# APN-062:
# NovAtel CORRECT™ with Veripos

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## Contents

## What is NovAtel CORRECT™?

NovAtel CORRECT optimally handles multiple GNSS satellite constellations and corrections, from a variety of sources, to deliver the best positioning solution possible. GPS, GLONASS, Galileo, BeiDou, L-Band or NTRIP–NovAtel CORRECT manages it all.

Providing a single source of GNSS hardware, correction services and support, NovAtel CORRECT simplifies the process of acquiring decimetre-level or better positioning. Most importantly, it exemplifies NovAtel's OEM partnership model by offering machine manufacturers and system integrators flexible, scalable and competitive positioning technology with great opportunity for future innovation.  For more details on NovAtel CORRECT, visit our website: http://www.novatel.com/products/novatel-correct/



RTK Corrections
PPP Corrections
SBAS Corrections

OEM6 with NovAtel CORRECT™

Centimetre Solution
Decimetre Solution
Metre Solution

**Figure 1: NovAtel CORRECT**

## What is PPP?

Precise Point Positioning (PPP) is a positioning method that uses precise GNSS orbit and clock corrections to obtain a solution with decimetre-level accuracy.  A  PPP solution can be obtained either through post-processing or in real-time.  NovAtel CORRECT offers an innovative, real-time PPP solution designed for NovAtel OEM6® receivers with no additional base station infrastructure required.

Acquiring a real-time decimetre-level PPP solution depends on the reception of GNSS satellite clock and orbit corrections, which are generated from a network of global reference stations.  Once the corrections are calculated, they are delivered to the end user via satellite or over the Internet.  These corrections are used by NovAtel CORRECT on a dual-frequency OEM6 receiver, resulting in decimetre-level or better positioning with no user-supplied or local base station required.

A typical PPP solution requires a period of time to resolve any local biases and converge to decimetre accuracy.  The actual accuracy achieved and the convergence time required is dependent on the quality of the corrections and how they are applied in the receiver, as well as the local observing conditions.

NovAtel CORRECT with Veripos is NovAtel's satellite (L-Band) delivered PPP solution that is available for offshore and marine applications[1], providing up to 6 cm of horizontal accuracy (95%)[2].

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[1] For land, airborne, and near-shore applications, refer to "APN-061 NovAtel CORRECT with TerraStar" available here: http://www.novatel.com/support/search/items/Application%20Note

[2] Calculated from 7 day of static data collected in Calgary using Apex[2] with GPS and GLONASS.  Accuracy will vary with observing conditions.
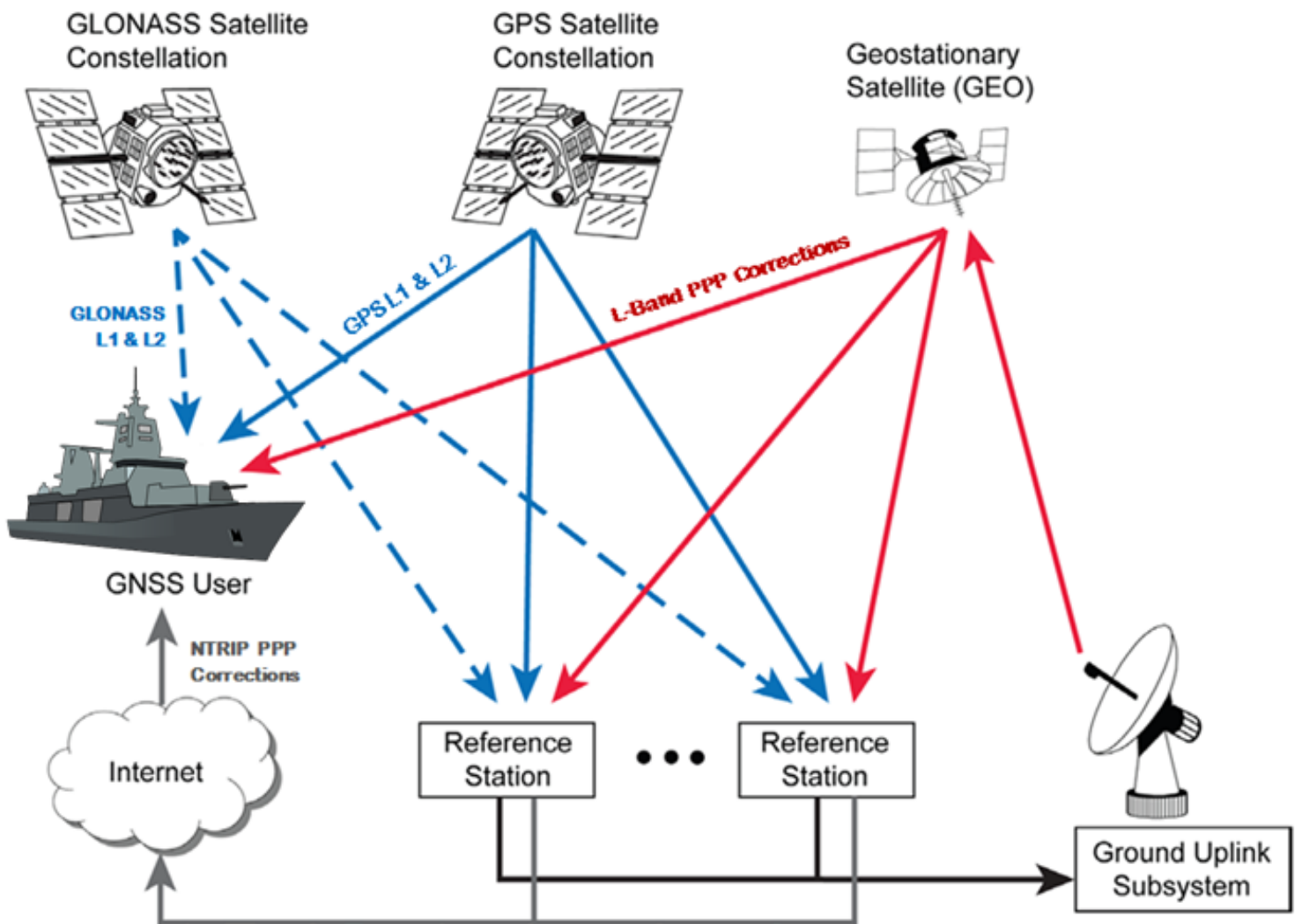
Figure 2: Typical PPP Infrastructure (L-Band & Internet Delivery)

