



Applanix POSPac post-processed Trimble CenterPoint RTX

White paper

Authors:

Joe Hutton

Director, Inertial Technology, Airborne

Nico Jaeger

Product Manager, Office Software

Trimble Applanix

trimble.applanix.com





Introduction

Trimble® CenterPoint® RTX is a real-time correction service introduced in 2011 providing centimeter accurate positions for real-time applications. This service relies on the generation of precise orbit, clock information and atmospheric delay models for GNSS satellites (GPS, GALILEO, GLONASS, BeiDou, QZSS) in real-time. It is based on a Trimble dedicated worldwide network of tracking stations.

Applanix® POSPac™ post-processed CenterPoint RTX (PP-RTX) is a cloud based global GNSS correction service which utilizes Trimble's RTX technology to provide centimeter level post-processed positioning accuracy *without* base stations. PP-RTX is an alternative processing mode to the Single Base, Applanix SmartBase™ and multi-single Base correction methods for the GNSS-inertial trajectory generation.



Workflow

POSPac Complete

The latest generation Applanix IN-Fusion®+ PP-RTX service available in POSPac Complete, directly downloads the correction data without the need to upload trajectory information to the RTX-PP server (one way direction).

In addition, if an internet connection is not available, RTX corrections can be logged over the air from L-Band satellite using the Trimble GNSS-inertial hardware products, and processed directly in POSPac Complete.

IN-Fusion+ PP-RTX also supports **better use of the multi-frequency and multi-satellite constellations**, including the new signals from the BeiDou-III generation which contribute to **improved robustness, reliability and reduced convergence time**.

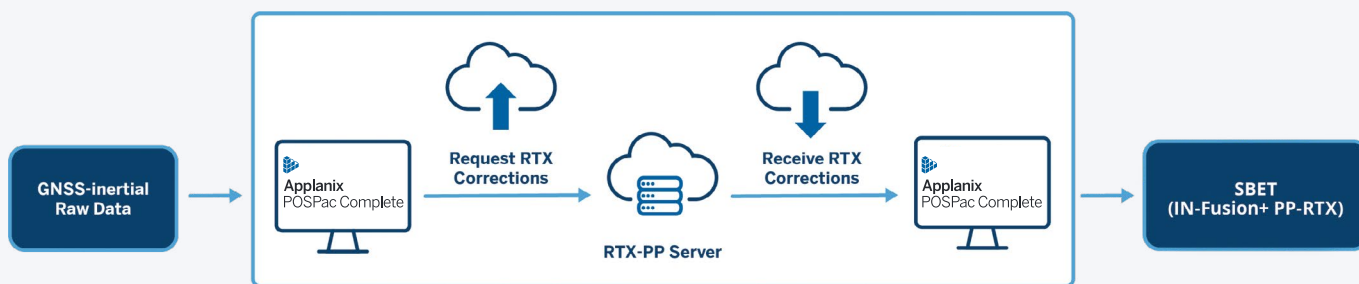


Fig 1: IN-Fusion+ PP-RTX workflow



How Trimble RTX[®] Works?

