

46th CGSIC Meeting
September 26, 2006
Fort Worth, Texas

U.S. States and Localities Session

Chair **Rudy Persaud** from the Federal Highway Administration opened the session by announcing that the group had had a successful meeting in Puerto Rico, and that the next meeting would be held in Oregon, followed by another meeting in Wisconsin.

Christa von Hillebrandt, the Director of the Puerto Rico Seismic Network (PRSN) gave a report on the Puerto Rico Seismic Network and GPS applications. A Tsunami Warning Center has been created, and has many stakeholders. The Center is monitoring the major subduction faults and tectonic motion in the region, but is more concerned about the minor faults. More than 2,000 earthquakes per years are occurring. In the past 500 years, more than 2,500 people have died, and one earthquake in 1918 produced 20 foot waves. One million people need to be alerted.

A Seismic Hazard Map has been produced, for which elevations are critical for inundation projections to determine evacuation plans. Previous data is from the 1950s and 60s. Concern exists because, during a major event, the 25 seismic recorders can be saturated and rendered useless by strong motions. The Center is collaborating with other nations in the Caribbean and needs timing and positioning info from the 16 tide gauges and DART buoys. The near-shore buoys are no help for the US mainland. The goal of the PRSN is PNT for real time monitoring between earthquakes, but also during for magnitude and slip. Hillebrandt said that many CORS stations exist, but are not available to the PRSN because they have poor mounts or do not collect data at a high enough rate. Funding is being provided by FEMA because no inundation models exist for the SE and NE US. A major earthquake near Puerto Rico would affect the NE US significantly. Many resources have been put into the Pacific Warning Center, but more is needed for the PRSN.

John Augustine from the US DOT gave an overview and status of the NDGPS network. The network has achieved single coverage for 92% of the US and dual coverage for 65% of the US. Because the FRA has decided that it is not needed for positive train control, it is unfunded for FY07. The system works well, and may be needed for Intelligent Transportation Systems (ITS). Remaining funds from FY06 are being used for operation and maintenance, but the system risks termination. The Coast Guard has indicated that it could operate 40 maritime and 10 NDGPS stations, but unless more funding is found, the system will be mothballed. Augustine said that, to keep the system active, an education effort needs to be mounted to increase user base support. The options are: 1) get an agency to assume responsibility; 2) secure interagency funding; 3) mothball; and 4) terminate (at a cost of \$10 million).

Karen Van Dyke from the Volpe Center gave a report on the activities of the Research and Innovative Technology Administration (RITA). RITA, an effort within DOT, is looking at NDGPS. It considers agriculture to be growth area. ITS needs ± 30 cm, something that the $\pm 1-3$ m NDGPS will not provide (High-Accuracy NDGPS would provide this accuracy, but it, too, is unfunded.) DOT is also looking at WAAS, and a move away from ground-based augmentation

systems to space-based systems. Van Dyke said that \$54 million has been invested in NDGPS so far.

Van Dyke referred to the 2004 PNT Directive, and said word is not reaching the top. Some have suggested a public-private partnership for the system. DeLane Meier from the North Dakota DOT bitterly complained about the death of the system and said that many users are benefitting from it. He also said that legal liability could be incurred if the system is terminated. An accusation that representatives from John Deere's StarFire augmentation system have been trying to kill the system by complaining to OMB about the public sector competing with the private sector was strongly denied by a John Deere spokesman.

Seth Gutman, from the NOAA Earth System Research Laboratory, in Boulder, Colorado gave a report on Real-time Tropospheric Signal Delay Corrections for the High Accuracy NDGPS, and said that they are using 387 CORS stations to establish the zenith tropospheric delay at 30-minute intervals. The column water vapor values are important for weather predictions and for climate monitoring. The work is being used to verify moisture observations from existing GOES weather satellites, and has resulted in a 50% reduction in analysis errors, which leads to better precipitation forecasts. The research is being cooperatively conducted with P. Alves, Y.W. Ahn, J. Liu, and G. Lachapelle at U. Calgary; S. Bisnath, D. Dodd at U. Southern Miss; B. Remondi, M. Albright at XYZ's of GPS; F. Nievinski, M. Santos at U. New Brunswick; and Y. Bock at Geodetics.

