



HEXAGON



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NTRIP on NovAtel OEM6/OEM7



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NTRIP Overview

Prior to the introduction of the NTRIP protocol (Networked Transport of RTCM via Internet Protocol), RTCM correction data could be broadcast by either radio or satellite telemetry. [TerraStar](#) is a Hexagon owned satellite-based broadcast service that offers users significant benefits when compared to the terrestrial broadcast systems.

Where RTK performance is required, RTK corrections must be broadcast to a rover system either using radio telemetry or over the Internet using the NTRIP broadcast protocol. Reliable radio telemetry requires the following:

- Good quality radio modems and antennas.
- A clear line-of-sight between the base transmitting antenna and the mobile receiving antenna.
- A radio license or radio equipment that operates license free (dependant on location).

Radio telemetry can have a significant burden in term of equipment, logistics and cost. Additionally, radio telemetry can be degraded by interference, blockage, and urban electronic noise.

NTRIP is a significantly simpler and more reliable method of broadcasting RTCM corrections. The final stage of the NTRIP data broadcast is typically delivered over Telecom cellular networks, the user will only need to organize a mobile data connection either via smartphone or a dedicated cellular modem. Mobile (3G/4G/5G) data connectivity will be significantly more reliable than radio telemetry especially in urban areas. In remote areas with poor or no cellular coverage, satellite internet is an alternative option.

There are commercial NTRIP RTK correction suppliers offering subscription-based services, these services remove the need for the user to install RTK reference stations and NTRIP Casters. Commercial NTRIP services will have limited RTK coverage.

If the end user already has access to RTK reference station hardware, they may prefer to organize their own NTRIP caster infrastructure. This will require:

- Reliable broadband internet access with a static public IP address.
- PC or server (preferably dedicated).
- NTRIP Caster software (this application note uses SNIP (LITE license)).

This application note provides details on how to configure NovAtel GNSS systems (OEM6 and OEM7) to input corrections to NTRIP Casters and interface NTRIP corrections for RTK rover operations.

NTRIP operations with NovAtel systems require the receiver to be authorized and the systems ethernet adapter to be correctly configured. Refer to [Receiver Model Requirements](#) for authorization guidance and [Ethernet Adapter Configuration](#) for instructions on network adapter configuration.

The following schematic illustrates the use of NovAtel GNSS systems operating with different types of NTRIP roles.

