By Shawn Billings, LS

Shawn Billings is a licensed land surveyor in East Texas and works for Billings Surveying and Mapping Company, which was established in 1983 by his father, J. D. Billings. Together they perform surveys for boundary retracement, sewer and water infrastructure routes, and land development.

Hemisphere GPS R220

One of the recent trends in precision GPS manufacturing is the enclosed, fully integrated receiver. This is no doubt in response to market demands by surveyors in the field for gear that offers more durability and less complexity in setting up and getting to work. This trend has certainly offered surveyors many benefits, however, it has also ushered in a few limitations. For instance, many of these receivers work with internal, costly and limited memory or require a specific storage medium such as compact flash or secure digital cards. Over the years we have seen some of these media types change or disappear altogether. Some of the older units required a 16 megabyte card. Where are you going to find such an anemic card today? Powering these units typically involves proprietary batteries that are expensive to replace or worse–internally sealed within the unit, rendering them impossible to replace without a trip to the manufacturer. Correction interface may be difficult to modify as well. Switching from a submeter correction source, to an RTN correction source, to a radio modem is not always easy depending on the receiver being used. So, while the receiver-on-a-stick offers wonderful advantages, it can also stifle flexibility. And in a market that still has not fully emerged from recession, flexibility can be a critical attribute to surviving intact.

In a market that seems to be singularly pressing for more task-oriented receivers (i.e., network-based, office-based, field-based, or field rover) enter the Hemisphere GPS R220 dual frequency receiver. This 39-channel, dual frequency receiver is housed in an aluminum box measuring 1.8 inches deep, 4.5 inches in length and 6.3 inches long, or roughly the size of two field books stacked on top of each other. The 39 channels include 12 L1 code, 12 L1 precise, 12 L2 precise and 3 SBAS (Space Based Augmentation System). The receiver can output up to ten positions per second (10 Hz) standard, or up to 20 per second as an option, making the system suitable for mobile applications such as machine control.

The Hemisphere GPS R220 is an enclosed dual frequency GPS receiver capable of receiving OmniStar XP and HP signals as well as WAAS, EGNOS and MSRS, corrections. It's modular design and realtime submeter, decimeter and centimeter level capabilities offer flexibility.

The unit has several ports for communicating with various peripheral devices. There are two RS232, nine-pin serial ports. The unit I "test-drove" had a FireFly serial Bluetooth adapter from Roving Networks affixed to serial port 1. Because the R220 is capable of outputting power through the serial port, there was no need for extra power to the module, which worked seamlessly with the Carlson Surveyor+ data collector I used to control the system. The other RS232 port, serial port 2, was plugged in to a Sierra Wireless Airlink Raven CDMA modem kit which allowed connection to the Texas Department of Transportation RTN. While I was out of range to really give it a good accuracy test, I did receive corrections and can attest that the system was capable of receiving and using the corrections. Of course, instead of being a cellular modem plugged into port 2, I could have just as easily used a spread spectrum or UHF radio for a base or

rover, offering a near limitless array of communication options. Being a ninepin, non-proprietary connection, the choices would be even more abundant. Along with the serial ports are two USB ports, one host and one client. The client allows for firmware updates or option installation while the host offers connection to any USB storage medium, to which the R220 writes directly.

The R220 has no onboard storage, which may seem like a hindrance at first, but in actuality is another example of the tremendous flexibility the system offers. Consider that onboard storage requires a PC connection, and quite possibly, specific, proprietary software to connect and download any stored data, such as data stored for an OPUS solution or other post-process work. Now consider that you can use a thumb drive or, as I used, a card reader tethered with a short USB cable with an SD card in one of the reader slots. With this, I could have used any of about 20 different memory options and I was able to "download" by simply plugging the reader into my computer and copying the collected files to my hard drive with Windows Explorer.

There is also a power port. Because inaccessible, internal batteries can be problematic, and can develop memory issues or fail to hold a charge (requiring a trip to the manufacturer for replacement) accessible, internal batteries are better; still, they tend to be proprietary in nature and are limited in capacity. External power requires cabling and packaging, but also offers unlimited capacity–the unit can be plugged into a protected wall socket as an office base station, or into a car battery for a long duration field set-up, or into a small rechargeable pack for light transport.