To mitigate the effects of the second largest error source in GPS (tropospheric delay, after ionospheric delay) GPS users have always used a deterministic model such as Hopfield or Saastomoinen. The result of the research, the NOAA Trop model, is physically-based and much better than the older models. The research has found that NOAA Trop is better in low-relief, high moisture areas such as the Gulf Coast. This appears to be due to the resolution of the model (that is, the spacing of grid correctors). In high-relief areas such as the mountains, resolution plays a bigger part and in low-relief areas, horizontal gradients are more important.

Plans call for broadcasting a use-me-don't-use-me correction. Gutman claims that, with good orbit info, clock info, iono model and tropo model, $\pm 1\text{m}$ can be achieved with single frequency receivers, and $\pm 50\text{cm}$ can be achieved from dual frequency. Part of the planned enhancements for NGS' OPUS is OPUS Rapid Static. The new facility will only require 15 minute observations as opposed to the current 2-hour obs requirement. OPUS Rapid Static will use the new NOAA Trop model to solve for trop delay around the user's locations and interpolate to derive the values at that location.

Ken Bays, Technical Manager, Oregon Real-time GPS Network reported on the Oregon DOT initiative, the Oregon Real-time GPS Network (ORGN). The system is using Leica's SpiderNET network software. With the selling point of a consistent datum and coordinate system, they have seen a lot of interest from GPS users. Bays said that with a normal single baseline RTK solution, accuracy is $10\text{mm} + 1\text{ppm}$. This means that at 30km from the base station, the total error could approach 40mm. With a network RTK solution, errors can be modeled with reasonable success, almost negating the ppm component. So, the accuracies for 30km may be nearer 10mm. Connectivity is being provided by radios, cell modems and possibly wireless. RINEX output is

available for post-processing. The system will work with any sensor that is capable of receiving the correct RTCM messages. Plans call for covering the western part of the state (the I-5 corridor) during the 2005-2007 time frame, and the eastern part of the state (the I-84 corridor) during the 2007-2009 time frame.

They are cooperating with UNAVCO Plate Boundary Observatory, the Washington State Reference Network (and have plans to exchange raw data streams across the Columbia River), and California and Idaho as the network develops. Bays said that a VPN is coming and that exchanging data is important because each installation, which use the SCIGN antenna mount, costs \$20-25K. Bays also mentioned that they have used the Appleton NDGPS site, which for them, is on the back side of Mt. Hood.

ODOT will perform QC and monitor the network, and also be responsible for the network software. They will partner with, not only other government agencies, but private organizations (such as David Evans) as well. For those who don't contribute by hosting a base station, a subscription fee will be imposed. The fee will be minimal, and only for cost recovery for network maintenance. Anonymous users will be able to access data for post-processing for free. Also free will be radio RTK signals. The network is using Ntrip authentication.

The network started in March 06, and at the time of the meeting, was still in test mode, which meant that the signals were free, but without warranty, i.e., use at your own risk. Complete partner agreements were to have been in place by October 06, with full operation slated for January 07.

Potential base station owners can download a recon packet at <http://www.theorgn.net/>, and provide such things as sky obstruction plots, monument info, electricity availability, Internet/data comm availability, site ownership/access info, and site photos.

CORS Forum

Richard Snay from NGS gave an overview and said that the national CORS Network contains 817 sites, the Cooperative CORS Network contains 168 sites, the California CORS Network contains 350+ sites, and that the combined CORS Network is growing at rate of 15 sites per month. More than 180 organizations participate in the CORS program. The entire northern half of the western hemisphere is now covered by CORS.

