NETWORK-RTK GPS POSITIONING AND ITS APPLICATION TO MAP PRODUCTION IN JAPAN

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INTRODUCTION

The Geographical Survey Institute (GSI) of Japan has established about 1,200 GPS continuous operating stations throughout the country. GSI began to supply the every-one-second observation data of some stations in real time for the real-time kinematic (RTK) GPS positioning survey in 2002. Since then, the network-RTK GPS positioning techniques has been used in surveying and some other applications.

Fig.1 A GEONET station

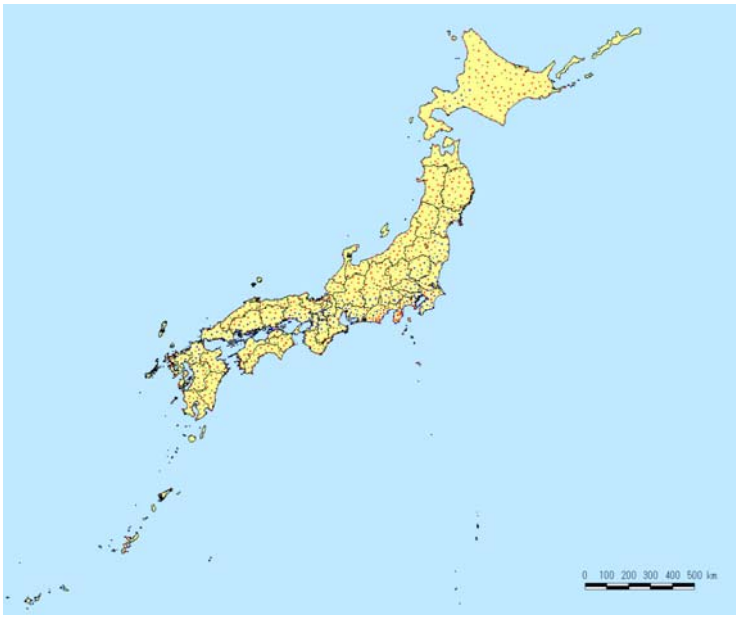

Fig.2 GEONET stations with real time data service

GEONET

The network system of the GPS permanent stations (Fig.1) including data processing and communication established by the GSI is called GEONET (GPS Earth Observation Network System). The purposes of the GEONET are to give control points for GPS survey and to monitor the crustal movement. It started in 1994 with 110 stations in a part of Japan. Today, it is a nationwide GPS observation system with over 1,200 GPS-based Control Stations (Fig.2) and some other continuous operating stations. The RINEX data of the GPS-based Control Stations has been published through website since 1999 and a lot of data has been used by surveyors and cartographers.

REAL TIME DATA SERVICE

In 2002, GSI decided to supply observed 1Hz data for RTK GPS survey so that the position information data, a kind of geospatial information, will be utilized more in a

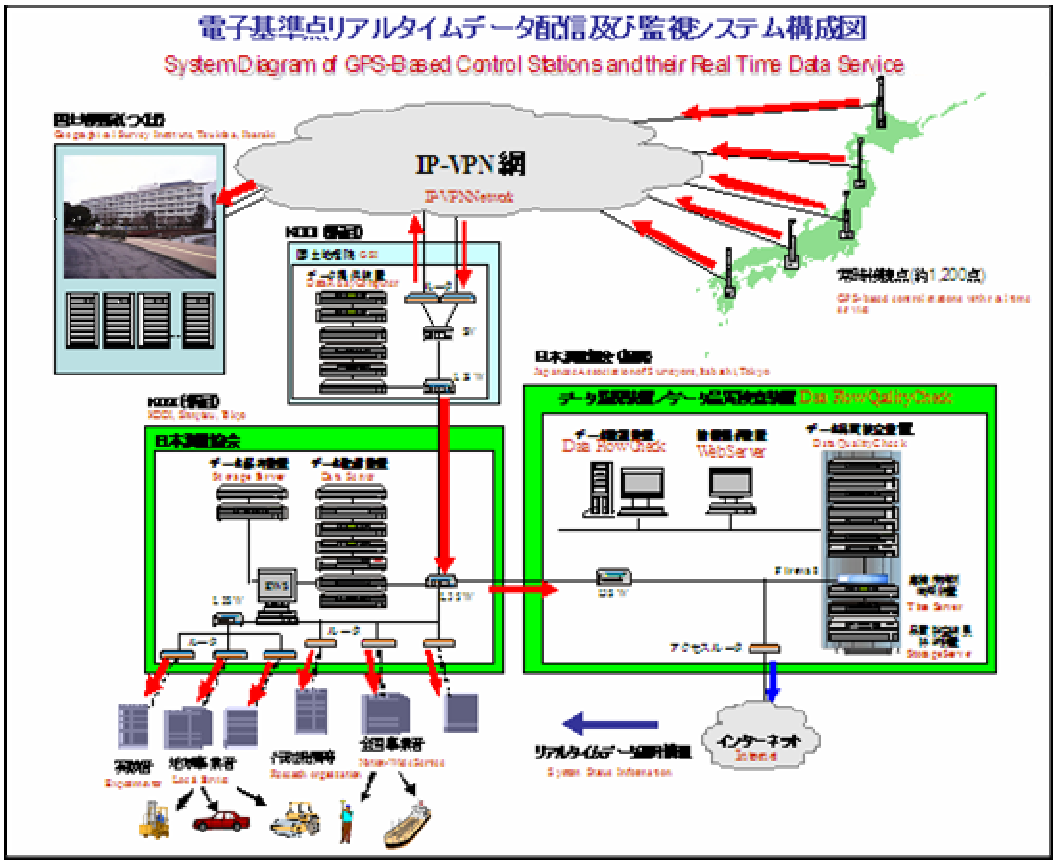

Fig.3 System of the "real time data" distribution service

highly developed information and communication society and authorized the Japanese

Association of Surveyors (JAS) as unique distributor of the "real time data", which is 1Hz data of the GPS-based control stations supplied in real time. JAS started the "real time data" distribution service accompanied with quality checking for a certain enterprisers who are to make civil positioning service (Fig.3). At first, the number of the available GPS-based Control Stations was only about 200 because of due to the limitation of communication, but now almost all stations throughout Japan are available .

