

For complete GNSS reference station management, the worldwide preferred choice is Trimble® GPSNet™ reference station software. Trimble GPSNet manages more reference stations 24/7 than any other GNSS infrastructure solution; it is the industry standard for quality and reliability.

The Trimble® GPSNet software is designed to connect to and control multiple reference stations in a GNSS infrastructure network. It is an integral part of the scalable Trimble GNSS infrastructure solution of small, medium, and full installations. In the Trimble solution, users of GPSBase™ software with a single reference station can upgrade to GPSNet as they expand to multiple reference stations; with the addition of the RTKNet™ module, a multiple reference station solution can expand into a full Trimble® VRS™ network.

Trimble GPSNet enables one person to operate a large number of GNSS reference stations in a network covering a wide geographic area. Using GPSNet, any company or government organization can set up a fixed reference station network over a city, state, or country to provide continuous RTK corrections and postprocessed data. Such a network eliminates the need for temporary GNSS base stations for individual projects, thereby saving significant time and money. Authenticated users in a wide variety of applications can utilize and benefit from the network.

When used with a Trimble® NetR5™ reference station, GPSNet software can process both GPS and GLONASS data. The new civil signal GPS L2C is used by GPSNet to improve ambiguity resolution, provide ionospheric modeling, and generate network corrections.

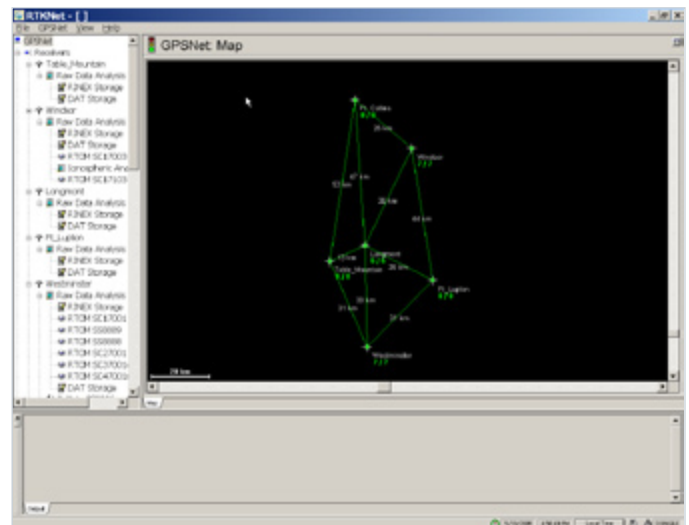
## UNIQUE AND POWERFUL TOOLS FOR NETWORK MANAGEMENT

Trimble GPSNet connects to the GNSS reference stations in a network using either a LAN/Internet or modem connection. At a central location a single operator can then use the software to monitor the status and performance of all reference stations in the network. GPSNet also provides the operator with unique and powerful tools for data management and distribution, receiver operation, and integrity monitoring.

With Trimble software managing and monitoring the integrity of a GNSS infrastructure solution, all owners and users of the network can experience optimum performance from the network and quality assurance in their data.

## CUSTOMIZED GNSS INFRASTRUCTURE SOLUTIONS

At Trimble, we focus on the needs of our customers, so every Trimble GNSS infrastructure solution with GPSNet software is completely customizable to meet unique or regional requirements. Whether a service provider needs to configure a handful of GNSS reference stations or model the systematic errors within a large network, Trimble has a practical, scalable, reliable solution.



*The Trimble GPSNet software connects to and controls multiple reference stations in a GNSS infrastructure network.*

<sup>1</sup> GPSNet software is not limited to use with Trimble reference stations: when used with third-party reference stations, GPSNet not only provides connection, but also total control.



In a medium-sized Trimble GPS infrastructure installation, a single operator uses the GPSNet™ software to manage a large number of permanent reference stations from a central location. Users receive single-reference-station GPS corrections over a wide geographic area.