Recently, the first of ten GPS/GLONASS receivers was added to the network. CORS will also be added to six additional tide gauges to help determine absolute sea level. ITRF 2005 is coming, and will do away with NAD 83. The entire northern half of the western hemisphere is now covered by CORS. In addition to OPUS Rapid Static mentioned above, other major enhancements are underway for OPUS. First is OPUS DB, which will allow users to store their information in a database on an NGS server and share results. Second is OPUS Projects, which will allow users to perform more than one adjustment at a time. Finally, OPUS GIS will allow less-expensive single-frequency GIS-grade receivers to be used by people that don't need survey accuracy. Here are the specifics for each new enhancement:

OPUS Database

- Streamlined method for users to publish their results

- User registration (ID & password, validation process)
- OPUS solutions can be integrated into the NGS database
- Data elements from OPUS, additional metadata
- Submission review by user and NGS

OPUS Projects

- Managers can define a project
- Process any number of stations under a project, project can span several days to weeks, contract work
- Project processing
- Each dataset goes to OPUS but is identified with a project, results returned to submitter a few minutes later, manager can monitor processing and submission
- Final adjustment
- Entire project adjusted as one campaign, review & submission to NGS

OPUS Rapid Static

- User requests, single frequency capability, rapid static solutions (10 – 15 minutes of data), will be processed with carrier phases
- Accurate to several centimeters, need more accurate ionospheric and tropospheric modeling, in development at OSU and NGS

OPUS GIS

- Compute a differential pseudorange solution for less expensive GPS receivers
- Aimed at those in the GIS community who do not require cm level accuracies
- Allows processing in a consistent approach and “certifying” their locations in the NSRS
- Generate rapid static solution from seconds or minutes of data
- Accuracies: A few decimeters to a meter horizontally

On-Grid

Gavin Schrock gave a presentation about OnGrid, an initiative to foster the implementation of RTK networks. Schrock said that it’s not just a matter of dollars, but rather a matter of policies. Schrock promotes the initiative under the banner of Infrastructure as an amenity for all. Several Europeans were there to lend their knowledge about RTN. The Germans have pioneered the use of Ntrip, an enhancement of the RTCM message protocol that provides a receiver with a hack-proof IP address, thereby eliminating the need for multiple server ports. According to the German BKG website: *Networked Transport of RTCM via Internet Protocol (Ntrip) stands for an application-level protocol streaming Global Navigation Satellite System (GNSS) data over the Internet. Ntrip is an RTCM standard designed for disseminating differential correction data (e.g., in the RTCM-104 format) or other kinds of GNSS streaming data to stationary or mobile users over the Internet, allowing simultaneous PC, Laptop, PDA, or receiver connections to a broadcasting host. Ntrip supports wireless Internet access through Mobile IP Networks like GSM, GPRS, EDGE, or UMTS.*

Gary Jeffress, with the Texas A&M Univ., Corpus Christi, TX, gave a report on the activities of the Texas Spatial Reference Center, and said that much effort has gone into the use of GPS in determining valid NAVD 88 heights for Texas CORS antennas. They found that 1) GPS can yield NGS-acceptable differences in height over short distances (less than 1 kilometer), and 2) that First Order digital leveling between control benchmarks validates vertical relationship, and also quality checks the GPS solution for bad integer determinations or other processing defects.

Other efforts by the Center have resulted in handheld software for digital leveling, as well as Hurricane Evacuation Route Elevation Profiling, which perform hurricane evacuation route surveys using the Applanix Pos-LV system. The Applanix system allows a vehicle to log accurate 3-D data by combining GPS + inertial sensors. The Center as also been working with the Harris-Galveston Coastal Subsidence District to establish a CORS on an NOS Tide Gauge located at the Galveston Pleasure Pier.

As part of the after-meeting discussions, Bays and Schrock met with Snay and discussed the need for dynamic coordinate datums, or, as Shrock put it, relative versus absolute versus dynamic. The West Coast has a great need for dynamic datums because everything is moving. Also discussed was the use of OPUS as part of daily network checking. Snay revealed that NGS will also start making raw observations available to network administrators for this purpose. The purpose of this will be to keep the network on the correct datum as well as serving as a monitor to check for network problems (moved antenna, etc.).

Respectfully submitted,

Marc S. Cheves, LS
Secretary