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QUASI-ZENITH SATELLITE SYSTEM
-A NEW SATELLITE POSITIONING SYSTEM OF JAPAN -

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1. INTRODUCTION

Japan has started a new project of Quasi-Zenith Satellite System (QZSS) in FY2003. QZSS consists of three satellites and will provide a regional satellite positioning service as well as communication and broadcasting services. Each satellite is in three different orbit planes, which are obtained by inclining the geostationary orbit (GEO) by about 45 degree. In this system, at least one satellite stays around the zenith for about eight hours and is visible with a higher elevation angle in mid-latitude area (e.g. at least 80 deg. in Tokyo) than in case of using a satellite in GEO. This characteristic is very beneficial in large cities where there are many tall buildings which block the signal from satellites in GEO. Thus, satellite availability for satellite positioning and mobile communication services is expected to be greatly improved.

Several organizations from government and private sectors cooperate to develop QZSS. The private sector has established a joint company, the Advanced Satellite Business Corporation (ASBC), which will develop and operate the communications and broadcasting system as well as satellite bus system. From the government sectors, four Ministries and their relating research institutions participate in the project and develop the satellite positioning system.

2. OUTLINE OF THE SATELLITE POSITIONING SYSTEM

The QZSS satellite positioning system is planned to be compatible and interoperable with the civil specifications of modernized GPS except its orbit and some experiments, and will compliment and augment the GPS. QZSS, therefore, broadcasts L1, L2 and L5 signals. L2 and L5 signals will have the same structure and characteristics as the GPS L2C and L5 signals. The L1 signal structure is still investigated, since there are many possibilities. Also, an additional experimental signal Lx with a global beam is planned.

QZSS time will be maintained by referring to the UTC(CRL), which is compared to the UTC(USNO) by TWSTFT on a regular basis. The coefficients of af0, af1, and af2, broadcast from the QZS, will be maintained so that users can get GPS-equivalent timing. The aimed accuracy of GPS-QZSS time offset is less than 3 ns rms over any 24-hour period.

QZSS plans to use the ITRF geodetic reference system, which is almost equivalent to WGS84 used by GPS.

The on-board equipments for satellite positioning are developed by Japan Aerospace Exploration Agency (JAXA) and Communications Research Laboratory (CRL). The ground system for this mission consists of the master control station, several monitoring stations in and out of Japan, and is developed by JAXA, CRL, and other institutes. As for the timing system, each satellite will carry Rb and/or Cs clock. In addition, the first satellite will carry an active hydrogen maser which will be developed by CRL in order to demonstrate the technology of Spaceborne H-Maser, as explained elsewhere. CRL also develops the two-way time transfer link between QZSS satellites and the ground system with sub-nanosecond precision.

3. FUTURE SCHEDULE

Concept design of the total system and each sub-system has been carried out in FY2003. Basic deign and manufacturing of the engineering models of the on-board equipment

will start from FY2004. The first satellite is scheduled to be launched in FY2008, and the second and third in FY2009. After three years of experiment, the satellite positioning service is expected to start in FY2011.