developed by Leica Co.,Ltd., it surveys as integrating GPS and total station physically. such a method of physical supplementing may be mutually connected with the data share by wireless communication.

- Modulation service for Network-RTK survey

The cervus is supported to support the forms such as RTCM, CMR+ for Network-RTK GPS survey by the NTRIP which is the internet protocol. Therefore, for realization of wireless internet to support the wireless internet on the field, the system may be organized to operate the task efficiently. Currently, in Korea, the USB-type modem is supported with CDMA and HSDP, and there is nothing to be concerned for data capacity or speed. Though the USB-type has demerit to be used for laptop or UMPC but the Wibro may be used for wireless internet.

2.3 Survey with voice recognition

Voice recognition is the technology available to be used for various fields, and has been gradually improved with the application especially for medical service, document, and communication field. Sometimes its recognizing speed is sometimes raised as issue, which is the demerit followed by personal voice. But when the previous training program is taken as enough, it would be applied to the field of survey.

2.4 Modulation processing of Network-GPS

Since the Real Time Kinematic GPS surveying method has the features that the location may be surveyed in the field, it is useful for setting up work such as piling. In the earlier, the RTK was the relative location determination system of standard country and moved country, and it was modulated with the UHF communication as limited within 5-10km for the project zone. Therefore, the coordinates for basic point should be entered and yielded before survey. But it is the model which draws the modulation signal as organizing the extensive network for the parts needed with unified yield of occupied point performance, support of power and operation for operation by project units and operating 3 or more standard countries and calculating the distortion model for range of 50~100 km and generating the new virtual standard countries.

<Advantages and Disadvantages of current system and improved plan>

- Current cadastral surveying processor

Korean cadastral surveying processor is mainly for occupied point surveying and detailed surveying, boundary restoration and situation surveying, and for the working process, it executes the occupied point survey as using the national trig point, the occupied point for surveying, and the cadastral supplementary control point, and survey the boundary as the real shape using the random occupied point for the no occupied point area, and then, modulates the coordinates for cadastral diagram file to be accorded. Such a modulation process may depend on the individual proficiency. Such an issue has the structural problem, since the Korean cadastral process used to depend on the paper diagram only instead of field survey for measuring. Therefore, the occupied point is used or the boundary of field is depended to make

the field and the cadastral diagram accorded. Therefore, the individual differences occur and the fundamental reason for this problem has not removed.

2.5 Cadastral surveying processor improvement

To improve the existing survey work system, the currently used surveying equipment and data flow should be designed for the accuracy improvement and simplified processing. For this, the IT should be applied and the new technology should be forecasted and designed as much as possible. Among the various wireless communication methods, the Wibro communication is one of the such an IT and the new information communication technology available to be extended. In other words, as depending on the geo-coding with wireless communication and the communication support between observer and leader, it may be applied for the urban area or forest area which are difficult for survey, as using the wireless communication. That is, it does not depend on the voice for beginning and communication with moving, but it may be substituted with beep sound or message. And when the leader decides and represents as diagram for the type of point from survey and active connection relation, the observer recognizes it as real-time to prepare for next survey. Furthermore, in the case of wireless internet, as various office work may be processed on the field as internet-based, even the telecommuting may be supported. For the organization of such environment, the data system may be accomplished with the standardization available for integration as hardware and standardization available for data integration as the OWI(Open World Interface) type.

As seen on the table, with the wireless communication, various C/S environment may be consisted and the survey process with Wibro communication system may be compatible with control survey and its result physically regardless of the hardware model, and most of all, the TS and GPS may be unified as connected. Furthermore, though the existing interface is used as the type of RS232 cable or bluetooth, in the case of Wibro, the wireless communication is available as wireless internet-based and it supports up to several hundred km of application range (distance). Therefore it may be considered as having no spatial restriction. That is, the data share and task support are available between field and office. Furthermore, it may transmit various information at the same time, and the video processing and voice signal delivery which are needed for cadastral surveying are also available. But when all of those functions are used, there may be restriction for program operation adversely.