### TRIMBLE GPSNet: MULTIPLE REFERENCE STATION CONTROL

Trimble GPSNet connects to a reference station, such as the Trimble NetR5, via a LAN/Internet or modem connection. Through this connection the software is able to configure the receiver using settings specified by the operator. These settings typically include activation of data logging, epoch rate, and elevation mask. The software thus provides total control of the Trimble or third-party receiver.

The configured receiver sends raw data to the server for integrity analysis by GPSNet. Because this process uses raw observables from the receiver, valuable information is not lost through conversion to a message protocol such as RTCM.

The data analysis carried out in GPSNet includes a realtime multipath plot/reduction of data, which changes with time to accommodate seasonal variations. Continuous integrity monitoring is performed by the software to ensure that only high quality data is used in the network processing.

Following analysis, only high quality data is distributed for real-time correction broadcast from a single reference station, or passed on to the RTKNet module for realtime processing.

### RTCM and CMR Generation

With Trimble GPSNet, data can be generated in standard message protocols such as RTCM and CMR. All types of RTCM outputs are supported, including 2.1–3 and 3.0. The new RTCM 3.0 network RTK messages are also supported by Trimble GPSNet. These messages can be either used in broadcast or “dial-in” mode.

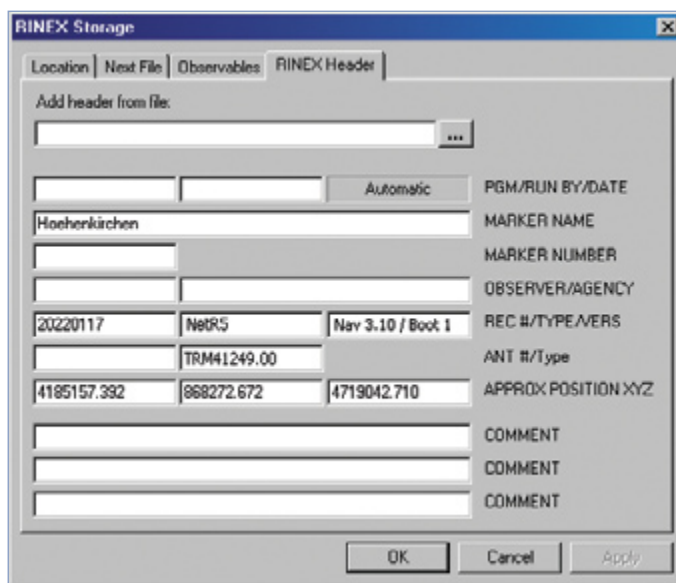
These outputs are fully configurable for maximum flexibility. And they can be output from each individual reference station either by direct Internet connection, NTRIP, modem link, or serial port.

Reference stations under GPSNet control can be equipped to broadcast corrections in the format of the operator’s choice. Using a communication option such as the Trimble HPB450 radio modem, receivers can broadcast corrections for use by rovers in the field.

### DATA STORAGE

GPSNet provides powerful features for storing data in industry-standard formats, for example, RINEX and DAT files:

- RINEX headers are fully customizable to meet the specific needs of a business or user.
- If data must be logged at different rates or for different file sizes, then multiple sessions can be logged.
- Several compression options are offered for data: RINEX and DAT files can be zipped, and Hatanaka compression is possible for RINEX files.
- Multiple FTP sessions can be created for upload to remote servers.
- Data storage space is managed by the DiskWatch utility. This customizable utility deletes files by date, type, or remaining disk space.



**INTEGRITY MONITORING**

Trimble GPSNet is designed to constantly monitor the integrity of the complete infrastructure solution. Its powerful integrity monitoring functions ensure that the system is fully operational and providing correct information. Its integrity checks include, but are not limited to:

- Coordinate Monitoring
- Position and status of the reference stations
- Quality of raw data observables
- Quality of final solution indices

**Coordinate Monitoring**

Trimble GPSNet continuously monitors the coordinates of all station positions with centimeter accuracy. This safeguards the consistency of the network and the quality of the service for field users. The Coordinate Monitor indicates changes in station positions caused by, for instance, human interference, subsidence, or land slides. It thus serves as a precise tool for deformation analysis.