## What is Veripos?

Veripos is a global provider of precise satellite positioning services for international offshore and marine industries.  Veripos fully owns, operates and maintains a global network of over 80 GNSS reference stations.  Corrections provided by the network are broadcast via 7 geostationary satellites.  For more information about Veripos, visit www.veripos.com/.

## Apex & Apex[2]

NovAtel CORRECT with Veripos is available using the Veripos Apex and Apex[2] services for decimetre-level accuracy.  Apex and Apex[2] are real-time correction services that provide GPS and GPS+GLONASS PPP corrections respectively for use in off-shore and marine applications[3].  Apex[2] uses both GPS and GLONASS constellations and thus benefits from better availability, faster convergence and improved accuracy[4].  For more details about Apex and Apex[2] correction services, visit the following links:

- Apex: http://veripos.com/veripos-apex.html
- Apex[2]: http://veripos.com/veripos-apex2.html

## Coverage

There are seven different L-Band satellites that broadcast Veripos corrections for specific regions.  The distribution of the L-Band satellites allows for dual coverage in virtually any location so information for regional subscriptions will be broadcast on the two beams covering that region.
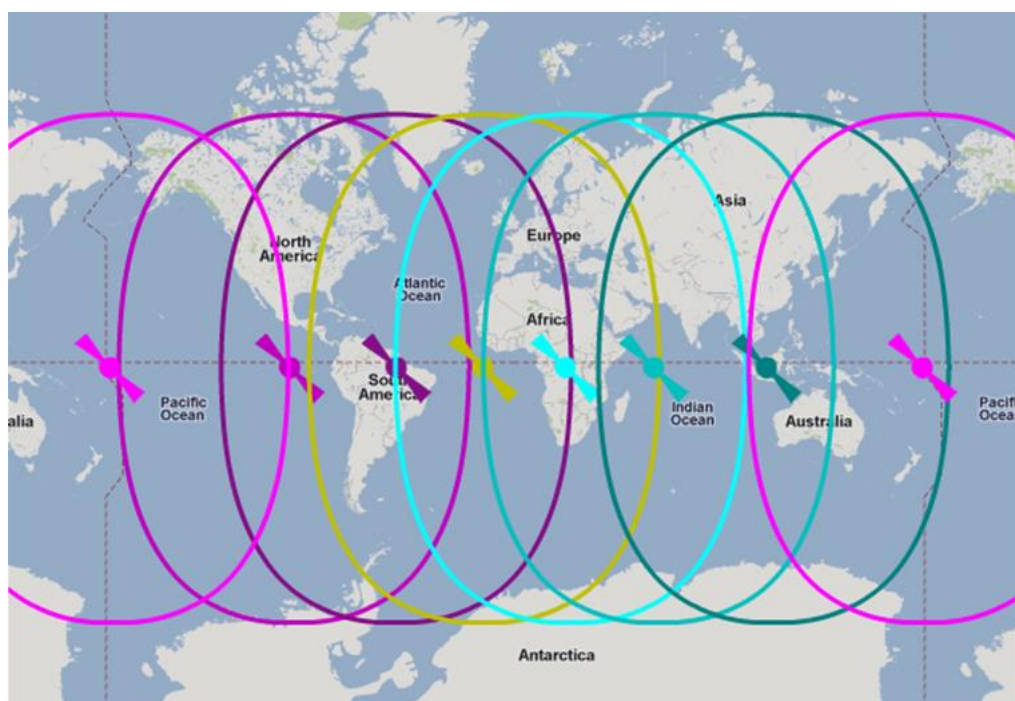


**Figure 3: Global Veripos Coverage**

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[3] For land, airborne, and near-shore applications, refer to "APN-061 NovAtel CORRECT with TerraStar" available here: http://www.novatel.com/support/search/items/Application%20Note
[4] www.veripos.com/files/files/Services_2.pdf

Coverage areas for specific beams can be viewed on the Veripos website:
www.veripos.com/global-coverage.html

