

FRONT RANGE SURVEYORS UNITE

In Colorado, a new RTK network has taken shape and grown rapidly, seeing many uses.

By Vicki Speed

Not every reference station network is created equal. At least members of the SmartNet Colorado Reference Station Network believe that. As a shared network, it consists of a series of independently owned public and private base stations located from Cheyenne, Wyoming to Pueblo, Colorado. In just two years since its inception, this unique network has more than doubled in size. Offering users RTK GPS capabilities, the network is used extensively to continuously monitor structures such as dams and bridges, support GIS databases, and drive conventional topographic surveys and mapping.

The SmartNet concept came about in 2007 soon after the Colorado Department of Transportation decided not to implement a DOT-run reference station network. Seeing increasing demand and need for GPS, Hixon Manufacturing & Supply Company, a survey supply company based in Colorado and Leica Geosystems dealer for Colorado and Wyoming, teamed with Leica Geosystems. They looked to bring existing and future GPS users together under a single umbrella, without creating unnecessary costs, while delivering a network that could provide greater accuracy than even Continuously Operating Reference Stations (CORS).

In this shared partnership network, Leica Geosystems owns the hardware and software to record and process the position data from designated base stations while the partners own the reference station hardware. The partners also define the base station locations. Hixon manages the user, owner, and host subscriber activities.

As a condition to the partnership, the base station receivers are Leica GRX 1200 PRO GNSS, so Leica Geosystems can manage and run the data re-

motely through its software. However, most modern GPS receivers can be configured to work with the network. Current brands in regular operation include Trimble, Topcon, Carlson, TDS, and Sokkia. Of the approximately 115 accounts set up on the network, 30 percent are using Leica rovers. Since inception, Hixon and Leica Geosystems have added GLONASS and VRS corrections as well as legacy-style correction for older receivers.

A second requirement says that partners must agree to update and optimize the reference stations to the most current capabilities to ensure that the reference station network is continually state of the art. In return, the partners have access to a growing reference station network online around the clock with coverage of more than 730 miles along the Front Range. Field crews no longer worry where to put the local base station, find the clearest radio channel, check base batteries, and verify they have the proper height and point location.

CORS Precision

Every receiver in the network meets the National Geodetic Survey (NGS) CORS configurations and standards. Every station has been submitted to the National Spatial Reference System (NSRS) as defined by NGS. The net-



With a GPS rover, surveyors can gather information anywhere along the Front Range in Colorado.

work's CORS-like accuracy was crucial to Nolte Associates, an engineering and land surveying firm with offices in California, Colorado, Utah, Wyoming, and New Mexico. As one of the founding partners in the network, Nolte bought and installed a reference station at Denver International Airport in spring 2007.

Perry Bassett, manager of survey technology with Nolte, says, "With GPS, we're always trying to 'seed' our projects with the best latitude, longitude, and ellipsoid height available. We all know that CORS stations offer the best control points on the planet. Since the SmartNet

stations are built to the CORS standards, they are the next best thing.”

The network combines receiver technology, processing algorithms, and cellular technology so that survey-grade accuracy is achievable at ranges around 30 miles and more. With one-minute occupation, the network can provide better than CORS level accuracy.

The City of Fountain joined the network in late 2007, and their water department regularly uses the GPS network to gather information about local infrastructure, population, customer base, acreage, and more. Jerry Cordova, a GIS analyst with Fountain, appreciates the level of accuracy and simplicity provided by the network.

Accuracy of GPS data is derived from the availability of other base stations within the network. Since the reference stations must be continually upgraded, the network has all the latest options available to end users from support for both GPS and GLONASS satellites to Online Positioning User Service-like (OPUS) capabilities. Every GPS position is established with data gathered from at least two base stations in the network, as well as the available satellites.



The SmartNet Colorado Reference Station Network includes 20 base stations from the Rocky Mountain peaks to parts of the eastern plains.