**Automated Fault Tolerance**

GPSNet warns of critical situations via an automatic alarm system. An e-mail, sound, or visual cue is used to warn of issues such as low disk space, communication or satellite tracking problems, inability to compute network corrections, and reference station movement.

**Data Storage Integrity Check**

GPSNet includes a Storage Integrity module that works with the Trimble GNSS system to ensure that DAT and RINEX files are complete. In the event of real-time data transfer problems, the module downloads missing data from the reference station automatically once communication is restored. This feature ensures that in any communication outage or server problem DAT and RINEX files can be obtained to maintain 100% of the data for postprocessing.

**Fully Redundant Systems**

Trimble GPSNet supports multi-server installations to distribute functionality among PC hardware. A fully redundant system can be set up in such a configuration. Each part of the software can be configured in a way that a backup Server-PC is taking over the functionality once the primary server-PC is malfunctioning. Such a fault-tolerant system set up is ideal for 24/7 operation.

**GPSNET REFERENCE STATION MANAGEMENT**

*The Trimble NetR5 reference station is an advanced GNSS receiver. It supports the new L2C and L5 signals that are part of GPS Modernization, plus GLONASS.*

*The Trimble NetRS reference station supports the new L2C signal.*

*Configure real-time output settings for transmitting to a radio such as the HPB450.*

*Choose the connection type: Internet, ISDN, or LAN*

*Trimble 5700 CORS reference station*

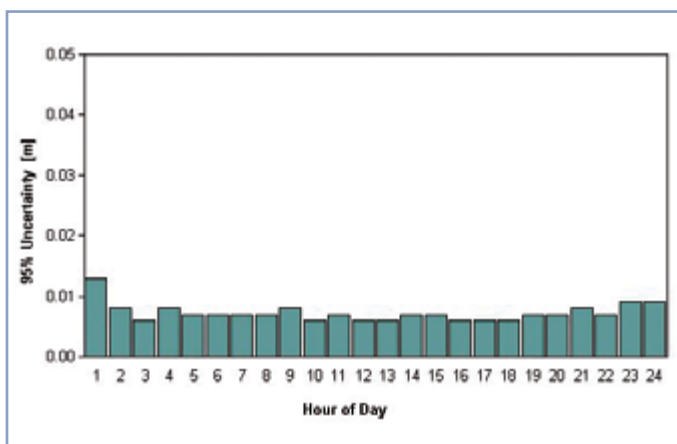


## FULL REFERENCE STATION NETWORKS: RTKNet AND TRIMBLE VRS

With the addition of the powerful Trimble RTKNet module to GPSNet™, a multiple reference station solution can expand into a full Trimble VRS network. Trimble VRS is the ultimate step in a scalable Trimble GPS infrastructure solution.

Once the reference stations in a network have sent raw data to the GPSNet software, the data can be processed in the Trimble RTKNet module. RTKNet uses the data to produce real-time correction models that allow users in the field to access RTK (real-time kinematic) positioning over a wide area. Centimeter accuracy is possible 24/7 throughout the network.

RTKNet can process up to 100 reference stations on one PC<sup>2</sup> to maximize the ease of managing large reference station networks. This is achieved by a new technology developed by Trimble based on parallel filters modeling all error sources in the network.



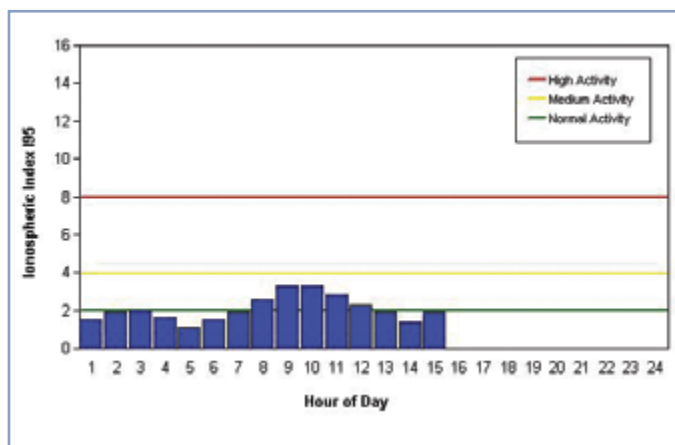
*View the remaining ionospheric errors in your network after applying the corrections.*