For example, **Figure 4** shows the region covered by one specific beam, "25E".
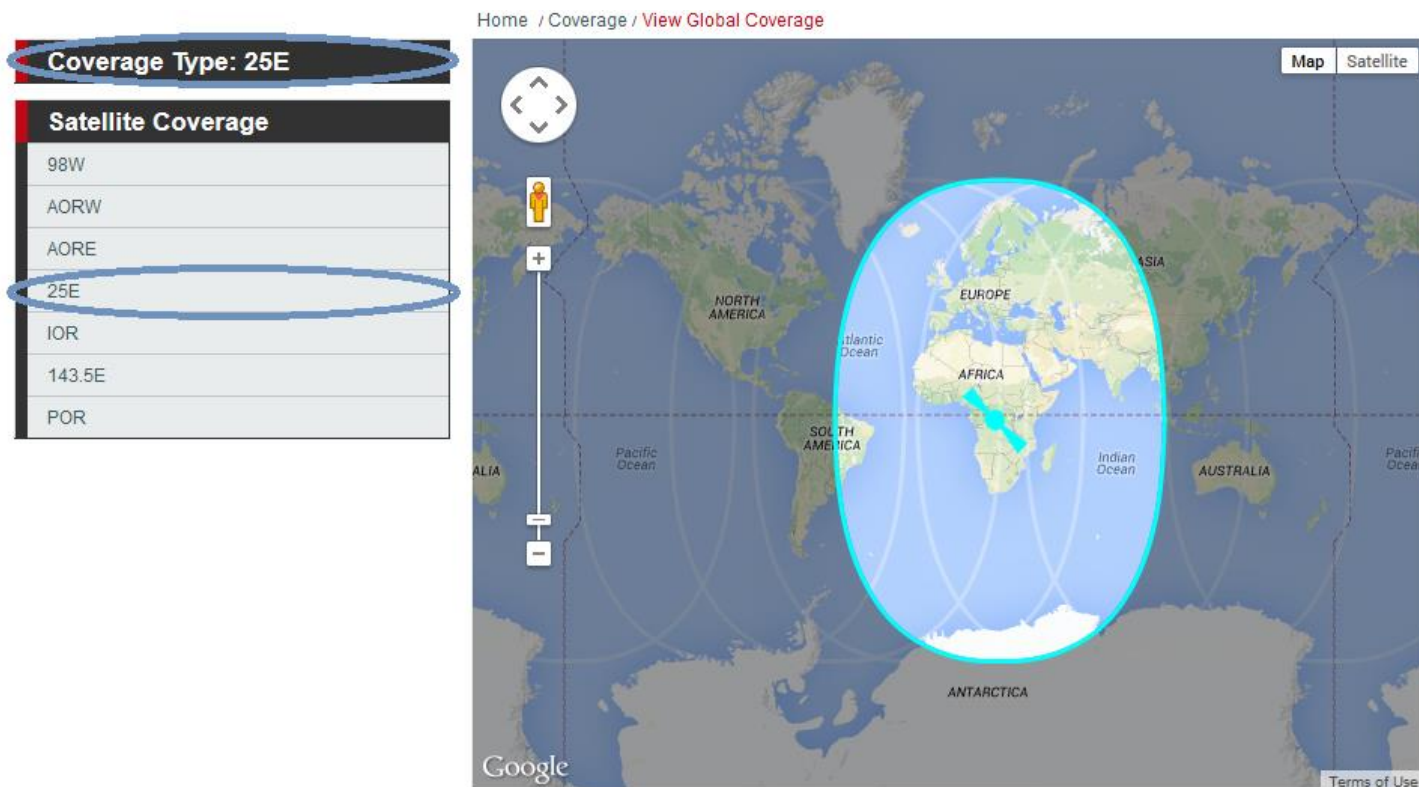


**Figure 4: Example Coverage by Veripos Beam[5]**

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[5] www.veripos.com/global-coverage.html

## Using Veripos

In addition to a Veripos subscription (see **Subscriptions**, page 10), there are specific hardware and software requirements that must be met in order to use Apex or Apex[2] corrections and obtain a PPP solution.

## Hardware Requirements

To use Veripos, the following hardware is required:

1. NovAtel OEM6 receiver capable of L-Band tracking, as well as dual-frequency GPS+GLONASS (for Apex[2]) or GPS-only (for Apex), including:
   - Receiver cards: OEM628™, OEM638™
   - Enclosures: FlexPak6™, ProPak6™, SMART6-L™
   - SPAN® on OEM6 (OEM628, OEM638, FlexPak6 and ProPak6)
2. Dual-frequency antenna compatible with GPS, GLONASS (for Apex[2]), and L-Band signals. For example:
   - GPS-702-GGL

Note that OEM615 hardware does not support L-Band tracking and therefore does not support Veripos.

## Firmware Requirements

NovAtel CORRECT is available with firmware version 6.400 (OEM060400RN0000) or later[6]. Also, specific model options are required to track and use the Veripos service.

To track and use Veripos, both L-Band and PPP options must be enabled. Based on the OEM6 Model structure, firmware options 3 and 5 must be "L" (or "J") and "P" respectively. For example:

- OEM628-G2**L**-0**P**G-TT0
- OEM638-D2**J**-R**P**R-TTN
- SM6L-D2**L**-0**P**G-0T0

| Firmware Model Options | | | | |
|---|---|---|---|---|

| Hardware Platform | | | | | | | | | | Channel | | | Positioning | | | Logging Rates | | | SPAN | | Options | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |

| Channel Configuration | | | | | | | Positioning Options | | |
|---|---|---|---|---|---|---|---|---|---|
| Constellation | | Frequency | | Other Systems | | | RTK Positioning | Other Positioning | Pseudorange Positioning |
| 1 | | 2 | | 3 | | | 4 | 5 | 6 |
| G | GPS only | 2 | L1/L2/E1/E2 | J | QZSS/SBAS/L-Band | | | P | PPP |
| D | GPS+GLO | | | L | SBAS/L-Band | | | | |