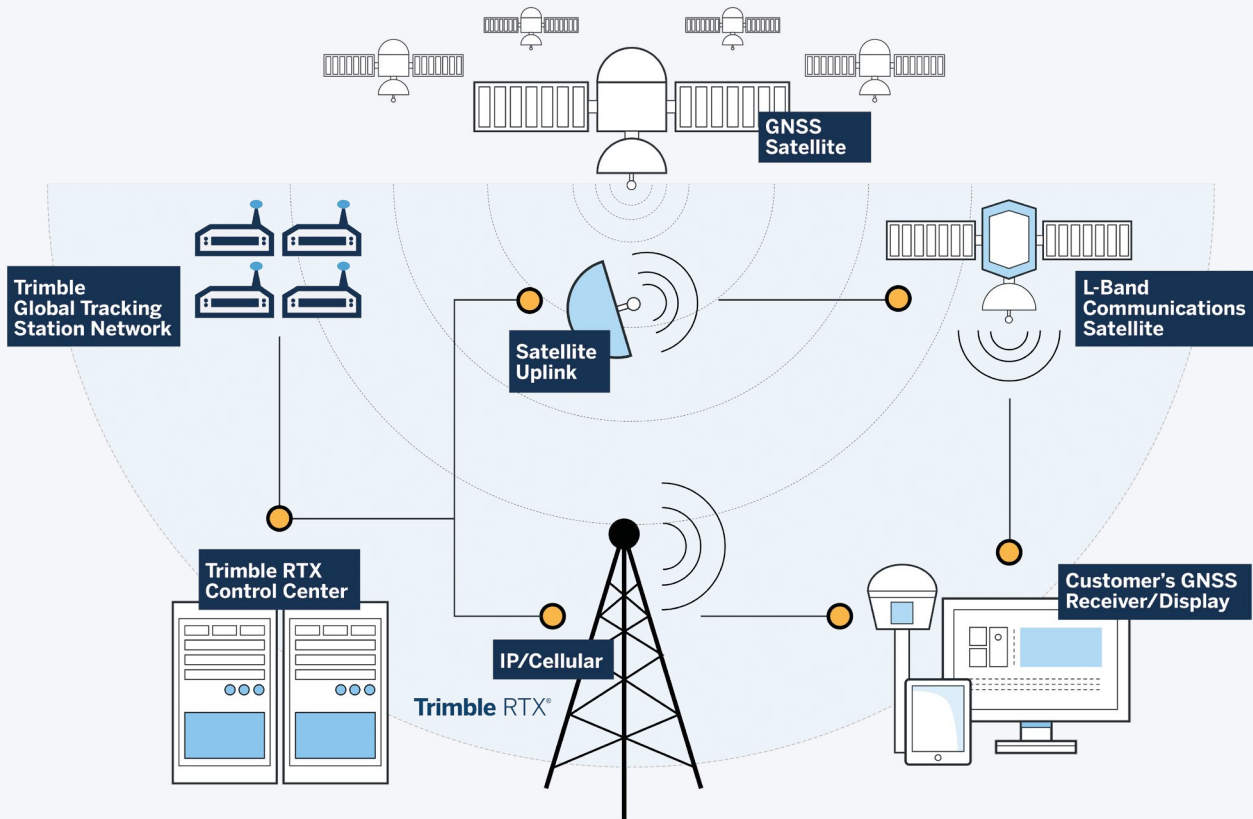


Fig 2: Real-time CenterPoint RTX corrections



Global and fast regions

The CenterPoint RTX services are split into two regions:

- Fast regions (Central Europe, North America, regions in Brazil)
- Global region (rest of world)

The global region corrections are based on a global ionospheric model, while the fast regions use a denser network of reference stations to compute a regional ionospheric model for atmospheric corrections.

