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## Build a **NETWORK**

*and They  
Will Come*

# Build a NETWORK,

..... *and* **THEY** *Will Come* .....

Real-time kinematic networks are spreading up and down the East Coast, as operators find that established networks draw subscribers once people see the results.



KeyNetGPS network map showing reference stations from Maine through Virginia.

By Craig Dylan

“When it comes to real-time networks, a build-it-and-they-will-come mentality seems to work,” says Kevin Chappell, PLS, PE, CP, director of surveying and mapping technologies at Precision Laser & Instrument, Inc. (PLI), a precision instrument supplier serving Ohio and Pennsylvania. He’s talking about the surprising response to his firm’s real-time network (RTN) ... *after* the GNSS receiver network was up and operating.

“When we had one receiver up and were trying to generate interest, no one seemed to care,” Chappell relates. “Now that we’re pushing out and are part of a large network, I get a dozen calls a week. Having a system in place made a huge difference in interest and in growing the coverage.”

Indeed, when it comes to RTNs, the rule seems to be “accuracy is addictive.” Private and public entities that push ahead and establish networks of GNSS receivers coordinated via the inter-

net and accessed by users with mobile phones find subscriber bases growing more quickly than projected. In some cases, the subscribers themselves are extending the network by hosting, under various arrangements, reference stations that extend the network farther and encourage even more subscribers to take a chance on technology that still seems relatively exotic.

PLI is taking advantage of a business model that makes maximum use of this dynamic. “We’re piggybacking with KeyNetGPS,” explains Chappell. “We work with them to expand their network. We have some of our own reference stations, and our users set up stations as well. At the end of 2008, we had only one station, and now [April, 2009] we have 15, a mix of our reference stations and customer-owned installations.” And the 15 reference stations “anted up” by PLI are now part of KeyNetGPS, Inc.’s multi-state network covering the northern half of the Northeast.

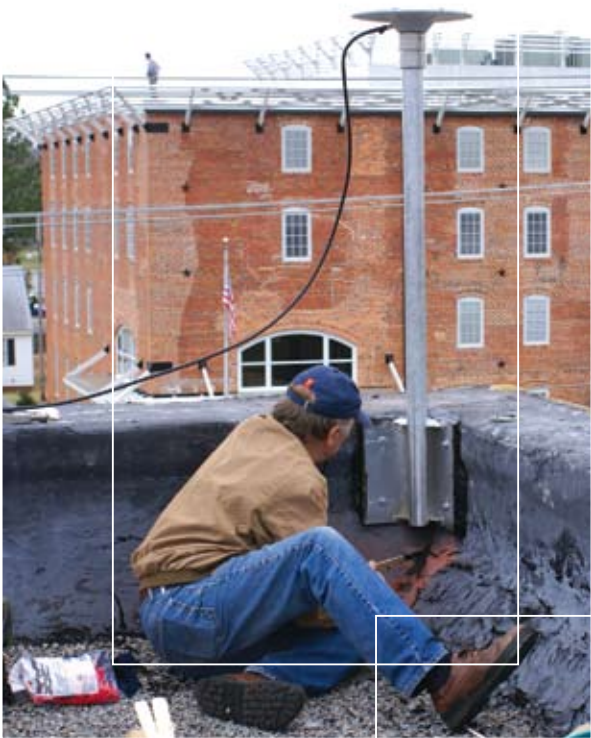
KeyNetGPS is just one of several large

RTNs using Trimble VRS technology that now blanket the East Coast. Using rover receivers from a variety of manufacturers, users can perform precise RTK surveying without setting up base stations. Accuracy throughout the covered area typically runs 2 cm or less horizontally and better than 3 cm vertically. Uptime is also good and keeps improving as new cellular towers are added to the cell networks.

Coverage consists of a variety of network types, some public and typically operated by state geodetic surveys or state departments of transportation (DOT). KeyNetGPS is private, made up of many individuals, public entities, and businesses working together to establish Continuous Operating Reference Stations (CORS) in different regions. There is some overlap and cooperation at network edges.

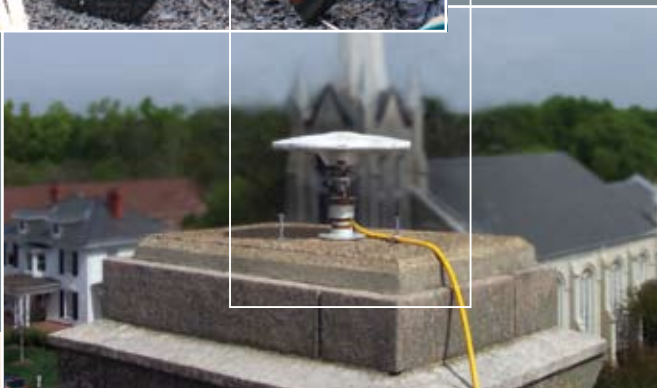
## Extends Beyond Pennsylvania

How big is the KeyNetGPS network? Bill Moore, PLS, owner of Earth Vector



◀ Bill Moore of Earth Vector Systems installs an antenna on the roof of the Old Electrical Building in Franklin, Virginia. The reference station is part of the KeyNetGPS network.