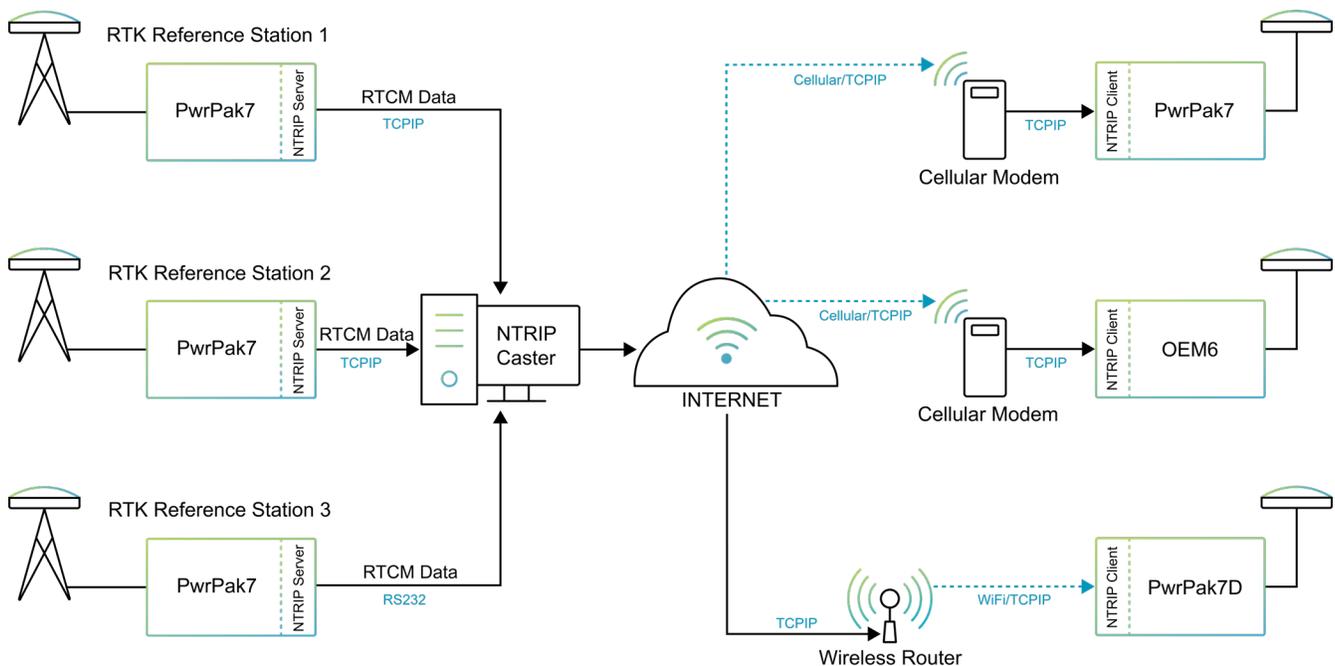


Figure 1: NTRIP schematic

An **NTRIP Client** logs in to an NTRIP caster using mobile internet, selects the required RTK or DGNS correction stream and interfaces the selected GNSS correction data to a GNSS rover. The GNSS rover will then operate in RTK mode.

The **NTRIP Caster** is a software application that performs the following functions:

- Connects to NTRIP servers providing GNSS correction data inputs (using either network or RS232 serial inputs).
- Organizes incoming GNSS correction data streams to NTRIP mount points.
- Performs account administration of NTRIP Clients (users).
- Configures network addressing (either IP address or URL).
- Broadcasts correction data to connected NTRIP clients.

NovAtel does not offer NTRIP Caster products, this application note details the use of a third-party software application SNIP operating in LITE mode. NovAtel is not promoting the use of SNIP and offers no technical support of the SNIP product.

The **NTRIP Server** interfaces Reference Station correction data to an NTRIP caster application by network connection. Note it is also possible to interface correction data to an NTRIP caster using serial RS232. In this case, the NTRIP caster is also performing the NTRIP server role.

The following sections explain each of the three NTRIP roles in more detail with examples and specific guidance on NovAtel system configuration.

NTRIP Client Mode

The NTRIP Client logs into an NTRIP Caster (typically via the internet), selects the required correction data broadcast stream (mountpoint) and then continually receives the broadcasted correction data. The NTRIP Client inputs this correction data to the GNSS receiver which will then operate in an RTK corrected mode.

NTRIP Client Configuration

The table below provides more details for each NTRIP Client configuration parameter:

Table 1: NTRIP Client configuration parameters

Parameter	Description
IP address or URL	NTRIP Caster address. If the NTRIP Caster is addressed by IP address, no NovAtel receiver DNS configuration is required. If the Caster is addressed by URL, then NovAtel receiver DNS configuration is required.
IP Port	The most common network port for NTRIP is 2101. This network port must not be blocked by firewall.
Mountpoint*	Defines the data stream to be used. The mount point selection will depend on the related RTK coverage and the format of the RTCM correction being broadcast.
Login	Each user requires a login and password (credentials) to connect to the NTRIP Caster. If the NTRIP caster is a commercial service, credentials are supplied when a subscription is purchased.
Password	Each user requires a password to connect to the NTRIP Caster unless anonymous access is permitted. If the NTRIP caster is a commercial service, these credentials are supplied once a subscription is purchased.

*It is possible to list the NTRIP Caster mountpoints by issue of command over the NovAtel command line interface and within the NovAtel Web User Interface. The user can then possibly determine the required mountpoint which can be selected and added to the configuration.