Industry studies indicate that a permanently mounted reference station can cost from \$5,000-\$10,000 per month in setup and tear down alone. These costs might include positioning the base station, finding the clearest radio channel, checking base batteries, and verifying proper height and point location.

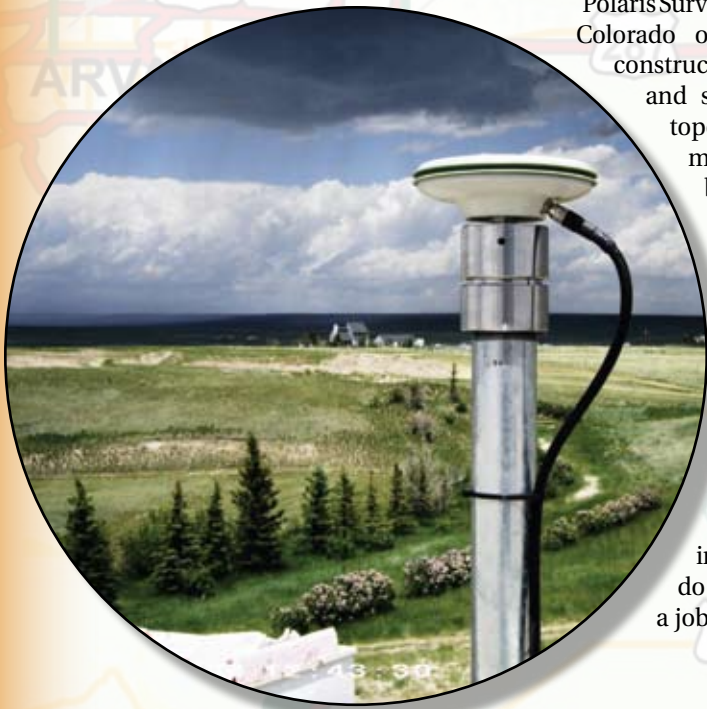
Polaris Surveying in Colorado Springs, Colorado offers services including construction staking, boundary and subdivision surveys, and topographic surveys primarily in the commercial building space. The firm bought its first GPS rover and base station in 2003 and joined SmartNet in April 2008. Polaris's base station is located in Pueblo, Colorado. President LeRoy Willener says, "Our business is predominantly along the Front Range. With the network in place, we don't have to do any additional setup for a job. We drive to the site, pull

out our rover, and get to work. We save at least an hour a day by eliminating base station setup." Polaris runs two survey crews almost every day on jobs from Denver to Pueblo.

Supporting a GIS

In January 2007, the Cañon City engineering department opted to add its existing base station to the network. Cañon City, located south of Colorado Springs in the Arkansas River valley, is home to approximately 16,000 people in an area of about 12 square miles. The city engineering department relies on a GIS to manage city infrastructure and growth and provide support to other city departments. GPS technology helps keep that database current and growing. The engineering department had implemented a permanent GPS base station to facilitate rapid data collection in and around the city using a GPS rover. Ed Galvez, GIS survey technician for the department, and one other staff member use the rover linked to a wireless modem regularly. Tasks range from mapping new construction and building project progress to marking locations of impervious surfaces to supporting the stormwater utility fee program.

SmartNet allows users to keep track of data, downloads, and costs while providing additional services such as constant



▲ Laramie County, Wyoming has three reference stations in the network, including this one at Gilchrist Elementary School.