NETWORK-RTK GPS POSITIONING

A few enterprisers are now providing the correction data for real-time GPS positioning to end users such as surveying and mapping or civil engineering companies through real-time communication system such as mobile phone under the contract with JAS (Fig.4). VRS (virtual reference station) method or FKP (Flaechen Korrektur Parameter) method is adopted for the correction. The high density of the GPS-based Control Stations is advantageous for the network-RTK GPS positioning to get ionosphere correction and other error corrections from the network, and enable users to carry out precise positioning of centimeter accuracy on site with single GPS receiver.

When the "semi-dynamic datum" is introduced, as GSI is planning in the near future, the crustal movement must be corrected appropriately in the correction data. Present correction data has already corrected and it is proved to be appropriate by GSI (Tanaka et al., 2006).

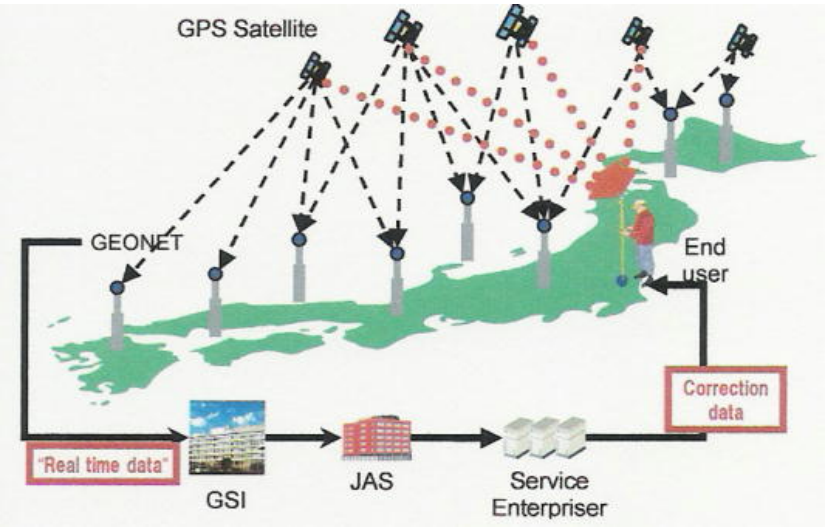

Fig.4 Network-RTK GPS positioning

PRESENT STATUS AND PROSPECT

The network-RTK GPS positioning is rapidly becoming popular in surveying and mapping, especially for large-scale mapping by local governments (Fig.5) and for cadastral mapping. It is effective for precise mapping in a short time and is highly estimated especially in case of urgent mapping after a big disaster occurred e.g. the *Niigata-ken Chuetsu* Earthquake of 2004 (Fig.6). It is supposed that over 3,000 GPS receivers for the network-RTK positioning are used in Japan, 50% of which belong to surveying and mapping companies, 30% to authorized land and house investigators and 20% to others. The network-RTK GPS positioning will be used more because the national government authorized it as an official method of control point survey for mapping by public sectors in March, 2008. Moreover, usage for precise positioning of moving object, *e.g.* measuring vehicle for road mapping, construction equipment which must be exactly controlled, etc., is spreading. Fig.7 shows a snowplow which can excavate invisible road very exactly.

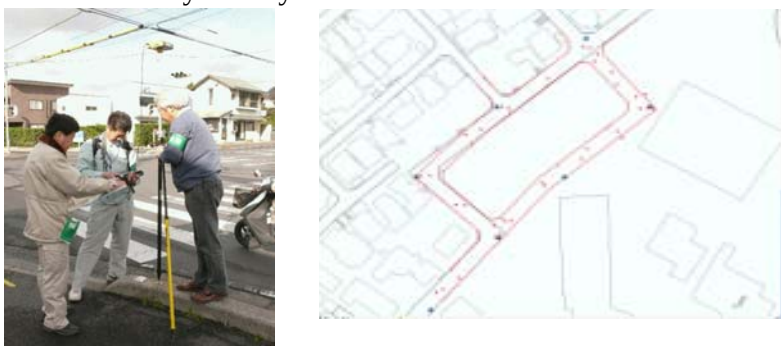

Fig.5　Surveying for large-scale mapping by local governments and its product

Fig.6　Surveying after the *Niigata-ken Chuetsu* Earthquake of 2004

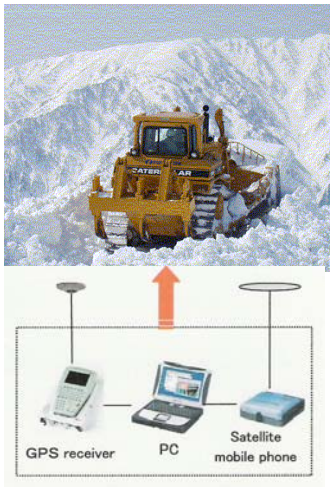

Fig.7　Snowplow system

One of the problem of the GPS positioning is that it is unavailable in a certain city area

because of the blocking of radio waves by tall buildings. As well as the use of the hybrid GNSS receiver (GPS + GLONASS, etc.), the introduction of the QZSS (Quasi-Zenith Satellite System) is expected to settle the problem. QZSS is now developing and it is also expected that various location- based services broadly expand in combination with geospatial information.

ACKNOWLEDGMENTS

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