## Ionospheric and Tropospheric Modeling for Generating Corrections

When Trimble GPSNet receives data from the reference stations in a network, it synchronizes the raw observables to the same epoch before forwarding them to the RTKNet processor. RTKNet then uses the data to calculate ionospheric and tropospheric models. This modeling enables an operator to monitor ionospheric activity during the day and to predict the remaining geometric and ionospheric errors at each reference station after the models are taken into account. The operator is thus able to see how well the system is performing in times of high ionospheric activity, which assists in troubleshooting and integrity monitoring.

Using automatically downloaded predicted orbits<sup>3</sup>, the network is solved in RTKNet, and ionospheric activity can be viewed using industry-standard I95 plots. Once the network is solved—in just a few minutes—users with access can perform VRS surveys.

Again, the quality control information that the Trimble GNSS infrastructure software produces is extensive and indepth, so data and network integrity is assured. RTKNet regularly produces reports on the network, and displays the status of each reference station in real-time.



*View the actual ionospheric activity in your network over the day and see how it changes.*

<sup>2</sup> Dual-processor, >3 GHz, 2 GB RAM required.

<sup>3</sup> Downloaded predicted orbits are significantly more accurate than broadcast ephemerides from the satellites.

**CONVENIENT, EASY-TO-USE WEB INTERFACE**

With the optional Trimble WebServer software, multiple reference station supervision is as easy as logging onto a customized Web site. The Trimble WebServer application presents the data produced by Trimble GPSNet in a Web page that can be completely customized to suit a service provider's unique needs in appearance, functionality, and controlled access.

The WebServer interface publishes several useful items, including:

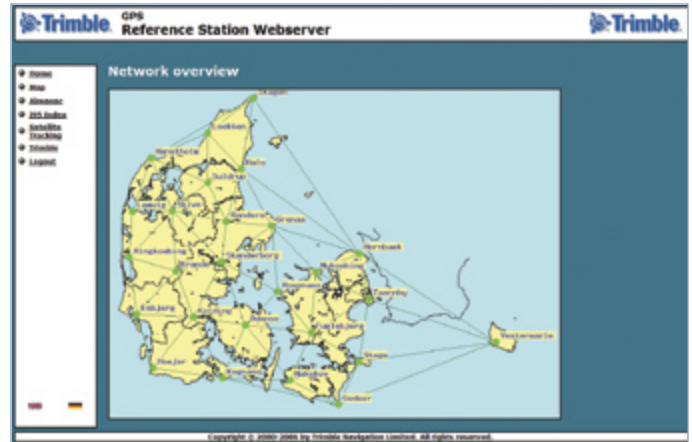
- View I95 plots and reports
- Monitor ionospheric activity and tropospheric errors in the network
- View satellite tracking and coordinates for each reference station
- Download RINEX files (virtual and actual) for a user-specified time span
- Request RINEX files to be automatically e-mailed at a specified time

Like the network itself, the WebServer Web site is easily adapted, so that user groups can have varying levels of secure access.

**CUSTOMIZABLE APPEARANCE**

A service provider can customize the appearance of its WebServer Web site by adding colours and images, such as a company logo, for branding purposes. Links to supporting Web sites can also be added. The WebServer Web site becomes an integral part of your company and business.

WebServer can also be customized to support most languages.



**RINEX Shop – File Details**

**Station:** Rosenheim

Date: Friday, 02/11/2005  
 Start time: 12:00:00 PM  
 Duration: 2:00 h  
 Interval: 5 s

Generation result: OK

Epochs requested: 1440  
 Epochs available: 1257 (87.29%)

Data analysis:

From	To	Epochs OK	Epochs missing
12:00:00 PM	12:12:00 PM	145	0 (0%)
12:12:05 PM	12:15:20 PM	0	40 (100%)
12:15:25 PM	01:33:05 PM	932	1 (0.1%)
01:33:10 PM	01:44:55 PM	0	142 (100%)
01:45:00 PM	01:59:55 PM	180	0 (0%)

A red row indicates a data gap, i.e. there are no epochs in a continuous time period of at least 1 min.  
 All times are in the GPS time system.

