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Feasibility Study of Satellite Data Transmission for Space Geodesy through the TCP/IP link

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1. Objective

To evaluate the feasibility of the GPS and VLBI data transmission using satellite communication through the TCP/IP link from Fiji to Japan.

2. Background

There are some geodetic and geophysical importance's in the South Pacific including the Fiji islands. The monitoring of the plate motions and sea level changes in the South Pacific is very important to be aware of natural hazards. In addition, the sea level change is also important to monitor the orientation of the Earth. The space geodetic measurements using global positioning system (GPS) and very long baseline interferometry (VLBI) have been carried out in order to detect the earth's orientation changes and earth deformation on global and regional scales.

Unfortunately, there is no VLBI station in the South Pacific. Therefore, the position coordinates of GPS stations in the local GPS network are not tied to the global reference system with sufficient precision. The local tie between a VLBI station and the GPS network is indispensable for high precision monitoring of the sea level change. We are now developing a compact VLBI system with a small antenna and Gigabit data sampling system to perform real-time Gbps VLBI observations at anywhere (e.g. the small islands in the South Pacific). Our main concern is to observe the earth orientation in real-time or quasi-real-time. This VLBI system can be applied to a local tie measurement. For this purpose, we need the high speed and wideband data transfer such as an optical fiber network or wideband satellite communication.

In addition since the zip disks containing the GPS data obtained from the local GPS network are mailed to the analysis center (University of Hawaii), real-time or quasi-real-time GPS measurements are difficult. The wideband data transfer system will be useful to send GPS data from the islands to the analysis center. However the wideband satellite data transmission is not reallistic due to the expensive cost at present.

The satellite communication system of the new POST-PARTNERS (NPP) Project is effective to evaluate the feasibility of the GPS and VLBI data transmission. Off course though the band width is not enough to transmit the huge data sets such as Gigabit VLBI data, it is no problem to investigate the satellite link speed and the effect of an around-trip time delay on the TCP/IP data transfer. Thus, we are now preparing a GPS data transmission experiment using NPP system for the demonstration as a first step in this fiscal year.

3. Preparing Experiment

The schematic image of GPS data transmission as shown in Figure 1 is now under consideration. We are now considering to install a temporal GPS station with a laptop PC in the USP. University of Hawaii has already installed one GPS station on the top of the government building in SUVA. We have a plan to connect both stations using a public phone line or cellular phone if it would be possible.

The experiment under consideration is as follows. First, the SUVA GPS data will be taken using

dialup access from the laptop PC in the USP station everyday. The GPS data in the USP will be also downloaded to the same PC using the RS232C serial interface. Second, the data sets of the both GPS stations will be transmitted via FTP from Fiji to Japan using the satellite communication link. Finally, these GPS data sets will be transmitted via FTP from Japan to University of Hawaii through the internet. The experiment time scale is up to ten days due to a time window limitation of the communication satellite. We are tentatively planing to perform the experiment in next January or February, 2004.

4. Equipments

CRL will be able to prepare these equipments as follows for the experiment.

#one geodetic GPS receiver with a choke ring antenna and a tripod
#two laptop PC's for the data downloading and TCP/IP link
#one desktop PC for multipurpose use
#two 56kbps card modems for the PC
(two 28.8 kbps modems are also available)
#interface cables (network, serial, and so on)

Key Word: Earth Orientation

The orientation of the Earth changes with time. The earth orientation is characterized by the rotation vector, which has the direction of the instantaneous spin axis and whose magnitude is the rotational speed. The rotation of the Earth is not uniform. Variations in UT1 or its time derivative length of day (lod) and the motions of the pole are due to the integrated effect of all changes in the Earth's angular momentum. These include angular momentum exchange among the solid Earth, the atmosphere, the oceans, and the fluid core, as well as changes in the Earth's shape from glacial, oceanic, and atmospheric loading.

