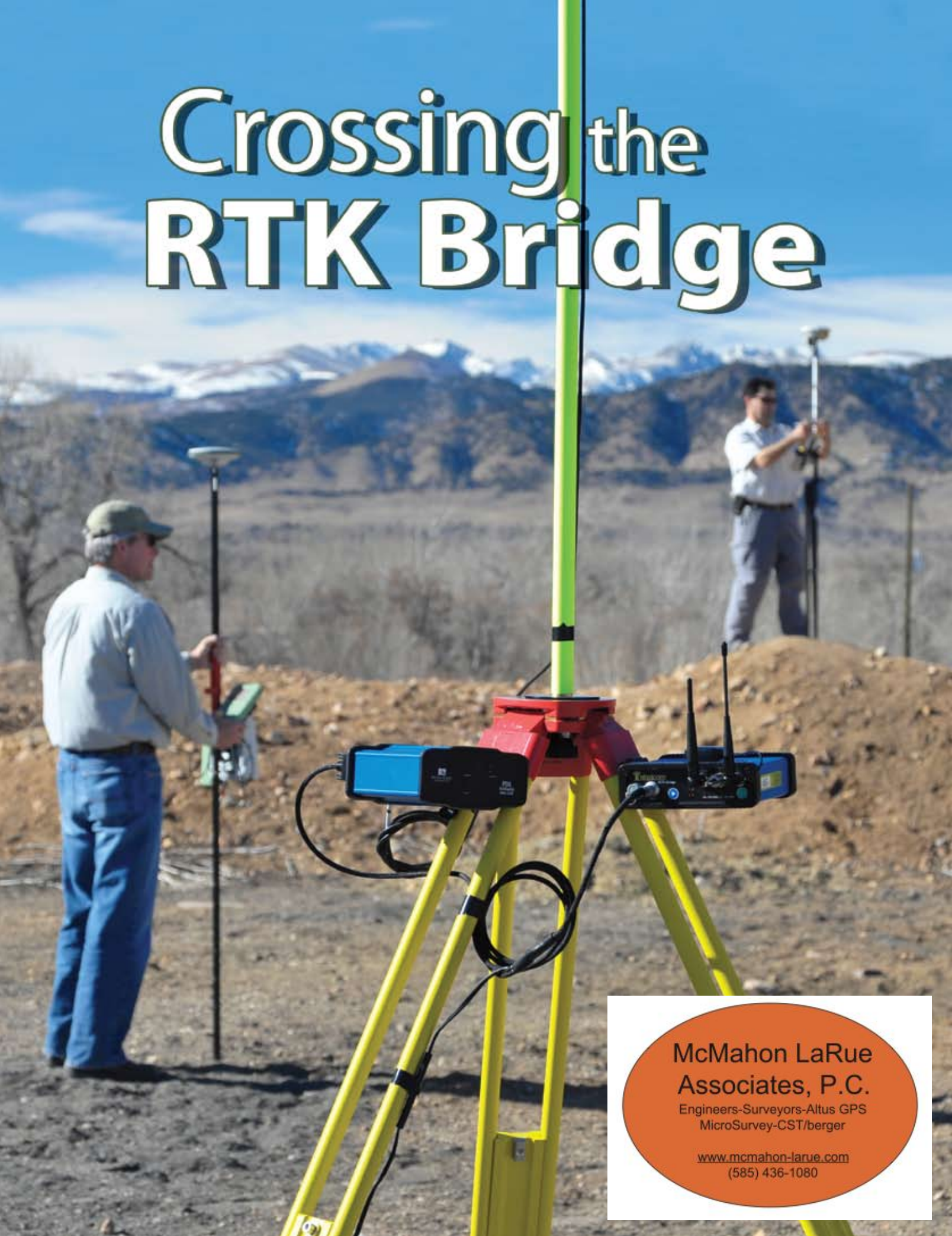


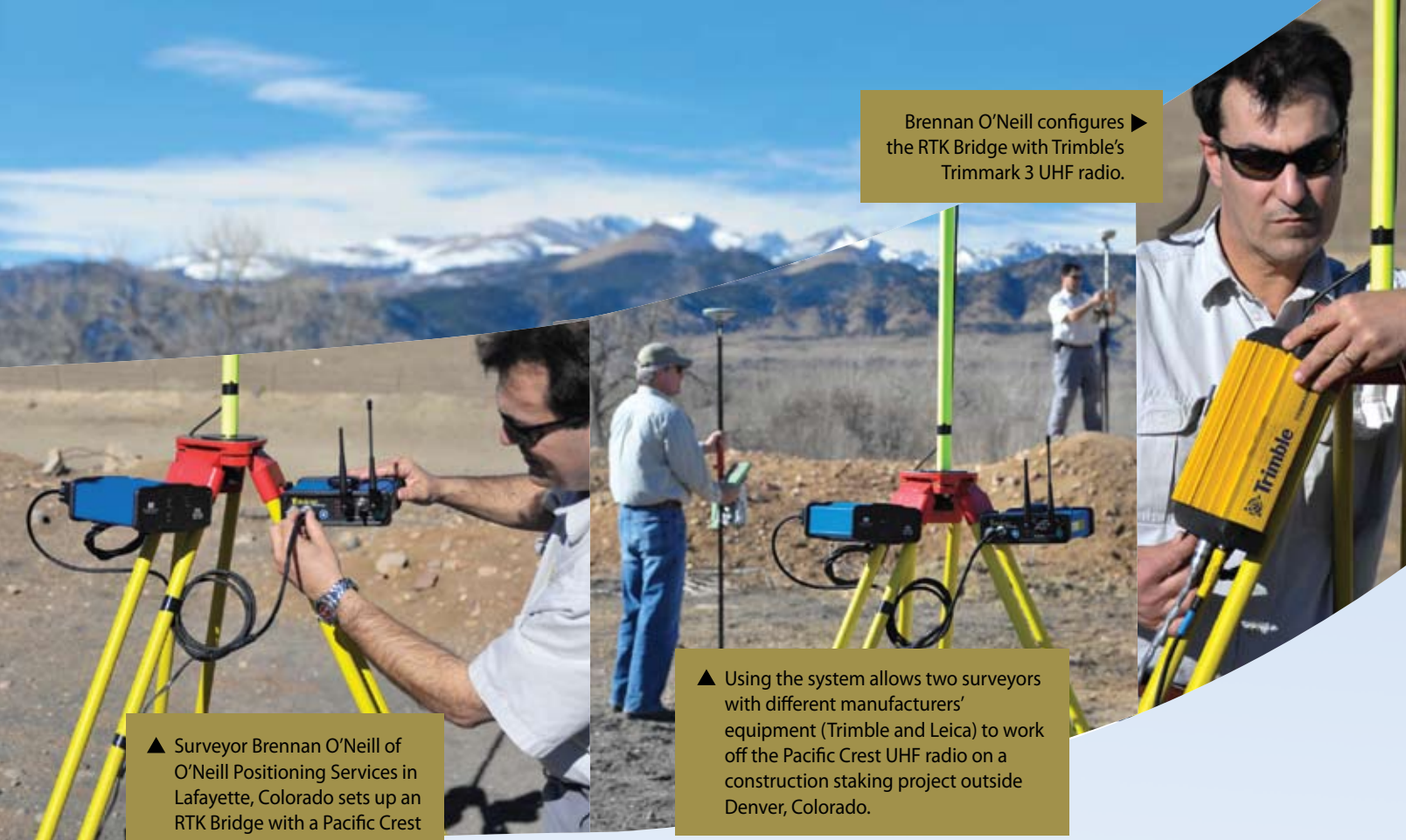
Crossing the RTK Bridge



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Brennan O'Neill configures the RTK Bridge with Trimble's Trimmark 3 UHF radio.

▲ Surveyor Brennan O'Neill of O'Neill Positioning Services in Lafayette, Colorado sets up an RTK Bridge with a Pacific Crest UHF radio having one cable to split power and data.