Buttons: Back to Order View, Previous File, Next File

*Many different reports and graphs are available via the Web browser to keep users and/or administrators informed of current network status. A RINEX shop allows users to request and download RINEX files for postprocessing.*



Once a Trimble GNSS network is established, a surveyor or engineer in the field with a GNSS rover that supports RTCM 2.X, 3.0 and CMR can access centimeter-accurate positioning information at any time. Access is obtained via cell phone “dial-in” or the NTRIP protocol.

## SOPHISTICATED AND SECURE ACCESS

### NTRIP Standard Protocol

The Trimble GNSS infrastructure solution supports NTRIP (Networked Transfer of RTCM via Internet Protocol), which is an RTCM-approved, publicly available, non-proprietary Internet protocol for distributing differential corrections and other GNSS data over the Internet. NTRIP allows multiple receivers to connect to the network simultaneously and securely. It also supports wireless Internet access through Mobile IP Networks such as GPRS and 1xRTT. NTRIP is therefore ideal for supporting precision navigation applications worldwide.

NTRIP provides secure access by allowing multiple users to connect without coming into direct contact with each other or the service provider. And NTRIP streams are usually not blocked by firewalls or proxy servers protecting Local Area Networks.

Mount point	Identifier
DGPS-TNZ-4079	DGPS-TNZ-4079
TNZ-RTCM2.1	TNZ-RTCM2.1
TNZ-RTCM2.3	TNZ-RTCM2.3
TNZ-RTCM3.0	TNZ-RTCM3.0
TNZ_SB_RTCM3	TNZ_SB_RTCM3

100%  
80%  
8  
1.800

Map  
Menu  
Favorites  
Switch to

Esc      No survey PDOP:2.2  
All    Refresh    Enter

*NTRIP source table listed in Trimble Survey Controller field software.*

### Authenticated User Access, Auditing and Accounting

To protect the infrastructure network from exploitation by unauthorized users, GPSNet™ offers powerful authentication features to ensure that only approved users can access the network. Using Trimble GPSNet a service provider can control user access in many different ways. Access can be unlimited or selective:

- Users trying to connect to the network must enter a password before they are granted access.
- Users can be granted different levels of services. For example, a service provider may offer three levels of service: a Trimble VRS (centimeter accuracy) for premium users, a networked DGPS solution (50 cm accuracy), and a traditional single-base RTK or DGPS.

GPSNet also enables service providers to implement their own tools to audit user access, that is, for information on the number of times a user accesses the network, the length of time spent on the network, and the amount of data accessed. Accurate billing is therefore assured, as well as transparency of invoicing to the client.

GPSNet offers authentication via the NTRIP protocol or the CISCO Access Server.

### Powerful Trimble Survey Controller Field Software

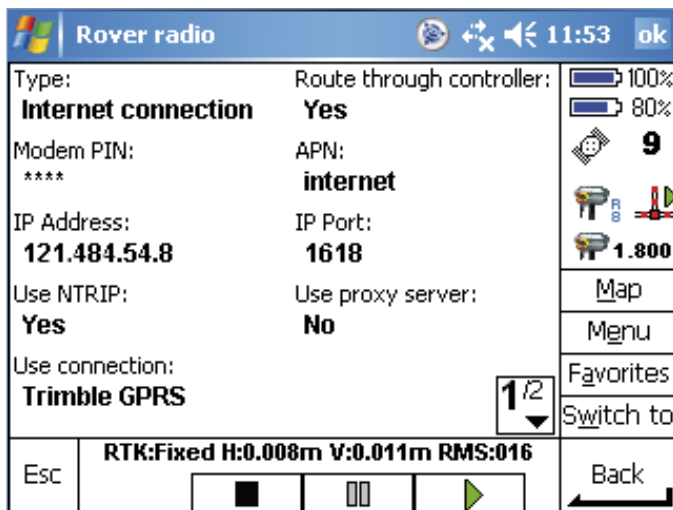
The Trimble Survey Controller™ field software is a powerful field solution for infrastructure network users. Its unique infrastructure-supporting features include:

