MidStates VRS provides RTK quality corrections via cellular connections.
**WHAT IS VRS?**

VRS is a Trimble trademark; it stands for Virtual Reference Station. A VRS network is an integrated system and consists of:

- GPS/GNSS reference stations spread out over a large area, typically 30-45 miles apart.
- A central server creates a correction model for the region covered by the network. GPS rovers communicate using a cell modem with this VRS server and receive RTK type corrections.

The data from the reference stations is used to model errors throughout your region. The model is used to create a network of “virtual” reference stations near your current location, which then provide a “localized” set of standard format correction messages for your roving receiver.

Since the error models are updated every second, all rovers receive an optimal correction model after connecting to the network. This ensures a high quality correction, and accuracy.

**WHAT IS THE DIFFERENCE BETWEEN CORS AND VRS?**

Continuously operated reference stations (CORS) are most commonly attributed to the National Geodetic Survey (NGS) in the USA. These GNSS receivers are often permanently installed. End users that access a CORS receive a single base correction, so the position accuracy decreases as the users move further away from the base. This is like using a single base solution with a cellular modem instead of a radio.

All reference stations used in a VRS system can be interpreted as a network CORS. The differentiating factor is that an end user who accesses a VRS network gets a network solution. The position accuracy is maintained even if the user moves away from the single base but is still within the network.

We have selected and placed our CORS in accordance with NGS guidelines.

**DO I NEED A SPECIFIC BRAND OF GPS/GNSS RECEIVER TO ACCESS THE MIDSTATES VRS SYSTEM?**

No, the Pivot server software will work with most, if not all GPS/GNSS receivers. The software will provide data corrections in both the CMR+, CMRx, and RTCM correction formats. It is always best to ask your equipment dealer which correction message format is best suited for your equipment and application.

MidStates VRS is a new service that provides RTK quality corrections via cellular connections. The Virtual Reference Station (VRS), networked using the latest in positioning software from Trimble, will utilize multiple GPS and Glonass (GNSS) Base Stations located across the Dakotas. Anyone with RTK correction needs that has sufficient cell coverage simply connects via a cell modem for a personalized signal, specific to their location without the hassle of setting up a base station or radio.
Coverage map subject to change as we grow and expand the network to better serve our customers.
HARDWARE
The Trimble NetR9 – a highly versatile, ground-breaking GNSS reference receiver for infrastructure and network applications. It has a full-feature, top-of-the-line receiver with an industry-leading 440 channels for unrivaled GNSS multiple constellation tracking performance. The Trimble NetR9 was designed to provide the network operator with maximum features and functionality from a single receiver.

SOFTWARE
MidStates VRS has deployed Trimble’s RTKNet Infrastructure software. Designed to provide true Network RTK performance, the Trimble RTKNet software enables high-accuracy positioning in real-time across a geographic region. The RTKNet software package uses real-time data streams from the GPSNet system and generates correction models for high-accuracy RTK GPS corrections throughout that network. It is ideal for any application requiring reliable, fast, high precision wide area positioning.

SUPPORT AND NETWORK UPTIME
MidStates VRS network is built upon the industry leading experience of Trimble Virtual Reference Station Systems, with VRS installations dating back to 2001. Trimble’s platform is the industry standard when it comes to reliable continuously operating real-time networks. With Trimble VRS networks all over the world including Wisconsin, Minnesota, and other surrounding states, users can be assured that they are receiving the highest quality real-time corrections when it comes to MidStates VRS. Our network is supported by our fully staffed Technology Call Center ready to take your calls and assist in all of your VRS needs.

CORS STATION INSTALLATION
To ensure the quality of our network each of our CORS Stations is built to National Geodetic Survey (NGS) standards and several are registered with NGS. All correction formats are using the NAD 83 2011 (Epoch 2010.00), same as NGS CORS stations including OPUS. Battery backup ensures continued network performance during power outages.
HOW DO I FIND OUT IF VRS IS RIGHT FOR ME?
If you are in agriculture and considering RTK quality guidance for row crops or water management, VRS will help tremendously.

Contractors and land surveyors who push the limits of their radio networks or find they are limited by how many base stations they own will also benefit greatly from VRS.

A TYPICAL VRS SYSTEM

WHAT IS MIDSTATES VRS?
The VRS system is a valuable technology and can cover more miles in harsher terrain without the hassle of setting up base stations. However, performance is dependent on cell phone signal reliability.

If you are in an area with mature and robust cell phone coverage:

- MidStates is confident that using VRS in machine control applications will be satisfying.

If you are in an area where cell phone signal reliability is not consistent, we recommend the following:

- Consider the VRS system as a complementary solution, not a replacement for traditional RTK.

- Understand that the viability of the VRS system will vary by location.

IS A CALIBRATION/Localization NECESSARY?
It is best that your measurements fit the local control as closely as possible. This would normally be a decision made by the user. This can only be confirmed by any degree of certainty by measuring to trusted control monuments in your area and examining the differences. Recommendations for calibration/localization are as follows:

- Vertical Calibration/Localization: 1 point or 4 or more points vertically. Normally on a small site project (i.e. less than 2 miles) a 1 point vertical adjustment is sufficient.

- Horizontal Calibration/Localization: 3 or more points are recommended. It is not recommended to use multiple points of horizontal adjustment when working within a chosen coordinate system like State Plane or UTM.

DOES THE MIDSTATES VRS SUPPORT GLONASS AND GPS SATELLITES?
Yes, both GPS and Glonass Satellites are supported by MidStates VRS.