▲ Using the system allows two surveyors with different manufacturers' equipment (Trimble and Leica) to work off the Pacific Crest UHF radio on a construction staking project outside Denver, Colorado.

Combining radio, cellular, and internet technologies results in connectivity that expands access to real-time networks and their applications.

By Robert Asher

Surveyors at the Drummond Company in Jasper, Alabama, one of the largest coal producers in that state, are achieving survey-grade solutions at the bottom of a pit mine with the nearest reference station more than 30 miles away. This feat is accomplished through the use of a real-time kinematic (RTK) GNSS correction network. While real-time networks (RTN) are nothing new to the survey community, the fact that there is no cellular coverage in the pit and the corrections are provided over a radio link is the result of an innovation growing in precision applications.

Over a thousand miles away, construction crews working on a large-scale project in Colorado began by using a local base station and traditional RTK techniques to achieve real-time positioning for survey crews and machine control equipment (transmitting corrections on both 900 MHz spread spectrum and UHF radio links). More than half way through their job, they converted to using corrections provided by the

regional RTN. However, every one of the rovers used by the surveyors, including the instruments on the machine-control equipment, leveraged the network corrections using existing communication devices, serving multiple rovers without the need to purchase new equipment or additional cellular technologies.

In both of these projects, the new RTK Bridge was used to provide the network corrections to GPS/GNSS receivers. Rapidly evolving communications solutions combining cellular protocols, internet access, and traditional radio-based wireless data combined with the ever-expanding coverage of RTNs are changing the face of GNSS surveying and quickly expanding the RTN user base.

This user base includes surveyors and engineers and construction, mining, and farming professionals. Leveraging the accuracies provided for machine guidance and control applications, the construction, agricultural, and mining communities are rapidly adopting this new merging of technologies. For those interested in proactive protection of our nation's infrastructure, RTNs provide continuous precise data for real-time



monitoring of bridges, structures, and geography. In some areas, these were previously inaccessible due to the constraints of limited communication techniques.

For several years, the advantages of network-corrected real-time GNSS information have led to the rapid adoption of RTNs for precise positioning applications. Improved accuracy over single baseline RTK (particularly in the vertical axis), reduced equipment requirements, and gains in field productivity are key benefits associated with RTNs. Through the use of the RTK Bridge, benefits can include expanded coverage area and availability of correction products previously unavailable to some legacy GNSS receivers. This ability to use more accurate correction information for existing legacy GNSS rovers can lead to more reliable solutions and reduced service cost, including those associated with cellular data usage.

First the Fundamentals

The use of network-corrected real-time GNSS data for precise positioning dates back more than a decade. Europe was one of the early adopters to broadly accept this technology and put it to use in applications ranging from survey to machine control for construction and mining to precision-guided agriculture. The United States was not far behind, but only in the last couple of years has this technology and the communications systems required allowed RTN to become broadly accepted across the country. Many states have established or are in the process of establishing a statewide RTN. Meanwhile, access to privately managed RTNs has been available in most major metropolitan regions for several years.

Without getting into a full-blown dissertation on RTNs, some basic principles need to be addressed. RTNs can be thought of as the next generation of the RTK approach used in precision GNSS. In RTK, correction data is provided from a GNSS base station to rover units over a data link, typically a UHF or spread spectrum radio. This data is incorporated with the rover's tracking data to determine a precise position. All this occurs in real-time. On a broader scale, RTNs take a similar approach but use a network of continuously monitored reference stations. Data from these stations are transmitted to a central processing center (CPC), where real-time correction products are created and data is logged. These products are typically made available to users via internet protocol (IP) across the internet.

Because the RTN can generate many types of data, ranging from simple single base-line corrections to more robust corrections that require location information from the field, access to these correction products may require multiple communication protocols. Enter the Intuicom RTK-Bridge. A communication link that supports a TCP/IP socket connection, it can access the internet, provide communication between the rover and the RTN, use onboard GPS, and use cellular and/or spread spectrum communication protocols while still having the ability to pass information out through an external radio device. This combination, coupled with a wireless provider, completes the RTN solution.