- Cable-free connection to the Internet through a GSM/GPRS cell phone with Bluetooth, or the internal GSM/GPRS module in the Trimble R8 GNSS system.
- The ability to receive network status information from GPSNet, that is, to confirm whether the network is in VRS mode or single base (raw) mode.
- RTK-on-Demand

**RTK-on-Demand (Patented)**

RTK-on-Demand is a unique feature of GPSNet that ensures efficient Internet connection to minimize costs for GPRS users in the field. When GPRS is used for connection to the Internet, payment is required for the amount of data received. RTK-on-Demand works by allowing the user to pause the data stream as necessary. This capability ensures that data is only streamed from the server to the rover when a point is being measured or if initialization is lost.

The RTK-on-Demand function is available when Trimble Survey Controller field software is running on the GNSS



*To pause the data stream, users just click on the pause button as shown.*

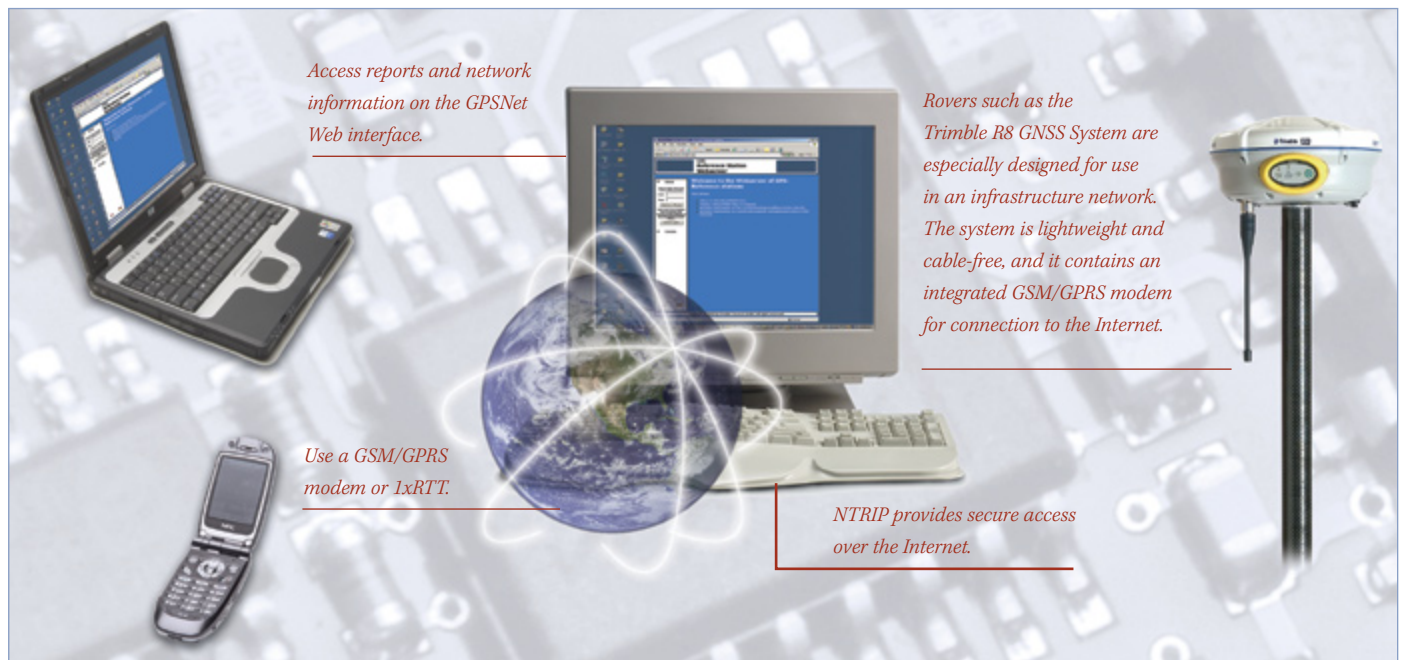
rover controller, for example, the Trimble CU. Trimble Survey Controller automatically prompts the GPSNet server when to stream data.