Classification	Current	Improved	Remark
surveying equipment operation	TS GPS separated	Integration of TS and GPS	Hardware compatible
Communication method	RS232	Wibro wireless internet Xbee-communication	Wireless communication
Operating method	Depend on Voice CAD	Geo-Coding method	3 person -> 2 person 1 team
Share of survey resource	Post-processing method	Real-time share	Process improvement

2.6 RS-232 Cable existing surveying method

As the most classical method, it is the wireline survey method which uses the surveying equipment and computer as using the RS232 cable, and it controls the surveying equipment as Data Logger or computer software. In the case of this system, 1 or 2 personnel works on it as connecting the total station and GPS surveying equipment with the cable(about 2m). In this case, the data transmission is stable, but the survey should be executed as adjacent always and it has a lot of difficulties in moving. Furthermore, the common survey of multi-processing method with multi-drop of wireless communication or the many-to-many communication of N:M is not available.

2.7 BTS(Blooth Talker System) Method

The bluetooth is available for wireless communication with various equipments and layers. Its merit is short-distance wireless communication and low electricity consumption. And as some of total station, GPS and laptop are applied with this module, the surveying work is available with initializing setup. With the wireless surveying method with equipments in the adjacent distance (10km), there may be the merit of wireless communication, but when the maintenance of connection is disconnected with pairing, the re-initializing work is complicated.

2.8 STS(Surveying Talker System) method

STS is available for analyzing the unique working pattern and programming as using the X-bee communication module and independent PLC, and is the communication type terminal which has been developed by cadastral researcher independently. This equipment is available for multi-survey with wireless communication as connecting the TS and GPS, and it has wide reaching distance to its size and stable communication. With this module, the electricity consumption is low and the cooperative working with multi surveying equipment is available as well as supporting the long distance survey, and simple initialization which is the demerit of aRS232 cable and bluetooth. But the C/S environment setting up is difficult with wireless internet. That is, the simultaneous work by remote office operation is not supported, and it is used for the share and survey of common data within the area of 1km. Furthermore, as using the TS and GPS in common, the improvement of surveying system is available.



Fig. 6 STS(Surveying Talker System)

2.9 WTS(Wibro Talker System)

The surveying method of Client/Server concept using the TCP/IP communication protocol by Wibro communication media is available. In addition, the RTCM modulation and VRS operation with internet, the remote searching of data from the office, and downloading and mailing are available as well as surveying as connecting the office and field by the remote survey with this.

Classification	Communication type	Feature	Remart
RS232	Serial Cable	Stability	TS,GPS divided
Bluetooth	Wireless	Wireless communication	TS, GPS divided
STS	Zig-bee	Initialization/Multi-Drop	TS,GPS integrated
Wibro	Tcp/IP	Client/Server	TS, GPS Integrated survey

3.Cadastral surveying system development of communication technology

The current cadastral surveying is the one-team processing method with the Stand alone method. In other words, it may be considered that it has a lot of matters to be improved for working processor with teamwork.

3.1 Application of Wibro connecting system

The merit of Wibro communication is speed and convenience. Especially, since is may be used without the restriction of wireless communication distance, it may overcome the disable of existing RF Communication and the sharing of voice signal, video and various information. Wibro depends on the communication network companies, and WIFI depends on the computer equipments. As the specification and the equipment models are different by companies in the case of Wibro, and the WIFI includes the Pen-Computer and Pocket-PC inside, the internet may be connected easily. After connected to internet, it sets up the IP address and Port numbers according to the TCP/IP protocol, and set up the approaching path of the form of user group-ID-PW-TYPE as software. The type with approaching path is divided as Master and Slave. In the case of server, it uses the fixed TCP/IP, and setups for management of use and processing of survey result and chatting process among the surveying team. The server may be saved and operated from the side of mobile with Wibro, and may be operate separate server. The mobile is applied for unit working, and when the server is operated, it is meant to be applied for long-term project management. In the field-coding, the PDA or Pen-computer has the merit, and especially it consists to execute the screen structure with multi-touching and processing efficiently.

Instrument	OBS Data	Add. Parameters	REM
TS	S-V-H	Inst-H, Prism-Offset	
GPS	B-L-H	Antenna Offset	
TS+GPS	S+V+H	Inst-H,Offset	

	B-L-H	Prism Offset	
Pen-computer	Reduction and CAD	Layer-Code-Topology	

3.2 System development and composition

- Total station/GPS
- PDA/Notebook
- Language : NABasic 8.0 / Delphi-2009
- Wibro Model : (KT Wibro KWI-82200) of Korea Telecom Co.,ltd.

