

Utah Department of Transportation

White paper

Statewide G.P.S. Virtual Reference Station Network

Identification Information

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| Project Name: | G.P.S. Virtual Reference Station Statewide Network |
| Project Estimated Cost: | \$1,867,000 |
| Project Sponsor: | |
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| Budgetary Years: | 2005-2006 |

The Utah Department of Transportation Design Survey Unit made the transition to a satellite based Global Positioning (GPS) surveying system in 1998. The transition to GPS surveying has resulted in efficiencies of more than ten to one over traditional survey methods. Over the last six years UDOT was able to reduce the number of survey crews from 20 to 4 while producing 10 times the number of location and right of way surveys at one fifth the staff we previously had. With all of the benefits that GPS has provided the department, there are still ways to significantly improve efficiency and accuracy. There is also opportunity to expand and enhance the benefits of GPS to many other areas of government and the private sector outside of UDOT.

Current issues

1. Currently an average survey crew spends between 1 to 2¼ hours per day in setup and teardown of GPS base stations and Radio transmitters.
2. Currently several hours a day are needed to verify and monitor the base station to ensure that it has not been moved, stolen, knocked over, lost battery life or is otherwise functioning correctly.
3. There are many coordinate systems in use currently. Much time is spent converting survey data from one system to another. This results in errors in the data that sometimes cannot be resolved, requiring the survey to be collected again.
4. One of the difficulties with GPS is that the atmosphere creates inaccuracies in the signal from the satellites which create errors in the survey on the ground.
5. Elevation accuracy has never been as reliable as positional

accuracies due to atmospheric deviations and a limited number of satellites available to triangulate from at any one time.

Project Objectives

Build an interlinked system of 50 strategically located, permanently mounted, continuously operating G.P.S. receivers. Establish a computer and communications network linking these GPS stations that will;

- Record, monitor, verify and post the data automatically.
- Allow central access to and graphical monitoring of the data stream and the ability to manipulate and adjust receiver settings from a central location.
- Provide alarms to a designated resource in the event of invalid data or other system malfunction.
- Broadcast Real Time Kinematic (RTK) information that can be utilized by any survey device in the area.

Direct Benefits

1. Reduce the amount of time required to perform a GPS survey by 25% per crew, per day. Reduce the time needed to set up and begin surveying to around 15 minutes or less per survey crew, per day and eliminate the need for anyone to monitor the base station and radio. This is true for State surveyors as well as any private surveyors using the system.
2. Define the coordinate system and standard that anyone and everyone using the system would use. This would significantly reduce errors and conversion problems between private and public surveyors as well as simplify communication and sharing of surveys across city, county, state and private sector entities.
3. Improve accuracy both horizontally and vertically. With survey grade equipment horizontal and vertical accuracy will improve by a factor of 5. With mapping grade GPS equipment accuracy will improve by a factor of 10 this means that for GIS level GPS surveys what used to be + or - 3 meters will now be + or - 3 centimeters. This can have a significant impact on many of the feature collecting activities conducted in the GIS environment.

Indirect and Potential Benefits

There are and incredible amount of potential uses for this infrastructure once it is in place. Though most of the uses that we are suggesting would require additional resources and development time, the potential benefits are well worth the investment effort.

At UDOT

- Use GPS tracking and transmitting to improve snow plow routing,

improve safety and optimize resources on the fly.

- Connect our Photo Logging System to the GPS network. This will enable us to very accurately define horizontal and vertical alignment information for every route in the state.
- Asset management; faster more accurate collection of feature inventory information.
- Automated Traffic information. We could link traffic monitoring sensors and RTK, GPS to measure traffic and average commute time, over months and years to improve traffic management options.
- Weather, Avalanche, forecasting and alerts. There is potential to get weather information in real time from base stations by the statistical deviation in signal time during weather events. This potentially could allow automated warnings to occur during sudden, localized weather events that are not currently picked up by Doppler radar. "disposable" GPS receivers and transmitters could be placed in avalanche fields and when there was an event, have a road closed automatically and officials notified instantly.
- Be able to track and monitor highway truck traffic 24/7 in particular hazardous loads, where you could set automated alarms for when the truck deviated from an assigned route, stopped for longer than a specified time or any other constraint that you could want. Have the alarms automatically alert Highway Patrol.

It is easy to see how many of these applications could be used in other areas of government. Track and monitor criminals or wildlife, "driverless" busses and trains, fleet management in many departments and countless applications in private industries.

It is easy to scale this solution to the money available and add additional resources as they become available. The time is now to begin this process.