Consider two example NTRIP Client scenarios:

- [Example 1](#): Connection to a basic NTRIP Caster established by an end user.
- [Example 2](#): Connection to a Commercial NTRIP RTK service.

Example 1 – Basic NTRIP Caster

An NTRIP Caster has been selected for use and user account information is defined. The key configuration parameters to be set in the NovAtel receiver are listed below:

- NTRIP caster IP address: **192.168.0.7**
- NTRIP caster port: **2101**
- User account name: **username**
- User account password: **password**

No mountpoint has been defined, therefore the available mountpoints must be checked by issuing the following commands (over the command line interface):

```
NTRIPSOURCETABLE 192.168.0.7:2101
LOG SOURCETABLE
```

The response (example) follows:

```
[ICOM5]<SOURCETABLE ICOM5 5 40.5 FINESTEERING 2221 224633.000 0b004020 71dd
16409
< "192.168.0.7:2101" 0 0 "SOURCETABLE 200 OK;Server: SubCarrier Systems
Corp SNIP simpleNTRIP_Caster_[wLITE]R3.05.00/of:Jun 20 2022;Date: Tue, 02
August 2022 14:24:47 UTC;Content-Type: text/plain;Content-Length: 309"
<SOURCETABLE ICOM5 4 40.5 FINESTEERING 2221 224633.000 0b004020 71dd 16409
< "192.168.0.7:2101" 0 0 "STR;CMR;;;;;SNIP;XXX;0.00;0.00;0;0;sNTRIP;
none;N;N;0;none;"
<SOURCETABLE ICOM5 3 40.5 FINESTEERING 2221 224633.000 0b004020 71dd 16409
< "192.168.0.7:2101" 0 0 "STR;NOVX;;;;;SNIP;XXX;0.00;0.00;0;0;sNTRIP;
none;N;N;0;none;"
<SOURCETABLE ICOM5 2 40.5 FINESTEERING 2221 224633.000 0b004020 71dd 16409
< "192.168.0.7:2101" 0 0 "STR;RTCM_31;;RTCM 3.0;1004(1),1006(10),
1008(10),1012(1),1033(10);2;GPS+GLO;SNIP;XXX;57.20;-2.19;0;0;sNTRIP;none;
N;N;0;none;"
<SOURCETABLE ICOM5 1 40.5 FINESTEERING 2221 224633.000 0b004020 71dd 16409
< "192.168.0.7:2101" 0 0 "NET;SNIP;;N;N;None;10.17.43.243;2101;None;;"
<SOURCETABLE ICOM5 0 40.5 FINESTEERING 2221 224633.000 0b004020 71dd 16409
< "192.168.0.7:2101" 0 0 "ENDSOURCETABLE"
```

The response lists the three available mount points (highlighted in **red**) available on the NTRIP Caster. The decision is taken to select mountpoint **RTCM_31**. The connection to the NTRIP Caster can now be configured with the command:

```
NTRIPCONFIG NCOM1 CLIENT V1 192.168.0.7:2101 RTCM_31 username password
```

The mountpoint **RTCM_31** uses the RTCM version 3 format, therefore port NCOM1 must be configured with the command:

```
INTERFACEMODE NCOM1 RTCMV3 NONE OFF
```

The final step is to verify the GNSS receiver (rover) is operating in an RTK corrected mode by issuing the command:

```
LOG GPGGA ONCE
```

The response as shown below confirms the DQI field (highlighted in **red**) is set to 4, this confirms the GNSS receiver is operating in the most accurate RTK mode (narrow integer).

```
$GPGGA,092157.00,5712.0869112,N,00211.5383688,W,4,37,0.6,64.29,M,50.40,M,15,6
9*6B
```

Finally, the configuration is saved by issuing the command:

```
SAVECONFIG
```

Example 2 – Commercial NTRIP RTK Service

Typically, commercial RTK network providers (using NTRIP delivery) offer automated RTK reference station selection or Virtual RTK station solutions. Automated RTK station selection ensures a user is selecting the closest RTK reference station. Virtual RTK technology allows the service provider to create the optimized RTK corrections based on the user location (in areas of sufficient physical RTK station density). In both cases, the user's NTRIP Client must regularly report its current position to the RTK service provider. Typically, this is done by periodic transmission of the NMEA GGA message via the NTRIP Client to the NTRIP Caster.