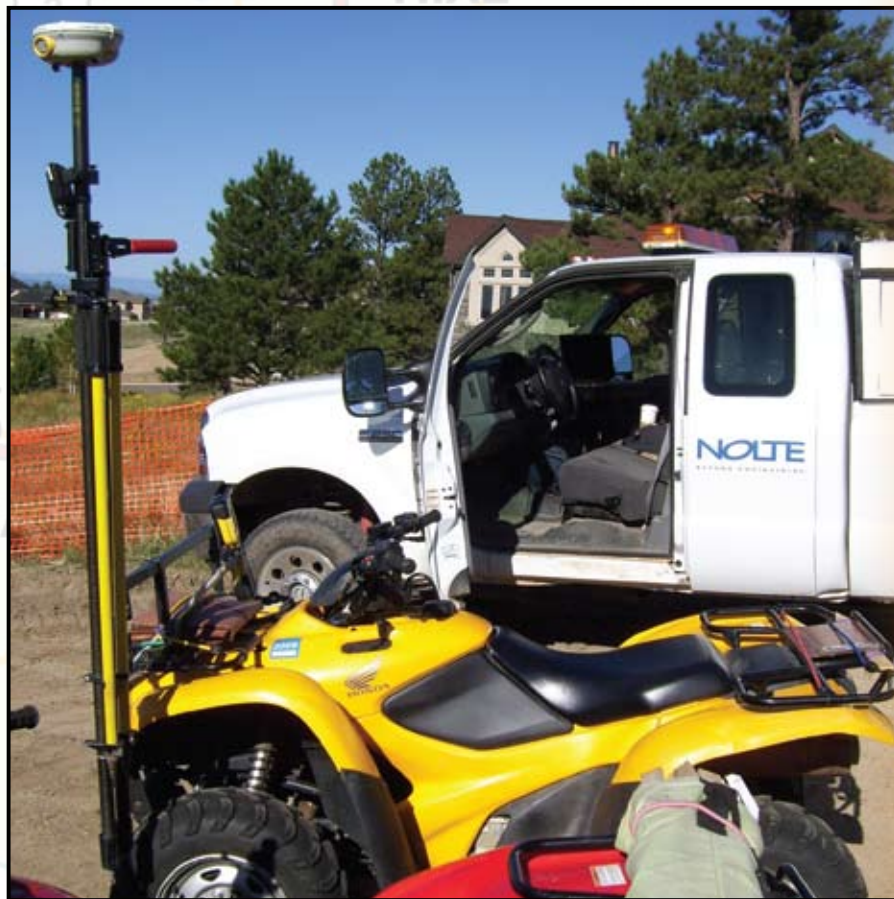
overview of file availability and data quality as well as network-corrected GNSS RINEX data for user-defined locations and upload for automatic coordinate computation. Clients upload GNSS raw data, and the network uses one or more nearest stations to calculate the coordinates of the given data sets.

GPS reference receivers compute RTK corrections once a second and make them available on the internet. Other services include the ability to automatically download RINEX base data for GIS at regular user-requested intervals. Rovers in the field receive corrections through the use of a wireless modem, allowing them to perform GPS measurements without the use of a base station.

As a partner, Nolte Associates engineers and surveyors have constant access to the entire network. Over the last two years, Nolte has used network reference stations along the Front Range for projects that range from simple construction layout or platting/mapping to comprehensive city mapping and reconstruction projects. On one project, they used the network to help map the city of Brush, Colorado an hour northeast of Denver in preparation for a significant downtown revitalization project.

Bassett explains, "We used a high-definition scanner to create a 3D as-built model of downtown with the network providing the survey control. We set up the scanner targets over the survey control and started scanning." As a quality check, Bassett and his team compared the resulting scan station data and survey control points with data gathered from a digital level.

The network was first implemented in July 2007 with nine reference stations. As of January 2009, it had grown to 20 with more planned in 2009. Shannon Hixon, product marketing manager for Leica Geosystems, says, "In the next



▲ A rover mounted on an ATV offers Nolte & Associates survey teams continuous topographic surveying over large areas.

year we will add more reference stations and work to integrate new GNSS technologies as well. We plan to integrate the newest real-time correction messages (RTCM) network standards in 2009 as well as adding rover messaging features using lesser-used RTCM messages."

Currently, about 115 surveying and engineering organizations belong to the SmartNet Colorado Reference Station

Network. That number is expected to double in coming years as public and private surveyors, engineers, and planners continue to take advantage of the speed, accuracy, and versatility of GPS. ↓

VICKI SPEED is a freelance writer specializing in the engineering and construction market. She can be reached at vickispeed1@comcast.net.