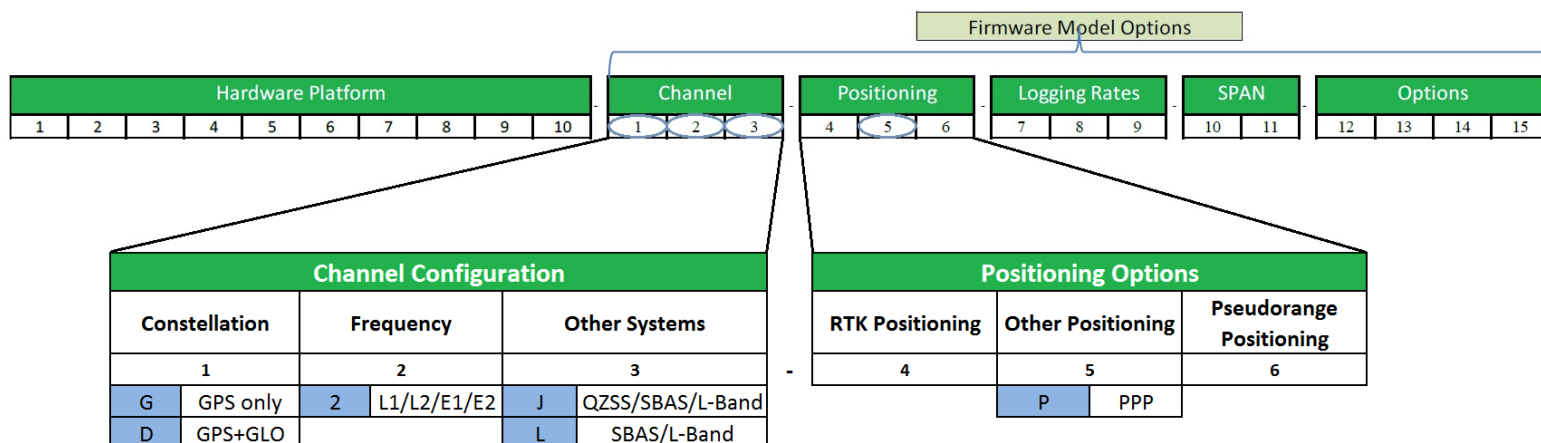**Figure 5: OEM6 Model Structure & Firmware Model Options Required for Veripos**

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[6] www.novatel.com/support/firmware-downloads

The "L" or "J" option enables L-Band tracking, and the "P" option allows the receiver to use PPP corrections, including those from Veripos. However, the user must configure the receiver to track the Veripos L-Band signal and a subscription must be purchased and activated before the receiver will start using the corrections and providing a PPP solution.

Channel configuration options for dual-frequency (L1 & L2) GPS tracking must be included in the model to use Apex, as well as dual-frequency GLONASS tracking for Apex[2]. To allow for this, the first firmware option must be a "G" or a "D", and the second must be a "2", as shown in the examples and **Figure 5** on page 8.

There are many other OEM6 firmware model options available, such as those that enable ALIGN®, RTK, API, SPAN, etc., but the options mentioned above are the minimum requirements to track and use Veripos corrections for both GPS and GLONASS. In the future it is possible that corrections for additional constellations will be broadcast by Veripos and in that case a different "constellation" option will be required in the model, as well as a compatible antenna, in order to take advantage of those corrections.

To verify the model currently loaded and being used on a receiver, use the command "LOG VERSION" to output the version information. For example:

> **<VERSION COM1 0 83.0 FINESTEERING 1786 421494.851 00000020 3681 12832**
> **<    1**
> **<        GPSCARD "D2LRPGTT0" "BFN11210275" "OEM628-1.00" "OEM060400RN0000"**
> **"OEM060200RB0000" "2014/Mar/26" "15:24:43"**

In this example, the model options indicate the following:

- Channel configuration options allow tracking of:
    - **D**: GPS + GLONASS
    - **2**: L1/L2/E1/B1 signals
    - **L**: SBAS/L-Band
- Positioning options available:
    - R: RTK Fixed, RTK Float, RTK Tx (transmit), DGPS Tx/Rx (transmit/receive)
    - **P**: PPP
    - G: GLIDE™

## Subscriptions

Before purchasing a Veripos subscription, it is best to ensure your hardware and software is compatible based on the previous sections.  To purchase any hardware or software upgrades that may be required, contact your NovAtel dealer or sales office[7].

Once the appropriate equipment is in place, contact Veripos sales by email (sales@veripos.com) or by visiting www.veripos.com/request-a-quote.html to obtain a Service Access License (SAL) number and purchase a Veripos subscription.  A subscription can also be purchased or modified by contacting the Veripos Helpdesk using one of the following options:

- Email: helpdesk@veripos.com
- Visit www.veripos.com/support.html

When contacting the Veripos Help Desk, you will need to provide the SAL number and the receiver's Veripos Serial Number (VSN).  To obtain the receiver-specific VSN, enter the command "LOG VERIPOSINFO" and verify the output.  An example VSN is highlighted in the VERIPOSINFO log below.

> **<VERIPOSINFO COM1 0 76.5 FINESTEERING 1785 150622.703 00000020 31fa 12832**
> **<    187360 NCC_CONTROLLED 00000101 "Q"**

Once a subscription is purchased, Veripos begins broadcasting the details at a specific time.  In order for the receiver to download the subscription information, it must be configured to track the Veripos L-Band signal shortly before the activation time.  However, the subscription information will be rebroadcast periodically every few hours.  In those cases where the initial broadcast is missed, if the receiver remains powered on and tracking it will simply download the subscription the next time it is broadcast.  This is because Veripos re-broadcasts all known and valid subscriptions in sequence.