WHAT ACCURACY DO I GET IF I AM IN NETWORK? HOW IS THIS RELATED TO RANGE?
Typically, VRS system performance is relatively the same as traditional RTK without the limitation of baseline lengths as long as you are in the network footprint.

WHAT ARE THE BENEFITS OF USING CELL MODEMS?
All of the rules of RTK radios change with cell modems. Distance limitations of 900Mhz go away, and there are no licensing issues with 450Mhz radios. VRS corrections are most frequently transmitted via cellular.

Cell modems also allow for significantly more data transmission to the field. This opens up additional data services that are impossible to access via 900Mhz and 450Mhz radios. These tools may be data transfer, fleet management, remote support, and cloud backups.

Additionally, VRS networks may offer better signal coverage in rough terrain if the local cellular network is robust and provides good data coverage. VRS networks via cell modems also offer an alternative correction source for agricultural applications with better accuracy than SBAS (or WAAS, EGNOS, or OmniSTAR) corrections.
WHAT ARE SOME OF THE ADVANTAGES OF USING VRS OVER A TRADITIONAL BASE STATION SETUP?

- Common coordinate system/datum – All data across the network is of a common datum and adjustment.
- RTK radio limitations – No FCC radio licensing requirements, radio link hassles, or downtime due to radio link limitation, while at the same time extending your operating range.
- No base station setup – Save time and money by not having to setup a base station each and every day. Setup, power, and physical security become a non-issue.
- System provides integrity monitoring 24/7.
- Eliminates the errors associated with single base setup.

CAN I GET A MORE ACCURATE SOLUTION BY JUST USING A CELL MODEM AND A SINGLE BASE SOLUTION?

No. The correction message you receive from a single base solution does not change if you use either a traditional 900/450 MHz radio or cell modem. In many cases, you may get a better range with a cell modem but the accuracy will be comparable to that achieved with a 900 MHz or 450 MHz radio. Additionally, the farther away a rover or machine is from a base station, the less accurate the correction. VRS corrections are uniform in the coverage area.

HOW FAR FROM A TOWER CAN I BE?

If you’re inside the network, you will have coverage no matter where the towers are. If you’re on the edge of the network, MSVRS will provide you RTK accuracy 6 miles from the network border.

HOW CAN YOU HAVE YOUR BASES SO FAR APART?

VRS technology has been pushing the envelope on how far you can go without compromising accuracy. A complex filter uses the information from all the base reference stations and computes a solution tailored to your location. MidStates VRS base reference stations average about 45 miles distance.

ARE THERE OUTAGES? IF SO, HOW LONG DO THEY LAST?

MidStates VRS endeavors to keep all outages to an absolute minimum and to notify all users of planned maintenance. There are a few ways outages could occur:

- On the VRS system side, an outage could be due to maintenance work. Additionally, there could be damage from severe weather. These types of outages could last a few seconds to a few hours. There are backup systems in place to reduce these risks. MidStates VRS will inform you on any planned outages for maintenance or upgrades.
- Cell phone network outages are related to “dropping” a cell phone signal. You may drive out of a coverage area and lose the cell phone link with the virtual reference station. There is no typical characterization on how long this could be. If XFill technology is available for your GPS receiver, these outages will be no problem if limited to less than 5 minutes.
- On the receiver side, we have observed that under certain conditions, certain receivers may momentarily drop out of RTK before re-engaging. The drop should be short, under 15 seconds. This should not be a regular occurrence; please call if any RTK drops are more frequent than once in a 4 hour period or last longer than 15 seconds.

CAN I GET VRS SYSTEM CORRECTIONS WHENEVER I WANT?

You can receive VRS system corrections 24/7.
HOW FAR IS MY VRS BASE ID FROM MY CURRENT LOCATION, WHEN I AM IN NETWORK?
Typically, when you send your location to the VRS server, the VRS server produces a reference location (base ID) very close to your current location. This base ID is your own personal virtual base station. A new base ID may also be created if you are dropped from a current session and you reconnect to the VRS server.

WILL I SEE A LINE SHIFT BECAUSE OF THIS BASE ID CHANGE?
No. Our tests have shown that there are no line shifts or positional drifts when a new base ID is used.

DO I NEED TO PAY A SUBSCRIPTION FEE TO ACCESS THE MIDSTATES VRS SYSTEM?
Yes, there is a fee to access the system. Please contact your Butler Machinery or Frontier Precision representative for subscription pricing. You can also request pricing information from info@midstatesvrs.com.

WHAT ABOUT VERTICAL ACCURACY?
Vertical accuracy is generally twice the horizontal accuracy.

WILL VRS WORK WITH TOPCON GPS EQUIPMENT / MACHINE CONTROL?
Yes. MSVRS supports Trimble and TopCon on construction equipment. We also support Ag Leader, Trimble, and Raven Ag systems.

DO I NEED TO SWITCH TOWERS (AG) OR CHANGE CHANNELS ON MY RADIO (CONSTRUCTION)?
No to both. We have a continuous, NGS-certified network. You will get the same accuracy in Williston that you will in Sioux Falls without changing anything.

WHAT ACCURACY DO I GET IF I AM OUT OF NETWORK?
Once you are outside of the MidStates network, you may or may not receive a correction. If you do receive corrections, this may be a single base solution and will not provide you with the accuracy that you would have obtained inside the network. The single base solution error increases as you move further away from that base location (like a traditional single base RTK solution).

WHO DO I CONTACT FOR HELP?
Email info@midstatesvrs.com or call 844.830.3974 for assistance.
SIGN UP TODAY AT MIDSTATEVRS.COM

FOR MORE INFORMATION,
EMAIL INFO@MIDSTATEVRS.COM OR CALL 844.830.3974