Do not report the operating location to a third-party system when conducting sensitive operations e.g., military scenarios or sensitive infrastructure with regard to national security or client confidential locations.

For this example, the NovAtel receiver's NTRIP Client connection is established to the NTRIP Caster with the command:

```
NTRIPCONFIG NCOM1 CLIENT V1 smartnet.nrtk.eu:9401 MSM_iMAX_ITRF username  
password
```

The format of incoming data is set to RTCM version 3 and outbound data set to NOVATEL:

```
INTERFACEMODE NCOM1 RTCMV3 NOVATEL OFF
```

The GNSS rover position is transmitted back to the NTRIP Caster every five seconds:

```
LOG NCOM1 GPGGA ONTIME 5
```

We can verify the system is RTK corrected by issuing the command:

```
LOG BESTPOSA ONCE
```

In the response as shown below, confirm the position type field displays the status **NARROW_INT** (highlighted in red), this denotes the system is operating in the most accurate RTK mode:

```
#BESTPOSA,USB1,0,68.5,FINESTEERING,1921,493424.000,00000000,b1f6,14039;SOL_CO  
MPUTED,NARROW_INT,57.20141868688,-2.19226798719,65.5517,50.4000,6.6410,  
43.4000,WGS84,0.0192,0.0158,0.0403,"13",1.000,0.000,16,16,16,16,00,21,00,33*1  
987b852
```

Finally, save the configuration by issuing the command:

```
SAVECONFIG
```

NTRIP Caster: SNIP

The SNIP NTRIP Caster (www.Use-SNIP.com) is a popular application with complex operational capabilities. This application note covers the most basic use case. This example use of SNIP version 3.05.00 will use the LITE mode of operation. The LITE operating mode has the following key limitations:

- A maximum of three mountpoints, therefore a maximum of three base station (NTRIP server) inputs.
- Only NTRIP rev1 support.

This basic configuration of SNIP (LITE) will be explained in three stages:

- [Adding a user account](#)
- [Setting the Caster IP address and port](#)
- [Interfacing correction data streams](#)

Adding a User Account

At least one user account must be configured. To create a user entry, open the **Caster and Client** tab, then click the **Edit Users** button.

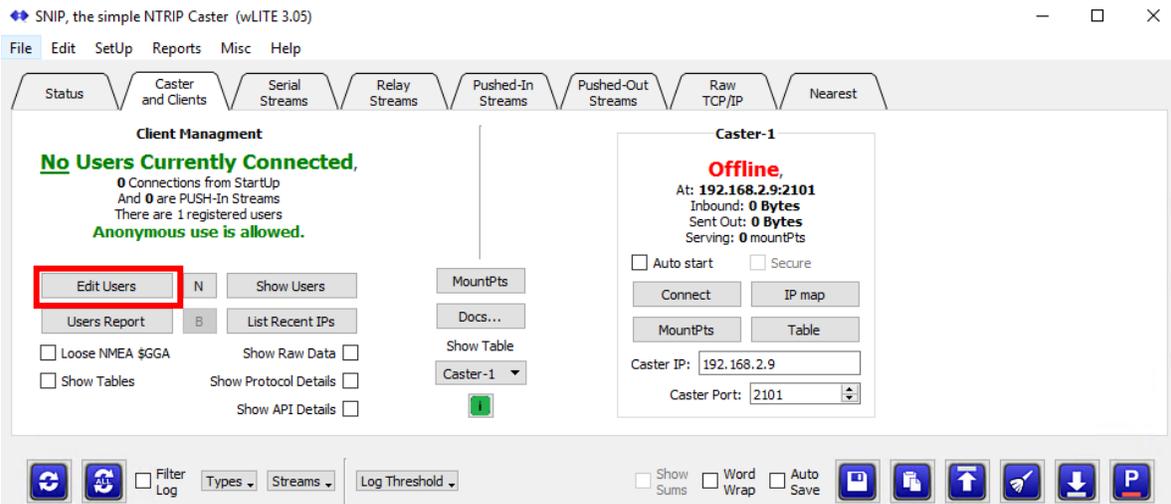


Figure 2: Client management

The “Registered Users” window will open, and existing account information will be shown.