The steps required to configure the receiver to track and use Veripos are described in the next sections.

To verify the Veripos subscription and status, use the command "LOG VERIPOSSTATUS" to output the VERIPOSSTATUS log.  For example:

> **<VERIPOSSTATUS COM1 0 79.0 FINESTEERING 1785 154612.705 00000020 0719 12832**
> **<    ENABLE LOCKED**

In this example, the access status is "ENABLE" indicating the subscription is valid and the Veripos decoder is "LOCKED" onto the data stream.

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[7] www.novatel.com/where-to-buy/sales-offices/

# Configuring a Receiver

## Enable L-Band Tracking

Before a receiver can download the required subscription information and start using Veripos corrections, it first must be configured to track the L-Band signal from a Veripos geostationary satellite. To enable L-Band tracking, the "ASSIGNLBANDBEAM" command is used. The factory default setting for "ASSIGNLBANDBEAM" is "IDLE", which means that the receiver will not track an L-Band signal unless configured to do so.

To enable L-Band tracking, the "AUTO" setting is recommended in most cases. Specifically:

**ASSIGNLBANDBEAM AUTO**

The auto option allows the GNSS receiver to automatically track the signal from the highest elevation Veripos satellite for the best performance. The receiver firmware includes a default list of Veripos satellites (see **LBANDBEAMTABLE**, page 17) and the receiver will search through the list as part of signal acquisition and tracking. To determine which Veripos signal is the best to use in a particular location, the receiver must have a position solution available.

A manual setting is also available with the "ASSIGNLBANDBEAM" command, which allows a user to specify a specific Veripos satellite to track. For example:

**ASSIGNLBANDBEAM 98W**   or   **ASSIGNLBANDBEAM MANUAL 98W**

## Verify L-Band Tracking

To verify the L-Band tracking status, the LBANDTRACKSTAT log can be used. For example:

**<LBANDTRACKSTAT COM1 0 80.5 FINESTEERING 1770 147622.000 00000020 29fd 12832**
**<    1**
**<        "98W" 1539902500 1200 974c 00c2 0 345.395 42.398 3.5073 71580.844 1363392 1168 1085 173150784 136010 0.0038**

This log reports the L-Band tracking status of the Veripos signal. Some helpful fields are highlighted above and described below:

- **98W**: This is the name of the Veripos beam or transmitting satellite being tracked. Additional details for the tracked beam can be output and viewed with the LBANDBEAMTABLE log.
- **00c2**: This is the "Tracking Status Word". A tracking status of "00c2" indicates that the receiver is tracking and locked onto the Veripos signal.
- **71580.44**: This is the "Lock Time" (in seconds). This field can be monitored to ensure that the L-Band signal is being tracked continuously without any loss of lock.

While the Veripos signal can be tracked even without any subscription, the receiver will not decode and use the Apex or Apex[2] service data until a valid subscription has been activated (see **Subscriptions**).

## Obtaining a PPP Position Solution

When the receiver is configured to track the Veripos signal and has downloaded a valid subscription, it will then begin decoding the correction data coming from the Apex or Apex[2] service. Shortly after the receiver begins decoding the corrections it will automatically start using the corrections to compute a PPP position solution. To verify the availability of a PPP position solution, the following position logs can be output using the "LOG" command:

- PPPPOS
- BESTPOS
- GPGGA

The PPPPOS log will always output the PPP solution when available, whereas the BESTPOS and GPGGA logs will output the "best available" solution. When using BESTPOS or GPGGA logs, another solution can be output in some cases, typically an autonomous or SBAS ("SINGLE" or "WAAS") position type, until the accuracy of the PPP solution becomes the best available. The receiver uses the estimated standard deviations, based on the "SETBESTPOSCRITERIA" command setting[8], to determine the "best" solution available. By default, the receiver will use the three dimensional standard deviation.

At first, the PPP solution will be flagged as "converging" in the position logs. After the convergence period, the position type will change to indicate a converged solution with the following position types:

<div align="center">

**Table 1: Position Types by Log**

| PPP Solution Status | BESTPOS/PPPPOS | GPGGA (Quality Indicator) |
|---|---|---|
| Converging | PPP_CONVERGING | 2 |
| Converged | PPP | 5 |

</div>

The PPP solution will transition from "PPP_CONVERGING" to "PPP" based on the "**PPPCONVERGEDCRITERIA**" command setting. By default, the solution will be flagged as converged when the horizontal (2D) standard deviation of the solution is 0.20 meters.

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[8] See www.novatel.com/assets/Documents/Manuals/om-20000129.pdf for the SETBESTPOSCRITERIA definition.