Regardless of the product, the first step is always for the rover side to establish a connection to the RTN's CPC. The reliable establishment of this data connection from the field is the first critical step.

The introduction of this new type of communication link is a subtle but significant change for RTK communications and the user in the field. Cellular data-modems provided the means to connect to the internet, make the network connection, and access the RTN corrections. Expanding cellular services, improved coverage areas, and more cost-effective data plans have intersected well and bring new benefits for users of the RTN.

In the United States, RTK applications have traditionally used a UHF or 900 MHz radio-based communication link to move data in one direction from a GNSS base station to rovers in the field. With the advent of RTNs, using cellular-based data services such as GSM/EDGE, CDMA/1xRTT/EVDO, and other high-speed wireless protocols are logical choices to access the internet and the RTN CPC. As you would expect, most major manufacturers of GNSS rovers have integrated the capability to take advantage of these readily available communication services.

However, a number of limitations accompany the use of cellular modems, particularly in the United States. In this country, while improving, cellular coverage is still far from ubiquitous, particularly in rural and remote areas. Each cellular modem requires a data plan with a monthly recurring cost. Many large construction sites have multiple rovers and machine-control-outfitted pieces of equipment, and a cellular data subscription for each device is not always practical. And finally, not all rovers are capable of supporting a cellular data modem and a TCP/IP data connection. Limitations such as these give rise to the merging of existing technologies, which can further exploit continued benefits of traditional radio data equipment in the RTN environment.

Filling a Void

To overcome these challenges, several industrious surveyors and other GNSS users established solutions consisting of combining radios with cellular modems or other internet devices to access the RTN correction products and transmit the corrections to the rovers. These early efforts produced reliable results but were commonly considered unwieldy and difficult to consistently manage in the field. Intuicom, a company that has provided radio solutions to the precision GPS industry for almost 10 years, took note. They developed a number of dedicated products designed to integrate and simplify these solutions. The U.S.-made RTK Bridge combines TCP/IP connectivity with NTRIP support, an onboard GPS receiver, and an integrated license-free spread spectrum base radio transceiver in a single, small,

weather-proof enclosure.

"We saw a void in the marketplace," says Peter Miller, director of engineering at Intuicom. "Real-time networks were exploding into the survey, machine control, and agricultural marketplace, but the cellular networks could not cover everyone who wanted access to the real-time products." The RTK Bridge products provide the means to connect to the RTN, log in to the central processing center, and pull down the appropriate

correction product and then broadcast that correction product via its internal radio or use commonly accepted third-party external radios.

The RTK Bridge-C device includes a cellular/3G modem (GSM or CDMA) that provides the access to the RTN. This is made through pre-programmed and stored IP addresses, user logins and passwords, and other connection parameters. In addition, the unit may use either the on-board GPS receiver or us-

er-entered locations to transmit its position to the CPC, allowing it to receive correction products that require location information. Corrections may be broadcast and received by rovers via an embedded 900 MHz radio or a 1-watt UHF radio developed for Europe. Higher power third-party external radios commonly used in RTK applications can be connected to the RTK Bridge and serve as an additional means of communication to the rovers. To date, all major UHF and 900 MHz radios have been tested and proven, including those made by Trimble, Pacific Crest, and Satel.

The RTK Bridge-E differentiates itself from the RTK Bridge-C by connecting to the internet via a standard ethernet port instead of the cellular modem. This device is designed to serve in the job-site trailer, farm buildings, or construction sites where internet access is available by hardwire.

The RTK Bridge was initially designed to obtain RTN access in areas where cellular coverage was absent or intermittent. Soon, other applications appeared and were put to the test. Most promising was providing RTN access to millions of dollars worth of legacy RTK survey equipment in the field. Replacing the GNSS base station with the RTK Bridge and if necessary connecting to the base radio, rovers now receive the benefits of network corrections without any change to legacy rover equipment.

Indeed, it is all about connectivity. As the number and size of RTNs continue to expand, their benefits of higher-quality results and higher productivity are becoming available to a wider base of users, provided they have the necessary connectivity. So, improve your position and cross the RTK bridge. ↓





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