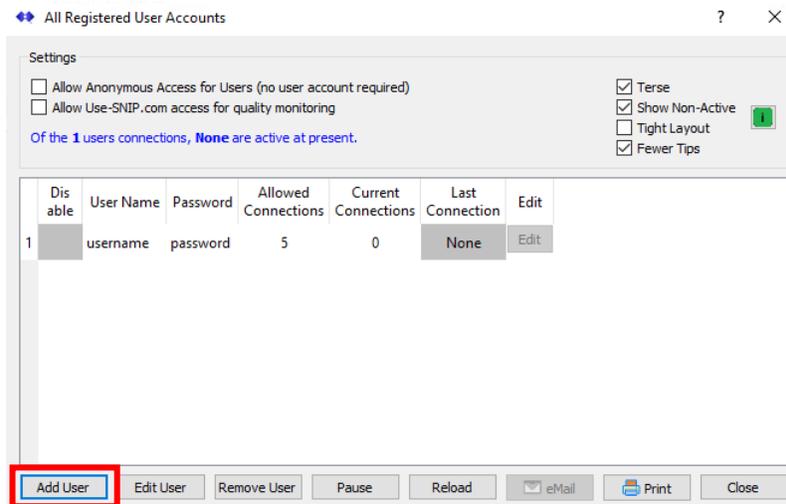


Figure 3: User list

To add a user, select **Add User**, enter a user name, password, then select **OK** to add the account. Before closing the window, it is recommended to ensure **Allow Anonymous Access** and **Allow Use-SNIP.com access** is deselected.

Setting the Caster IP Address and Port

By default, SNIP will automatically use a detected IP address and port 2101. If SNIP is installed on hardware using multiple IP addresses (e.g., dual ethernet), the NTRIP caster IP address can be configured. It is recommended to use IP port 2101 which is reserved for NTRIP data. In this example, the NTRIP Caster IP address and port is 192.168.2.9 : 2101.

Select the “Caster Management” part of the Caster and Clients window.