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For example, when the PPP solution is converging and is the best available:

**<PPPPOS COM1 0 64.5 FINESTEERING 1785 150920.000 00000020 e2df 12832**
**< SOL_COMPUTED PPP_CONVERGING 51.11679486247 -114.03886448423 1065.2213**
**-16.9000 WGS84 0.5505 0.5237 0.8792 "APEX" 4.754 0.000 22 19 19 19 2 00 00 33**

**<BESTPOS COM1 0 65.5 FINESTEERING 1785 150920.000 00000020 7145 12832**
**< SOL_COMPUTED PPP_CONVERGING 51.11679486247 -114.03886448423 1065.2213**
**-16.9000 WGS84 0.5505 0.5237 0.8792 "APEX" 4.754 0.000 22 19 19 19 0 00 00 33**

**$GPGGA,175504.00,5107.0077,N,11402.3319,W,2,19,0.8,1065.22,M,-16.90,M,04,APEX*66**

And when the solution has converged:

**<PPPPOS COM1 0 63.5 FINESTEERING 1785 152400.000 00000020 e2df 12832**
**< SOL_COMPUTED PPP 51.11679169050 -114.03886785696 1064.5243 -16.9000 WGS84**
**0.0828 0.0947 0.1150 "APEX" 15.972 0.000 22 19 19 19 2 00 00 33**

**<BESTPOS COM1 0 63.5 FINESTEERING 1785 152400.000 00000020 7145 12832**
**< SOL_COMPUTED PPP 51.11679169050 -114.03886785696 1064.5243 -16.9000 WGS84**
**0.0828 0.0947 0.1150 "APEX" 15.972 0.000 22 19 19 19 0 00 00 33**

**$GPGGA,181944.00,5107.0075,N,11402.3321,W,5,19,0.8,1064.52,M,-16.90,M,15,APEX*6D**

The "station ID" field in all three position logs can also be used to verify the type of corrections being used in the solution. For both Apex and Apex[2], the station ID will be "APEX" as shown in the above examples.

# Commands

All of the commands and logs mentioned in this document are described in full detail in the OEM6 Firmware Reference Manual (www.novatel.com/assets/Documents/Manuals/om-20000129.pdf).

## ASSIGNLBANDBEAM (Configure L-Band Tracking)

The "ASSIGNLBANDBEAM" command is used to configure L-Band tracking, which is disabled by default. In most cases, the "AUTO" setting can be used to enable tracking of Veripos and to download subscription information as necessary (see **Enable L-Band Tracking**, page 11).  In some cases it can be desirable to use a specific beam in which cases the "MANUAL" setting can be used.  The **LBANDBEAMTABLE** log (page 17) contains a list of Veripos beams known to the receiver and can be helpful when using the manual option.

Examples:

> **ASSIGNLBANDBEAM AUTO**

> **ASSIGNLBANDBEAM MANUAL AORW**

The default setting for ASSIGNLBANDBEAM is:

> **ASSIGNLBANDBEAM IDLE**

## PPPCONVERGEDCRITERIA (Configure the Decision for PPP Convergence)

The receiver uses the standard deviation of the solution to determine when the PPP position has converged.  By default, the receiver will label the PPP solution as "converged" when the horizontal standard deviation (2D) is 0.20 m or less.  The PPPCONVERGEDCRITERIA allows the user to control how the receiver determines if the solution has converged.  This is the default setting:

> **PPPCONVERGEDCRITERIA HORIZONTAL_STDDEV 0.20**

Another example is as follows:

> **PPPCONVERGEDCRITERIA TOTAL_STDDEV 0.15**

The second example will use the total position standard deviation (3D) to determine when the solution has converged.

Relaxing the convergence threshold shortens the time before a PPP solution is reported as converged. However, it does not alter the absolute behavior of the solution.  During the initial PPP solution period, the positions can have decimetre error variation.  It is recommended to only relax the convergence threshold if the application can tolerate higher solution variability.

## PPPDYNAMICS (Set the PPP Dynamics Mode)

This command configures the dynamics assumed by the PPP filter.  The default setting is "DYNAMIC", which is recommended for marine applications:

**PPPDYNAMICS DYNAMIC**

Alternatively, the "AUTO" setting allows the receiver to automatically detect antenna dynamics and adapt filter operation accordingly.  This can be particularly advantageous in land applications where the antenna can and will remain completely stationary during convergence or normal operation.

**PPPDYNAMICS AUTO**

Very slow "creeping" motion, where the antenna consistently moves 2 cm/s or less, can be interpreted by the receiver as stationary while in "AUTO" mode.  In such cases, particularly marine applications, the mode should remain as the default or explicitly be set to DYNAMIC.

## PPPSEED (Control Seeding of the PPP Filter)

The "PPPSEED" command controls the seeding of the PPP filter.  Accurate position seeding can accelerate PPP convergence.  However, "PPPSEED" should only be used in cases where the antenna will be completely stationary during convergence and "PPPDYNAMICS" is explicitly set to "STATIC" or "AUTO" mode.  This is typically only possible in land applications.

The command "PPPSEED SET" is used to explicitly specify the coordinates of a seed position. The seed position must be in a datum consistent with the PPP corrections that will be used.   For NovAtel CORRECT with PPP, this is ITRF2014 current epoch.

Caution must be exercised when using "PPPSEED SET".  While a "good" or accurate seed position can accelerate convergence, a "bad" or inaccurate seed hurts performance.  In some cases, a bad seed can prevent a solution from ever converging to a correct position.  In other cases, a bad seed might be rejected immediately or the filter might operate with it for a period of time only to reject it later.  In the last case, the filter position is partially reset with a corresponding discontinuity in the PPP position.