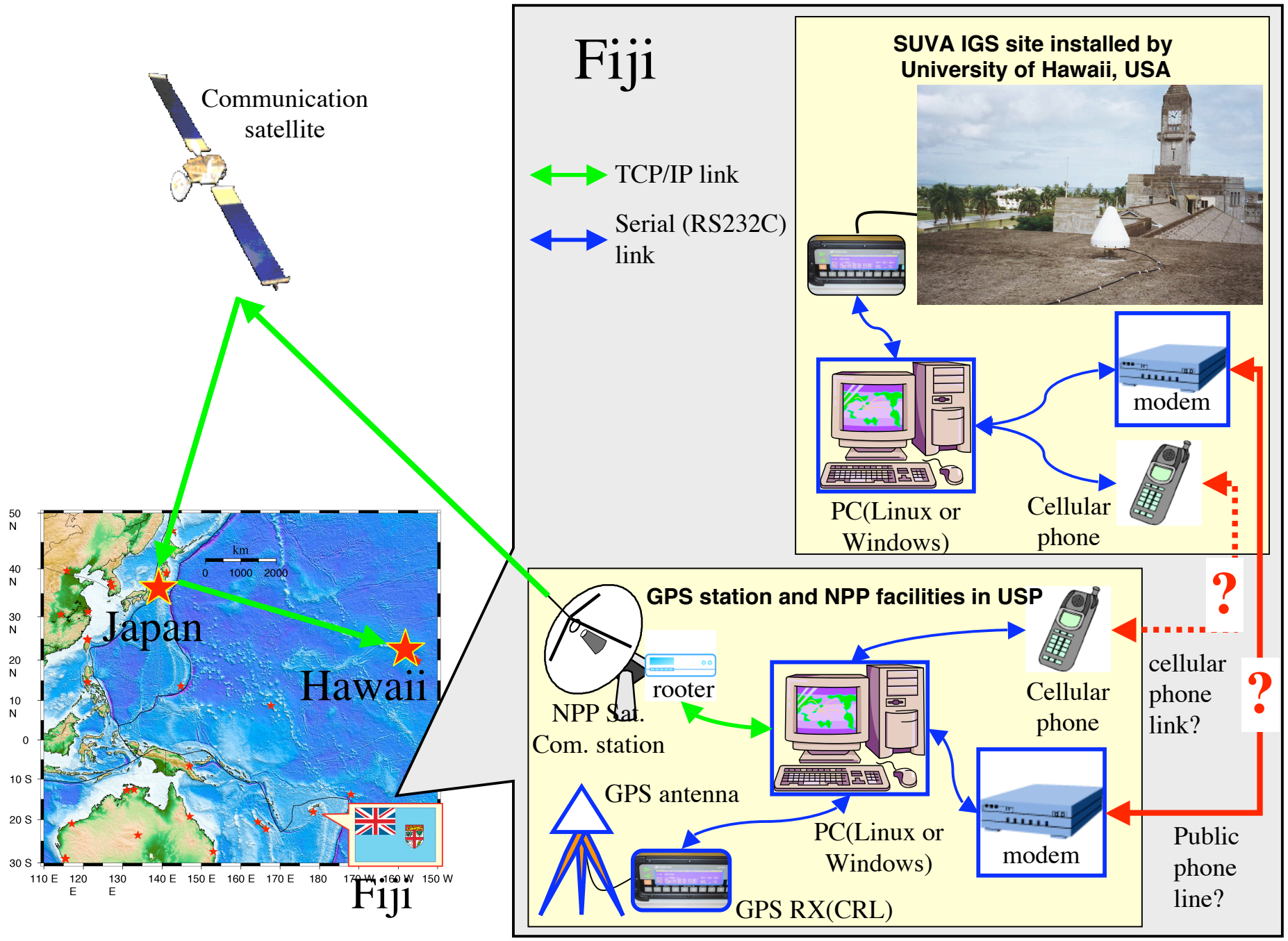

Figure 1 Schematic image of the data transmission experiment