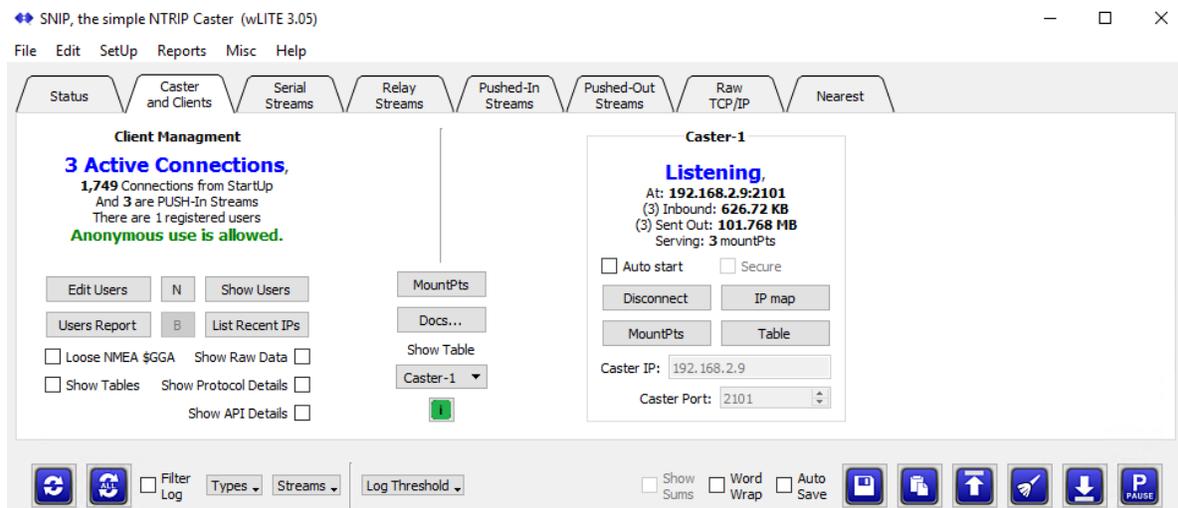


Figure 4: Caster overview

The Caster overview displays the current Caster IP address and port. To change these settings, select **Disconnect**, press **IP Map** and specify the IP address and port. Finally select **Connect**.

Note down the caster IP address and port as users will need this information and their account details to be able to connect to the caster.

Interfacing Correction Data Streams

SNIP can input serial RS232 and NTRIP Server correction data inputs. For serial RS232 inputs, the NTRIP caster is also acting as the NTRIP server, and the mount point must be manually configured. This application note details the setup of [NTRIP Server correction data inputs](#). For NTRIP Server inputs, a password must be defined. Select the **Pushed Streams** tab then select **Set Up**.

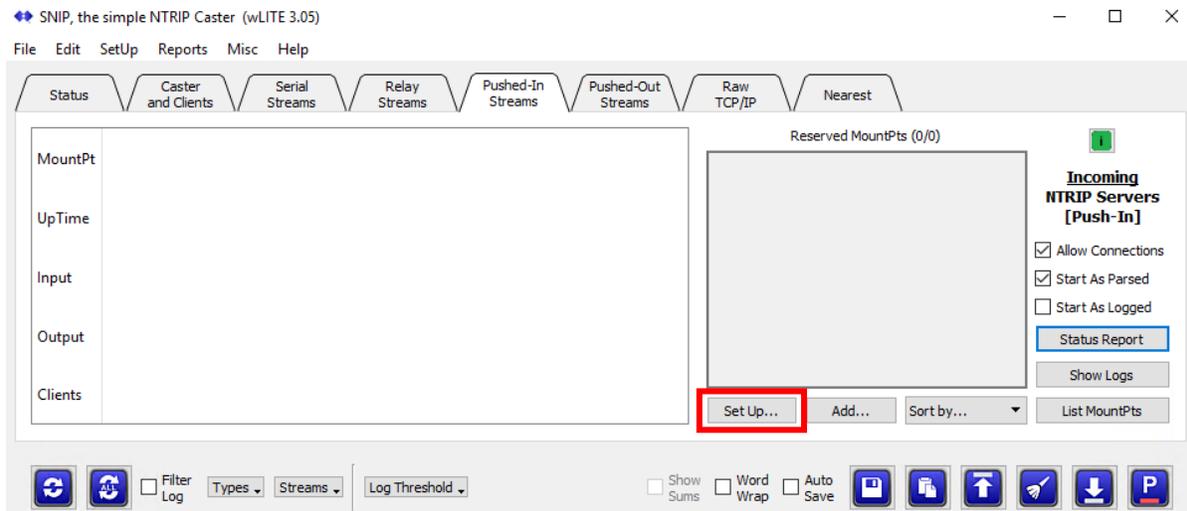


Figure 5: Pushed streams

Assign a password (or use **Generate**) and select **OK**.

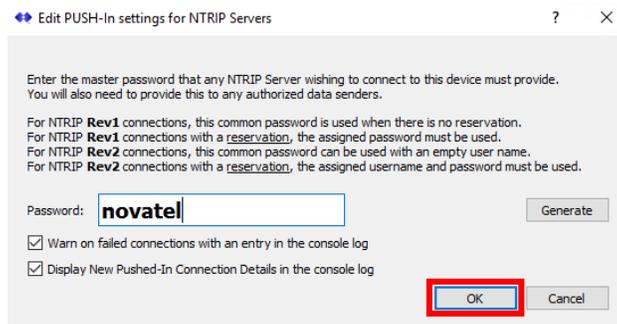


Figure 6: NTRIP Server password

When NTRIP Server correction data inputs are activated, the **Pushed-In Streams** tab will display the mount point names for each input and the related summary status information. The example below displays three input streams. Note: the number of NTRIP clients connected to the mountpoint is shown in the **Clients** field.



