

**Title: Experiences with Fugro's Real Time GPS/GLONASS  
Orbit/Clock Decimeter Level Precise Positioning System**

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**Abstract**

Fugro has introduced a new satellite based precise positioning service called G2. This high performance navigation service combines the navigation satellites of both the American GPS constellation and the Russian GLONASS constellation, to produce a composite GPS/GLONASS position solution. With the full GLONASS constellation of 24 satellites expected in a couple of years, GPS and GLONASS can also be used as independent systems. The service utilizes Fugro's own network of dual system reference stations to calculate 'orbit and clock' corrections on a satellite by satellite basis for all 50 satellites of the two global navigation satellite systems, thus providing consistent decimetre level accuracy positioning on a worldwide basis. By using the full range of satellites from both the American and Russian systems, best possible service can be ensured when satellite visibility is partially obstructed. This can occur in equatorial regions when severe scintillations tend to make it difficult to track satellites. The scintillations tend to affect parts of the sky, making it more likely to track enough good satellites when using both GPS and GLONASS. G2 is the first real-time, precise, orbit and clock service using GLONASS. The development of G2 has benefited from the close cooperation between Fugro and ESOC (European Space Operation Centre), an establishment of ESA (European Space Agency). The system comprises about 40 dual frequency GPS/GLONASS reference stations evenly distributed around the world. Raw range data for all satellites are transmitted to processing centers for calculation of the orbit and clock error of each GPS and GLONASS satellite. Correction data is then broadcast to the user via geostationary communications satellites, providing close to global coverage. In the mobile equipment, the orbit and clock correction data is used to improve the ephemeris information read from the GPS and GLONASS satellites providing decimeter accuracy. This is also known as Precise Point Positioning (PPP). Fugro utilizes a proprietary software engine for the mobile position calculations. This software is embedded in GNSS receiver manufacturer's hardware and Fugro's own range of products. The paper presents the elements of the complete G2 system from the reference station network to the user end. Series of test results are presented both from benign and challenging environments, both static and dynamic. Even results from GLONASS-only precise orbit and clock real-time navigation are presented showing the full potential of GLONASS as an independent positioning source for DP applications.

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