The available options with the PPPSEED command are as follows:

- CLEAR – resets the stored seed, and prevents any auto seeding from occurring
- SET – immediately apply the specified coordinates as a seed position
- STORE – store the current PPP position in NVM for use as a future seed
- RESTORE – retrieve and apply a seed  that was saved in NVM via the STORE or AUTO options
- AUTO – automatically store and restore PPP seed positions

PPPSEED command uses this format:

*PPPSEED option [<latitude> <longitude> <height> <northing_std_dev> <easting_std_dev> <height_std_dev>]*

Examples:

**PPPSEED SET 51.11635322441 -114.03819311672 1064.5458 0.05 0.05 0.05**

**PPPSEED STORE**

## PPPSOURCE (Specify the PPP Correction Source)

The PPPSOURCE command allows the user to specify the type or source of corrections the PPP filter will use.  It can also be used to disable the PPP filter.  The default setting is "AUTO", which allows the receiver to automatically select and use the best corrections.

Examples:

**PPPSOURCE NONE**

**PPPSOURCE AUTO**

**PPPSOURCE TERRASTAR**

**PPPSOURCE VERIPOS**

## PPPTIMEOUT (Set the Maximum Age of the PPP Corrections)

The maximum age of corrections that will be used by the PPP filter is determined by the PPPTIMEOUT command.  If the correction stream is interrupted, the receiver will continue using the last received corrections but the age of those corrections will begin to grow.  If the corrections become older than the specified PPPTIMEOUT duration, the receiver will no longer use those corrections.  The default setting is 360 seconds (6 minutes), the minimum is 5 seconds, and the maximum duration is 900 seconds.  For example:

**PPPTIMEOUT 360**

**PPPTIMEOUT 900**

**PPPTIMEOUT 200**

## Logs

Any of the logs described below can be output using the LOG command. Appending an "A" or a "B" to the log name when sending the LOG command will output the message in full ASCII (examples below are 'abbreviated' ASCII) or binary respectively. For example, the command "LOG PPPPOSB" will log the PPPPOS log in binary format.

For complete details about the LOG command, including how to specify the data rate/interval and trigger, see the LOG command definition in the OEM6 Firmware Reference Manual (www.novatel.com/assets/Documents/Manuals/om-20000129.pdf).

### LBANDBEAMTABLE (List of L-Band Beams)

This log provides a list of Veripos L-Band beams known to the receiver. The receiver firmware contains a default list that will be output until the receiver downloads new beam information from Veripos. Using the command "LOG LBANDBEAMTABLE", this is an example output:

```
<LBANDBEAMTABLE COM1 0 78.5 UNKNOWN 0 1.775 004c0020 f3b2 12832
<     7
<        "AORE" "A" 1539982500 1200 -15.50 1
<        "AORW" "B" 1539892500 1200 -54.00 1
<        "IOR" "C" 1539902500 1200 64.50 1
<        "POR" "D" 1539942500 1200 178.00 1
<        "25E" "E" 1539882500 1200 25.00 1
<        "143.5E" "F" 1539992500 1200 143.50 1
<        "98W" "G" 1539902500 1200 -98.00 1
```

The first two fields in each entry, for example ""POR" "D"", correspond to the beam/transmitting satellite name and the region ID. The next three fields correspond to the broadcasting frequency (Hz), the baud rate, and the longitude (degrees) of the L-Band satellite.

### LBANDTRACKSTAT (Report the L-Band Tracking and Viterbi Decoding Status)

The "LBANDTRACKSTAT" log provides information that can be used to verify L-Band tracking. Specifically, the name of the L-Band satellite or beam and its frequency, baud rate and service ID are included in this log. Also, the carrier to noise ratio (CNo) and lock time (in seconds) are indicators of tracking performance.

For example:

```
<LBANDTRACKSTAT COM1 0 78.0 FINESTEERING 1785 160741.000 00000020 29fd 12832
<     1
<        "98W" 1539902500 1200 974c 00c2 0 -271.092 44.380 4.8400 10121.678 192704 91 91
24473408 11363 0.0002
```

In this example, the receiver is tracking the "98W" beam with a frequency of 1539902500 Hz and a baud rate of 1200. Also, the CNo is 44.380 dB-Hz and the continuous lock time is 10121.678 seconds, indicating solid tracking performance. The CNo is typically about 40-45 dB-Hz in ideal conditions.

## PPPPOS (PPP Filter Position)

The PPPPOS log contains the position solution computed specifically by the PPP filter. The possible position types in this log are as follows:

**Table 2: PPPPOS Position Types**

| Position Type | Description |
|---|---|
| NONE | No solution |
| PPP_CONVERGING | Converging PPP Solution |
| PPP | Converged PPP Solution |

Examples:

```
<PPPPOS COM1 0 64.5 FINESTEERING 1785 150920.000 00000020 e2df 12832
<     SOL_COMPUTED PPP_CONVERGING 51.11679486247 -114.03886448423 1065.2213
-16.9000 WGS84 0.5505 0.5237 0.8792 "APEX" 4.754 0.000 22 19 19 19 2 00 00 33

<PPPPOS COM1 0 63.5 FINESTEERING 1785 152400.000 00000020 e2df 12832
<     SOL_COMPUTED PPP 51.11679169050 -114.03886785696 1064.5243 -16.9000 WGS84
0.0828 0.0947 0.1150 "APEX" 15.972 0.000 22 19 19 19 2 00 00 33
```

See also **Obtaining a PPP Position Solution**, page 12.

## PPPSATS (Satellites Used in the PPPPOS Solution)

This log provides a list of the used and unused satellites for the corresponding PPPPOS solution. The signals of the used satellites are also described, along with the reasons for exclusions.