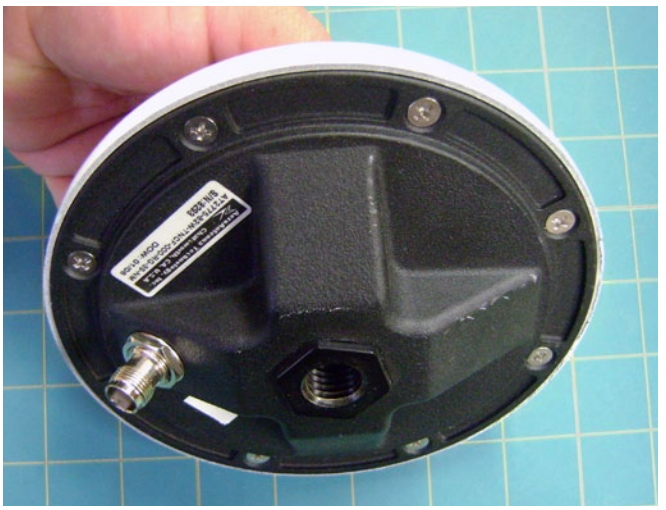
Submeter GPS is well suited for locating shorelines quickly with more forgiveness for canopy than typical RTK and less labor than conventional traverse/sideshot methods.

Last is the antenna port, which is a standard TNC-male connection. At the other end of the antenna cable is an incredibly lightweight and small AeroAntenna Technology, Inc., AT2775 dual-frequency antenna, measuring about 5.5 inches across and about 2.1 inches in height with a 5/8 inch by 11 threaded bottom nut. This antenna was equally at home in use for submeter applications and precision work.

The faceplate of the R220 has three LED indicators for power, GPS lock, and DGPS position status. There is also a backlit screen measuring two inches by one inch that displays a variety of information and allows for interface while using the three buttons located below the screen. A button for scrolling up, one for scrolling down, and an Enter button are used to navigate the LED screen menu.

The system works with DGPS corrections with a separate DGPS receiver using the RTCM version 2 format. It can also be optionally used for RTK and can work with CMR, CMR+ (receive only), RTCM v3.x, and its own proprietary format. With no additional hardware the R220 can work with the subscription services from OmniSTAR HP and XP.

The R220 goes well beyond the sphere of submeter positioning, and is able to perform as an RTK base or rover. It can accept corrections from RTN stations as well. With the receiver's characteristics, it could function as an office base station, with a cabled antenna securely attached in an unobstructed location outside. It can also work as a field base, and finally as a field rover. While it is unlikely you could get it all on a pole, you would probably use a backpack with a cable to the antenna. It sounds "old school" to even suggest a backpack these days, but after toting those 4+ pound bricks with a data collector on a pole, the back really starts feeling it after a long day of topographic ties or construction staking, humping it over hills, creeks and uneven terrain. A backpack setup may ultimately offer better ergonomics over the long haul. The R220 is enabled with Hemisphere's own COAST technology that allows a receiver to keep working even after it loses corrections for up to 40 minutes. From my own experience, I can think of a few jobs that had spotty cell phone coverage or loss of



Above: Cabling affixes to the top of the unit.

Left: The antenna receives GPS and OmniSTAR and is fine for precise applications and submeter applications. It has a standard 5/8 x 11 threaded mount and TNC cable connector.

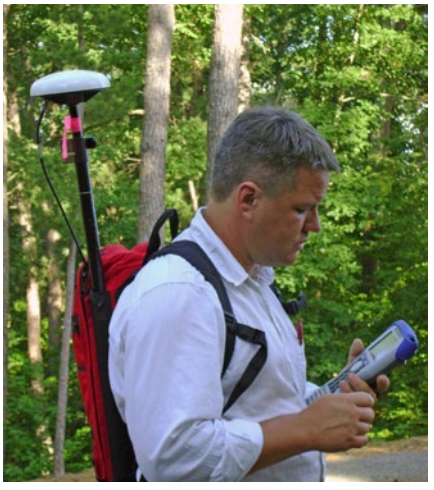
Submeter Positioning and OmniSTAR

Recent advances in the government operated Space Based Augmentation Systems, such as WAAS in North America, have allowed for substantially better-than-autonomous positioning. Because of the way in which the corrections are derived, however, much of the globe is still not improved by these systems. OmniSTAR has been around for about 25 years and has corrections available over most of the land mass on the planet through three different correction options–VBS (virtual base station which is spec'd to be submeter), XP (which works with dual frequency receivers and is spec'd to be accurate to 15 centimeters), and the HP service (which also works with dual frequency receivers and is spec'd to be accurate to less than 10 centimeters).