**Rover Integrity Module**

At the same time GPSNet is sending corrected GNSS data to a rover, the rover is transmitting a position estimate and other data back to GPSNet. However, the reliability of a rover's data can vary due to factors such as its receiver firmware, satellite visibility, multipath, and the network data. The GPSNet software's optional Rover Integrity module allows a service provider using GPSNet to monitor the performance of the network, plus the expected performance of RTK users within the network area.

To monitor the reliability of rover data, clients can set up a rover in a known location within the network area. This rover will continuously send position data and initialization information for the Rover Integrity module to analyze. The module analyzes the NMEA string and performs statistical computations on it, then reports the findings.

**GPSNET USER ACCESS**



*Access reports and network information on the GPSNet Web interface.*

*Use a GSM/GPRS modem or 1xRTT.*

*Rovers such as the Trimble R8 GNSS System are especially designed for use in an infrastructure network. The system is lightweight and cable-free, and it contains an integrated GSM/GPRS modem for connection to the Internet.*

*NTRIP provides secure access over the Internet.*



## ACCURACY AND CONVENIENCE FOR ALL USERS

The need for accurate positioning is not limited to surveying. Today, many different industries need accurate positioning and geomatics data sharing.

A multiple reference station solution managed by the Trimble GPSNet™ reference station software is ideal for a range of precision GNSS applications. Users collecting data for surveying, engineering, construction and high-accuracy GIS applications can all utilize and benefit from the quality data, and time and cost savings, provided by the network.



*Service providers, clients, and users alike all benefit from the innovative and easy-to-use Trimble GNSS infrastructure solution with GPSNet software.*

## CONCLUSION

Trimble GPSNet reference station software provides total control in a GNSS network. As an integral part of the scalable Trimble GNSS infrastructure solution, GPSNet enables clients to grow their infrastructure solution as their business needs expand. With unique and powerful tools for network management and reference station control, GPSNet offers service providers and users complete confidence in the performance of the network and the integrity of their data.

## SYSTEM REQUIREMENTS

A Trimble representative will work with you to install the GPSNet software as part of a customized Trimble GPS infrastructure solution that will meet the unique and regional needs of your organization.

### For the GPSNet software:

- Microsoft® Windows® XP Operating System OR Windows 2003 Server
- 1 GB Memory
- 80 GB Hard Drive

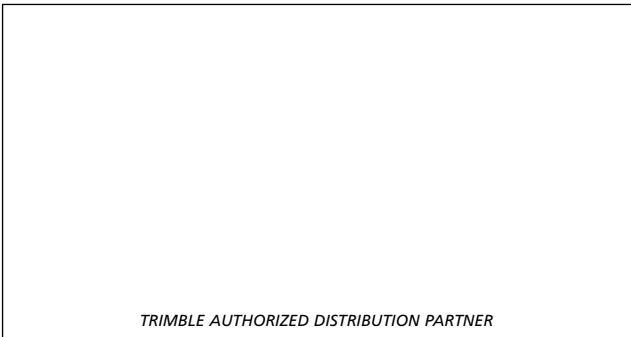
### For network access<sup>4</sup>:

- Trimble Survey Controller 10.7 or later
- Trimble R8 GNSS system, and Trimble R8/5800 and Trimble R7/5700 GPS systems
- Any third-party GPS rover that supports the NTRIP protocol, RTCM<sup>5</sup> 2.X, 3.0 or CMR

<sup>4</sup> GSM data access without NTRIP is also possible, for example, via hardware such as an access server.

<sup>5</sup> RTCM 2.1 and RTCM 2.3 also support FKP broadcast for network corrections for use in areas where the service provider may prefer that format.

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