Figure 7: SNIP active pushed-in streams

NTRIP Server Mode

An NTRIP Server is not a NTRIP Caster, an NTRIP Client cannot connect to an NTRIP Server.

NovAtel reference station receivers can interface DGNSS corrections to an NTRIP Caster using the built-in NTRIP Server function. The NTRIP server logs into the NTRIP Caster over the internet (or internal network) and continually sends GNSS correction data to the NTRIP Caster.

Correction Data Input to an NTRIP Caster

The following example NTRIP Server configuration parameters are listed below:

- NTRIP caster IP address: **192.168.0.7**
- NTRIP caster port: **2101**
- account name - *none, typically not required*
- Password: **novatel**

When issued to the NovAtel receiver, the following command will set the receiver to operate as a reference station and assign the reference station position (note these coordinates must be accurate):

```
FIX POSITION <antenna latitude> <antenna longitude> <antenna MSL height>
```

Substitute the latitude, longitude, and antenna **MSL** height of the reference station with actual values. Here is an example command:

```
FIX POSITION 57.201367821 -2.192296828 64.0329
```

This following command establishes the network connection to the NTRIP Caster and defines the mountpoint to be used (in this case RTCM):

```
NTRIPCONFIG NCOM1 SERVER V1 192.168.0.7:2101 RTCM "" novatel ALL
```

Note the two double quotation marks in the command above is required to denote the absence of a username.

The following command defines the RTCMV3 format of the correction being output over the port NCOM1:

```
INTERFACEMODE NCOM1 NOVATEL RTCMV3 OFF
```

The following commands output the RTCM message types required to the NTRIP Caster and sets the update intervals (seconds):

```
LOG NCOM1 RTCM1004 ONTIME 1
LOG NCOM1 RTCM1012 ONTIME 1
LOG NCOM1 RTCM1006 ONTIME 10
LOG NCOM1 RTCM1008 ONTIME 10
LOG NCOM1 RTCM1033 ONTIME 10
```

A second correction data stream in CMR format (mount point - CMR) is added by issuing the following series of commands:

```
NTRIPCONFIG NCOM2 SERVER V1 192.168.0.7:2101 CMR "" novatel ALL
INTERFACEMODE NCOM2 NOVATEL CMR OFF
LOG NCOM2 CMROBS ONTIME 1
LOG NCOM2 CMRGLOBS ONTIME 1
LOG NCOM2 CMRREF ONTIME 10
```

To close the NTRIP Server connection to the NTRIP Caster, send the following command:

```
NTRIPCONFIG NCOM1 DISABLED
```

If an NTRIP Server is simply powered off, the NTRIP Caster will maintain the corresponding Mount Points which can cause problems with the NTRIP Caster and connected NTRIP Clients.

Receiver Model Requirements

Apart from NovAtel OEM719 systems, all other OEM7 GNSS receiver boards and enclosures natively support NTRIP. The OEM6 based OEM628 and OEM638 boards and enclosures also support NTRIP.

In addition to compatible hardware, NTRIP functionality must also be authorized. To check if a NovAtel system is authorized for NTRIP, issue the following command:

```
log modelfeatures
```