For example:

```
<PPPSATS COM1 0 77.0 FINESTEERING 1785 161767.000 00000020 ce3f 12832
<     23
<         GPS 29 GOOD 00000003
<         GPS 13 GOOD 00000003
<         GPS 32 GOOD 00000003
<         GPS 4 GOOD 00000003
<         GPS 16 GOOD 00000003
<         GPS 23 GOOD 00000003
<         GPS 10 GOOD 00000003
<         GPS 31 GOOD 00000003
<         GPS 7 GOOD 00000003
<         GPS 2 GOOD 00000003
<         GPS 20 GOOD 00000003
<         SBAS 138 NOTUSED 00000000
<         SBAS 133 NOTUSED 00000000
<         SBAS 135 NOTUSED 00000000
<         GLONASS 14-7 GOOD 00000003
<         GLONASS 23+3 GOOD 00000003
```

```
<         GLONASS 5+1 GOOD 00000003
<         GLONASS 15 GOOD 00000003
<         GLONASS 22-3 GOOD 00000003
<         GLONASS 13-2 GOOD 00000003
<         GLONASS 6-4 GOOD 00000003
<         GLONASS 3+5 GOOD 00000003
<         GLONASS 4+6 GOOD 00000003
```

## VERIPOSINFO (Veripos Subscription Information)

Details about the current Veripos subscription are contained in the "VERIPOSINFO" log.  Also, the receiver-specific "Veripos Serial Number" or VSN is available from this log and is required when purchasing a subscription.

Example:

```
<VERIPOSINFO COM1 0 84.5 FINESTEERING 1786 72993.074 00000020 31fa 12832
<   187360 NCC_CONTROLLED 00000101 "Q"
```

In this example the VSN is "187360".

## VERIPOSSTATUS (Veripos Decoder and Subscription Status)

Additional Veripos decoder and subscription status information is provided in the "VERIPOSSTATUS" log. This log can be used to verify that the receiver is locked onto the Veripos signal and is decoding data.

For example:

```
<VERIPOSSTATUS COM1 0 82.5 FINESTEERING 1786 73008.352 00000020 0719 12832
<   ENABLE LOCKED
```

If the receiver currently has a valid subscription and is locked onto the Veripos data stream, the two fields after the log header will be "ENABLE" and "LOCKED".

# Convergence Recommendations

The Veripos Apex or Apex[2] solution will have an associated convergence time during which the accuracy will stabilize and converge towards the quoted accuracy for NovAtel CORRECT with PPP[9].

Although it is not currently possible to completely remove the convergence period of the PPP solution, there are techniques to help improve or shorten the time required to reach the specified accuracy. Some of these include:

- Take advantage of additional observations by using a receiver model enabled for both GPS and GLONASS along with a subscription to the Apex[2] service.
- Ensure the antenna is located in an area that has a clear view of the sky with no obstructions, especially during initial startup and convergence.
- In cases where the vehicle and antenna can and will be stationary during convergence, use the "AUTO" setting for **PPPDYNAMICS** (page 15) to take advantage of automatic dynamics detection and filtering.  For marine applications, however, the recommended setting is still "DYNAMIC" due to the possibility of slow or "creeping" movement.
- Where it is appropriate for the application, use the **PPPSEED** (page 15) command to specify the location of the antenna if it is located in a known position.  At the same time, avoid using a "bad" seed if the accuracy of the known location is poor as this can increase the convergence time.

For most applications it is best to allow the PPP solution to be flagged as "converged" before proceeding with operation.  This is due to the variation that can be present in the solution as it converges.  Waiting for a converged position status will help ensure the solution has stabilized and is operating within the expected accuracy.  If the application can tolerate higher solution variability, the **PPPCONVERGEDCRITERIA** command (page 14) can potentially be used to relax the convergence tolerance or threshold.

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[9] www.novatel.com/products/novatel-correct/novatel-correct-ppp/

May 15, 2019

# Where to go for Support

To help answer questions and/or diagnose any technical issues that may occur, the NovAtel Support website is a first resource:  www.novatel.com/support/

For questions or concerns related specifically to Veripos subscriptions or service, visit www.veripos.com/support.html or contact the Veripos Helpdesk (helpdesk@veripos.com) and include your SAL number and the receiver's VSN (see **Subscriptions**, page 10).

Remaining questions or issues can be directed to NovAtel Support by visiting www.novatel.com/support/contact/.  To enable the online form and submit a ticket, first select a "Product Line" and then an associated "Product" from the list.

However, before contacting Support, it is helpful to collect data from the receiver to help investigate and diagnose any performance-related issues.  In those cases, if possible, collect the following list of logs (the LOG command with the recommended trigger and data rate is included):

```
LOG VERSIONA ONCE
LOG RXSTATUSA ONCHANGED
LOG RAWEPHEMB ONCHANGED
LOG ALMANACB ONCHANGED
LOG IONUTCB ONCHANGED
LOG GLORAWEPHEMB ONCHANGED
LOG GLORAWALMB ONCHANGED
LOG GLOCLOCKB ONCHANGED
LOG RANGEB ONTIME 1
LOG BESTPOSB ONTIME 1
LOG PPPPOSB ONTIME 1
LOG PPPSATSB ONTIME 1
LOG LBANDTRACKSTATB ONTIME 1
LOG VERIPOSINFOA ONCHANGED
LOG VERIPOSTATUSA ONCHANGED
LOG LBANDBEAMTABLEA ONCHANGED
```

The data described above can be collected using a terminal program that supports binary data logging, or NovAtel's CONNECT utility can be downloaded and installed from the NovAtel website: www.novatel.com/support/info/documents/809