A Trimble Zephyr Geodetic 2 antenna installed on top of the York County Courthouse in South Carolina. This reference station is part of the SCVRS network and also national CORS site SCYK.



Systems (EVS) in central Virginia and a KeyNetGPS participant, gives the short answer: "Subscribers can work from Maine to Virginia with the same logon."

A more nuanced answer comes from Emerson Bornman, PLS, who manages KeyNetGPS, Inc., on behalf of Keystone Precision Instruments, a distributor of survey and machine control products in the Northeast. "The network's size is best described in terms of area covered. We currently collect data from the New York DOT and other New England entities, which agreed to share data. That gives us coverage of New Hampshire, southern Vermont, southern Maine, and all of Massachusetts, Connecticut, and Rhode Island.

"Other reference stations extend coverage to all of New York City, all of Delaware and New Jersey, Virginia—north of Richmond, and east to Virginia Beach—and Maryland east of Cumberland," Bornman continues. "Our main network

is in Pennsylvania, covering the eastern half and southwest quarter of the state, and we expect to have the entire state covered by July. It adds up to more than a hundred reference stations."

The collaborative nature of the network is a consequence of KeyNetGPS's unique business structure, which relies on reference stations owned and established by many different parties. "We started investigating VRS in 1999 and really liked it," explains Bornman. They initially discussed a potential network with the Pennsylvania DOT (PennDOT), but in 2004 Keystone decided to build a network on their own. "Now PennDOT is using the service."

To leverage the law of increasing returns—stated loosely, "the more you sell, the more you sell"—Keystone's owner, Keith Border, approached existing GNSS users and entities such as PLI and EVS to add reference stations (GNSS receivers) to the network and become

customers. Participants get discounted rates on subscriptions; a portion of network income proportionally based on the number of reference stations maintained is remitted annually.

The network grew considerably more quickly than expected. "We didn't expect it to grow like this," says Bornman, "but when people try it, they're hooked—95 percent of users who sign up for test accounts end up joining as subscribers."

KeyNetGPS was offered free to anyone interested until 2007 as a way of testing the new system. Beginning in 2007, 100 users signed up immediately, and that number doubled by the end of 2008, growing to 250 in the first quarter of 2009. (A "user" is a license for one rover, and individual companies often sign up multiple users.) Bornman describes a typical sales pitch: "We take interested surveyors or contractors outside with a GNSS receiver and internet-capable data collector, either by mobile phone or internal modem, hit start survey, and after a minute or two the corrections start coming back—in fact, some modern receivers will initialize in ten seconds."

To guarantee the integrity of the network, as far as possible, KeyNetGPS maintains two cloned five-server clusters, one in Allentown, Pennsylvania, and one in Crofton, Maryland. That way, even power outages don't disrupt service. "All our users have redundancy," explains Bornman, "and if one server system goes out, all they have to do is log out and try the other one." Thanks to this, and to constantly running network integrity checks, system uptime is better than 98 percent.

In addition to privately owned CORS, KeyNetGPS also makes use of publicly available resources, such as National Geodetic Survey (NGS) CORS in Virginia and on Chesapeake Bay.

How does the system work from an end user's point of view? "I'm 60 years old, been licensed since 1973, and have been working by myself for most of that time. When my wife asked why I was investing in this, I told her I wanted to be at the cutting edge and make things easy for myself," says Ralph Clay, PLS, owner of Clay Land Surveying Services in Carbon County, Pennsylvania. Carbon County is hilly and tree-covered, and Clay purposely arranged for the network demonstration to take place in especially rough

country. "I'm in mountainous country, and I've been using the network since October, 2008. Once I'm localized, I can just take my unit and do my job." Clay uses a Trimble R8 GNSS receiver to access the KeyNetGPS RTN and now uses state plane coordinates for most jobs. He routinely checks "within an inch" on USGS monuments.

Jesse Kozlowski, PLS, director of surveying technology at Taylor, Wiseman & Taylor, is another RTN user. "It has put our company-wide operation on a whole new level," he says. Using the RTN, two-man crews are still routine at his firm, but now "they can go in two directions at once." That is, one crewmember will set control with the VRS-enabled rover, and the other will work with a robotic total station from the control. "The use of VRS has more than doubled the production of our two-man crews."