In the example (OEM6) receiver response below, it is clear that NTRIP functionality is authorized:

```
log modelfeatures
<OK
[ICOM5]<MODELFEATURES ICOM5 0 45.0 FINESTEERING 2221 303074.446 03004020 141a 16409
< 25
< 20HZ MAX MSR_RATE
< 20HZ MAX_POS_RATE
< DUAL ANTENNA
< COMMERCIAL MEMS IMU
< STANDARD INS
< AUTHORIZED MEAS_OUTPUT
< AUTHORIZED DGPS_TX
< AUTHORIZED RTK_TX
< AUTHORIZED RTK_FLOAT
< AUTHORIZED RTK_FIXED
< AUTHORIZED PPP
< AUTHORIZED LOW_END_POSITIONING
< AUTHORIZED RAIM
< AUTHORIZED ALIGN_HEADING
< AUTHORIZED ALIGN_RELATIVE_POS
< AUTHORIZED API
< AUTHORIZED INTERFERENCE_MITIGATION
< AUTHORIZED NTRIP
< AUTHORIZED INS_PLUS_PROFILES
< AUTHORIZED HEAVE
< AUTHORIZED RELATIVE_INS
```

Ethernet Adapter Configuration

Before any NovAtel receiver can connect to a network, the Ethernet adapter must be configured with either a static or dynamic IP address. The Ethernet port can be configured for DHCP networking using the following command:

```
ETHCONFIG ETHA AUTO AUTO AUTO AUTO
```

Once configured and connected to a network, the receiver will attempt to obtain a DHCP assigned IP address from a DHCP server. To verify the receiver has been assigned with an IP address, issue the following command:

```
LOG IPSTATUS ONCE
```

An example receiver response:

```
<IPSTATUS USB1 0 74.0 FINESTEERING 1921 488532.101 00000000 7fe2 14039
< 2
< ETHA "192.168.0.130" "255.255.255.0" "192.168.0.200"
< SERPPP "" "" ""
< 1
< "192.168.0.200"
```

The values after **ETHA** show the IP address, subnet mask and gateway IP address. The last line contains the IP address of the DNS server

The Ethernet port can be configured for fixed IP networking using the following command (example):

```
ETHCONFIG ETHA STATIC 192.168.0.130 255.255.255.0 192.168.0.200
```

The values after **ETHA** set the IP address, subnet mask and gateway IP address. For fixed IP addressing the DNS server should be configured using the [DNSCONFIG command](#) (example):

```
DNSCONFIG 1 8.8.8.8
```

8.8.8.8 is the IP address of the DNS Server (in this example: the Google DNS server).

Once the ethernet configuration is complete, the setting must be saved using the command:

```
SAVEETHERNETDATA
```

TCP/IP Considerations

The examples used in this application note use NTRIP Servers and NTRIP Casters working within the same LAN network. When an NTRIP Caster is connected to an NTRIP Server or client outside the NTRIP Caster LAN network, the network configuration must ensure:

- Firewalls (including the software based) allow incoming connections to the NTRIP Caster port.
- The NTRIP Caster port is routed (NAT/PAT) from an external IP address to the internal IP address of the NTRIP Caster.

NTRIP Servers or Clients not connected within the same LAN as the NTRIP caster must connect to the external IP address of the modem and the modem port that has been forwarded to the caster, instead of the “internal” IP address and port of the caster directly.

NTRIP Servers and NTRIP Clients initially connect to port 2101, once the connection has been established, the NTRIP caster will negotiate and assign a different port over which the network communications will be routed.

Support

To help answer questions and/or diagnose any technical issues that may occur, the [NovAtel Support website](#) is a first resource.

This application note describes the most common NTRIP setup scenarios, however, if your operational scenario is not covered or further assistance is required to configure a Novatel receiver, please contact [NovAtel Support](#).

Before contacting Support, it is helpful to collect data from the receiver to help investigate and diagnose any performance-related issues. A list of appropriate troubleshooting logs can be found on the [OEM7 Documentation Portal](#) (the LOG command with the recommended trigger and data rate is included with each log).

The data can also be collected using [NovAtel Application Suite](#).

Documentation

For any questions on logs and commands, please visit the [OEM7 Documentation Portal](#).

Contact Hexagon | NovAtel

support.novatel@hexagon.com 1-800-NOVATEL (U.S. and Canada) or 1-403-295-4900
For more contact information, please visit novatel.com/contact-us

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