3.3 Coordinate Transformation processing

It is the produce of conversion parameter with the commons with occupied point with orientation, coordinates of declination and the GPS use. The primitive data becomes the relative position coordinates with the national constant occupied point, and uses the existing performance to yield that. For the narrow area, it may be used simply and practically as separating the plane transformation and height transformation. For the plane, the transformation variables may be yielded with 2 or more points, and for the height, the height for 3 points are needed. Therefore, as assuring at least 3 or more points in common, the orientation work should be executed for the initialization for GPS and total station, and after the orientation work completed, the field work may be accomplished easily with the transformation variables not with the occupied point as joined with VRS. Therefore, the working processor for orientation for occupied point and declination needed by existing surveying processor may be dropped. In other words, it is convenient when the repeated work is executed for regular area.

3.4 Geo-coding

The geo-coding should be simple and clear to respect the reality at most and display it for the field surveying process. Therefore, it is efficient to analyze it into 7 ranges of patterns, and this may share the process of dividing into layer, code and displaying with the feature categorizing method, since it makes the observer and leader share the data with wireless communication. This work is efficient when it is defined previously to shorten the field work.

3.5 Application of Network-RTK(VRS)

For the accuracy of relative location, the modulation signal is to be processed as based on the national constant occupied point. The Network-GPS gets the modulation service, and when the independent base station is established, it



Fig. 7 Wibro and Network-RTK GPS

should use the initialization coordinates as connected to the national coordinates as much as possible. When it is difficult to connect to the national coordinates, the data may be efficient when it is used as transforming to the local coordinates, and the primitive coordinates is post-processed as connected to the national constant occupied point. When this processing procedures are ignored, the efficiency of data is lowered as the data arrangement process is expected to be complicated.

3.6 Coordinate system

The coordinate system transforms the calculation and the performance of surveying into the international and local coordinate system. It manages the transformation variables and transformation coordinates for the entire integration and local coordinates with GPS, and makes the teamwork and the organization of team member and the transformation processing of data maintained with identical coordinate system. Though the cadastral survey follows the procedures for observing and modulating as individual data by range, the efficiency may be raised when it is managed as integrated with international coordinate by the national coordinates as stated above.

3.7 Management of survey resource with Web

It is the evolution of system which presents the survey performance and integrate with Web. Web makes the data shared from anywhere. It displays the relation of project with web operation, phase setup and data relation and consists the flow of work as same as the flow of task.

3.8 Establishment of communication topology relation

The wireless communication should form the pairing of master-servant relationship of data transmission by each equipment as hardware and the pairing of master-servant relationship and sharing system of data as software. In this study, the composition of node or tree as hardware has been composed to receive the mutual data in the method of N:M, and the data share language system was composed for data processing as establishing the topology relation as software. To form the topology relation, it completes the elements as noun, verb and conjunction of language. The attribute for point is the element of noun, and the surveying and orientation are the elements of movement with the observation, and the processing phase conforms to the conjunctive.

4. Field test

4.1 Overview of test

For the test of RTK-GPS geo-coding processing with the internet chatting system support, preferentially, the server program was executed, and the client program was executed as divided into the chatting partner and the data part. It forms the teamwork or establishes the directivity of data according to the name of team. Preferentially, it is about the remote surveying equipment control survey with Wibro communication and the geo-coding processing with server operation.

- Server operation

It operates one server with the TCP/IP protocol, and constitutes the communication among the PDA/Tablet PC as using the Wibro and USB modem or 2 Wibro for each of machine side and display side as using the Wibro from mobile station. The mechanist and leader may be in the side of client, and when it is separated from the office, it is available to operate independently and simultaneously with server. When it is applied with the office simultaneously, all of the members become clients on the field, but just the survey is needed as the teamwork is constitute. As attaching the PDA on the total station and using the TCP/IP protocol with the Wibro, and WIFI function on PDA , TS+GPS and GPS field observation As sharing the total station and GPS observation performance and deciding the operating matter with function key with coding and draw as the performance for point-line-plane.

5.Conclusion

The result from this study raises the flexibility of cadastral survey, which is still included in the legal regulation. And the new technology is bound to be generated, and the application of such new technology may be connected to the national power, therefore the law and system should be supportive to apply the new technology. As such, for more application of the studied result, the technical review should be performed. In this study, the conclusion like follows have been got:

- 1.The communication technology has made the sharing of mutual data, recognition of work processing procedures and the stable processing for surveyed performance with multilateral share system.
- 2.To extend and apply the Ntrip operation with network surveying and the user's offer

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