## Spreading South to the Carolinas

But the expansion of networks in the east doesn't stop at Virginia, as it is rapidly continuing south. "We mainly en-

courage our customers to use it because it makes business sense," says Elsa McNamara, president of Spectra Integrated Systems, a distributor of precision construction technology in Virginia, North Carolina, and South Carolina. The "it" she refers to is RTNs generally, for her clients typically use any of three existing RTNs: KeyNetGPS in Virginia; the North Carolina Geodetic Survey RTN, currently based on Trimble VRS technology; or the South Carolina Geodetic Survey RTN, consisting of 42 Trimble NetR5 stations.

McNamara says the publicly administered networks have been good for her customers. "We're big proponents of the public side," she says. "They're easy to use—we can get people trained and working in 48 hours—they're reliable, and they're very cost efficient."

The public systems also cooperate with each other, sharing data streams from reference stations along their borders. In addition to construction, SIS also serves the agriculture market. McNamara says the RTNs in her region "are fully effective for construction projects and agricultural. Surprisingly, some

of the high-dollar crops like strawberries, where efficiency counts, are making use of the system's centimeter-level accuracy."

GIS users are also benefiting from the precision and availability of RTNs, and Duncan-Parnell, a survey supplier in the Carolinas and Georgia, is doing its part to help surveyors capitalize on that. The company runs classes to train surveyors in the world of GIS and GIS software. "We're trying to help surveyors take advantage of both the networks and the economic downturn to learn about GIS," says Duncan-Parnell's Chuck Drouillard. "As GIS is getting more precise, county landfills and many city water and sewer agencies are becoming VRS users. Many of these entities do not have the manpower for an initial precise GIS data-collection effort. Rather than keeping GIS at arm's length, surveyors can expand their services by learning how to use their high-precision tools to bid on these high-precision GIS projects."

Speaking of South Carolina's system, Dr. Lewis Lapine says, "Theoretically, I know how all this works, but it still seems a little miraculous when you realize that the satellites are 20 million meters overhead, traveling approximately 8,500 miles per hour, and here on Earth we can get to sub-centimeter accuracy, real time, with just one rover and the network."

Dr. Lapine knows how it all works better than most. He's a former director of NGS for NOAA, holds a Ph.D. in geodesy (one of about 50 such degrees in the nation), and is currently chief of the South Carolina Geodetic Survey (SCGS), where he founded and administers the state's network using VRS technology. "I'd been



▲ Dr. Lew Lapine, PLS uses a GNSS receiver within the SCVRS network to obtain orthometric heights as quality control for a lidar survey in Charleston County, South Carolina. He stands in front of South Carolina's largest live oak tree, known as Angel Oak, over 1,500 years old and supposedly the oldest living thing east of the Rockies.



A tractor equipped with a Trimble AgGPS AutoPilot System runs off the South Carolina VRS network during a demonstration. The pin flags were used to show repeatability; the tractor ran for four hours without hitting a pin.

following the literature and dreaming about RTK networks for a long time, but communication was always the problem,” he recalls. “That changed with mobile phones and the internet. When I saw that some states were investing in RTK networks, I encouraged the South Carolina Department of Transportation (SCDOT) to help fund one here. It took about a year of presentations, but they saw the advantages and agreed, and about four years ago we also got a federal grant.”

Working with SCDOT proved a big advantage, as SCGS was able to place 32 reference stations on SCDOT facilities, “where we wanted stations anyway,” according to Lapine. It was also a big advantage to have a clean slate, with very few CORS installed in the state. “We had a clean piece of paper to work with.” Like KeyNetGPS, South Carolina tested its system by opening it to anyone interested for about six months. “I felt that when we put the system online I’d be glad to have 75 users,” says Lapine, “but in fact we immediately had 160. Now we’re at 200, even with the recession.”

## **And on to Georgia and Florida**

Completing the East Coast sweep is a large, 60-station RTN in Georgia run by eGPS Solutions using Trimble VRS technology. “While the network was originally built for its primary market of surveyors, all RTK users can benefit from it,” says eGPS president Lonnie Sears, PLS. “We currently have about 300 users, including governmental agencies, construction, and agriculture.” And in Florida, a Trimble VRS Now network covers the state and supports different applications with tailored correction data, including a visual real-time rover tracking service.

So how big can an RTN be? Bill Moore of EVS says, “My philosophy is that it is possible and desirable to provide coverage over, say, the whole United States and have repeatable positioning in that whole area.”

Moore’s philosophy seems to match that of most European nations, where nationwide networks have been commonplace for some time. And even in this country, that dream is drawing close to realization, though the exact method

of fulfillment is still being determined. With the expanding coverage, new applications are emerging, especially as more users begin to take advantage of the systems and routinely attain high accuracies at relatively low cost. For example, emergency response units have expressed interest.

In fact, the recently released Allen Report demonstrates that the existence of a nationwide standardized RTN in Australia would contribute to an increase in its gross national product of between AU \$6.7 and \$12.6 billion by 2030, when applied to the precision agriculture, mining, and construction industries.

Indeed, network operators have found a business model that has put them in an expansion mode, and RTK networks should continue to spread around the country ... and the world.

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