The R220 I tested was set up for a subscription to the OmniSTAR XP service and was extremely fast at acquiring the OmniSTAR satellite as well as the GPS satellites. Once the unit was indicating a corrected signal on the data collector display, I was able to collect points for mapping and reconnaissance. Because the R220 is a dual-frequency receiver, it is capable of using the more precise XP and HP services. Imagine the capability of being able to work with decimeter-level performance (less than half a foot) anywhere you work, with no need to connect to a correction service by cell modem or radio.

I still contend that submeter GPS is a marvelous tool for any boundary surveyor. Many receivers on the market are dedicated to that specific purpose, but in the case of the R220, the ability to switch from one mode of operation to the other adds to the overall utility of the unit. Because Hemisphere elected to build "the box" and leave the choice of data collection to the surveyor's discretion, the surveyor is free to use a data collector, locate a few points, or navigate to recover some points, and then plug it in to his or her total station to continue the job. Or the submeter application can be used to navigate to a control point and then observe that point with the R220 for a static observation for later post-processing, or be occupied for a base RTK set-up.

Submeter positioning technology alone offers so many uses to the surveyor that it bears consideration. There are so many objects that we map in the course of our work that do not require tight positional tolerances–water features, dirt roads and trails, utilities, marshes (such as wetland delineation), and reconnaissance work–to recover control and boundary monuments. Submeter positioning doesn't require near the level of rigorous procedure that other positioning does and can be much faster to implement in the field. However, it must be remembered that you cannot simply take a map that was not done on a georeferenced coordinate system and begin finding boundary corners. At least two boundary corners will have to be located on a coordinate system before the map can be rotated and translated into a coordinate system (unless the map was based on astronomic or geodetic North, in which case only a single point is needed to get started). Or, perhaps the boundary can be approximately fit to a coordinate system by taking the outline of the property and overlaying it on an georeferenced orthophoto, which we commonly do when working in a new area. Ultimately, if you use GPS positioning on every boundary job, you will eventually develop a patchwork that you can connect other described parcels to for very close search coordinates, and as you see a boundary corner across the road from your job today, you may tie it in simply for future reference. Such extra steps make return trips with a submeter system very rewarding.



Mapping a wooded trail is as easy as walking the line and letting the data collector save a point on a timed interval. With a hydration pocket in the Camelbak pack, toting water makes work seem more like a picnic.

contact with the base via radio that just a few more minutes would have made a tremendous difference.

While I did not test the unit as a rover, I did put the unit on the office base station mount we refer to as the "Post". I ran the receiver for three hours and twenty minutes and converted the collected files to RINEX. The resulting RINEX files were then sent to the Online Positioning User Service (OPUS) for processing. We have been collecting data on the Post for years and having submitted those years of data to OPUS, we have a very accurate position from numerous averages of the resulting positions. The coordinates returned for the R220 session differed from our long observed average by a very respectable 0.05 foot in elevation and 0.06 foot horizontally.

The receiver is simple, capable, and offers an incredible degree of flexibility. For those curious about what it might take to drive one home, the R220 costs about $6,500 which includes the receiver, antenna, cabling, firmware for OmniSTAR and RTK base corrections. An additional cost of $3,000 buys the RTK rover firmware. Hemisphere GPS is a division of a Canadian company based out of Calgary, Alberta, that has been around since the early 1990s that focused primarily on the agricultural market. With a substantial portion of the company's intellect based in Scottsdale, Arizona–from design to tech support–it is heartening to see a domestic manufacturer offer a product that competes with the dominant manufacturers. It offers a product that isn't just a copy of what is already available, but offers the buying public something that approaches the market from a different angle altogether. At least from my point of view, that's good for the surveyor.