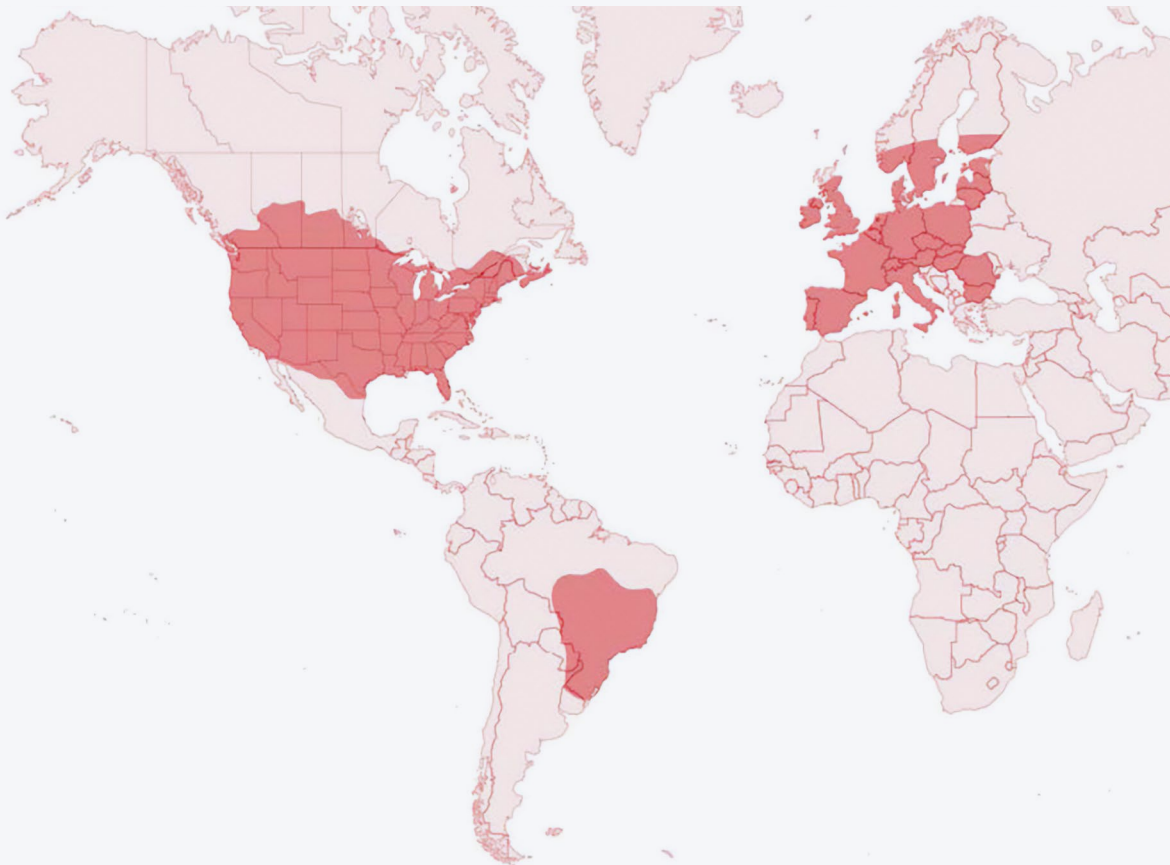


Fig 3: Fast CenterPoint RTX region



Convergence time and performance

Convergence time

The convergence time is the amount of time it takes for the PP-RTX position accuracy to reach its final centimeter level accuracy, hence the time span of the trajectory itself must be longer than the convergence time to achieve full accuracy. Since the PP-RTX solution is processed in the forward and reverse direction and then combined, all convergence effects are removed.

- **Fast region:**
 - Convergence time is < 1 to 2 minutes
- **Global region:**
 - Convergence time is < 3 minutes with IN-Fusion+ PP-RTX and BDS-III signals

Please refer also to the document “Technical Note for IN-Fusion+ PP-RTX” accessible from our [customer support hub](#) for details about how to properly configure a system to take advantage of IN-Fusion+ PP-RTX.

With reduced convergence time in the global region, IN-Fusion+ PP-RTX thus allows higher accuracy GNSS-inertial processing for short uncrewed aerial vehicle (UAV) flights without using a dedicated base station.

Performance

The accuracy when using PP-RTX processing in POSPac is < 3 cm horizontal RMS error and < 6 cm vertical RMS error. This is independent of the region as long as the solution has converged.



Requirements

In order to make use of the PP-RTX mode in POSPac Complete the following requirements apply:

- POSPac Complete, POSPac UAV Complete or RTX Complete license
- Internet connection¹
- Minimum of 10 - 15 minutes rover data, ideally including BeiDou-III signals
- Rover must be using a calibrated GNSS antenna and associated model set in POSPac
- Clean GNSS observables must be available throughout the mission (minimal cycle slips)

¹ Not required if RTX corrections have been logged in real-time (over-the-air).



Applications

Crewed airborne

Due to the mission size, crewed airborne projects can exceed the maximum of 20 km distance from a single base station required for a precise GNSS-Inertial solution. PP-RTX has no such limitation and is hence ideal for crewed aerial surveys. Since PP-RTX is a global service, it eliminates the cost and headache of setting up or procuring local base stations in different countries or remote locations.

Uncrewed airborne

Short flights (10 – 20 minutes) can be processed using IN-Fusion+ PP-RTX in fast or global regions. For the global regions it is strongly recommended to have BDS-III signals logged for optimal conversion. PP-RTX is also ideal for UAV mapping applications in remote regions such as mountainous and forested areas where base stations are not present, and setting up a base station can be difficult.

Land application

PP-RTX currently requires clean GNSS observables with minimal cycle slips and interruptions. Since land applications are typically exposed to frequent GNSS disruptions (buildings, vegetation, tunnels) in urban environments, the PP-RTX service will not achieve full accuracy. For missions in rural areas with no or only a few GNSS occlusions, it may produce adequate results.

Marine application

The POSpac PP-RTX service can be used for all Applanix POS MV systems and applications. For off shore projects and remote coastal line surveys, it is the only cost-effective method for achieving centimeter level position accuracy. Surveys in ports or missions close to the mainland, POSpac PP-RTX eliminates the cost needed to procure or set up local base stations.



Benefits

The core benefits of using PP-RTX in POSPac are:

- Worldwide coverage
- Data are available within minutes after mission completion
- Centimeter level accuracy, approaching that of RTK
- Eliminate the need of base station data
 - From own setup
 - From various download sources
 - From commercial provider procurement
- Reliable 24/7/365 monitored cloud service
- Single button or automated functionality
- Improves efficiency and productivity

The additional benefits for the latest IN-Fusion+ PP-RTX processing mode are:

- Faster convergence time, especially in the global region
- Correction data can be logged in real-time (over-the-air corrections)
- Better performance



Performance test results: IN-Fusion+ PP-RTX

Uncrewed airborne data are characterized by a short time span (10 - 15 minutes), low altitude with respect to the ground and high dynamics. IN-Fusion+ PP-RTX processing of uncrewed airborne data (UAV) dramatically reduces the convergence time in the global RTX region when using BeiDou-III signals.

Figure 4 compares the horizontal and vertical position solution of IN-Fusion PP-RTX and IN-Fusion+ PP-RTX in the forward pass for one dataset in the global region.

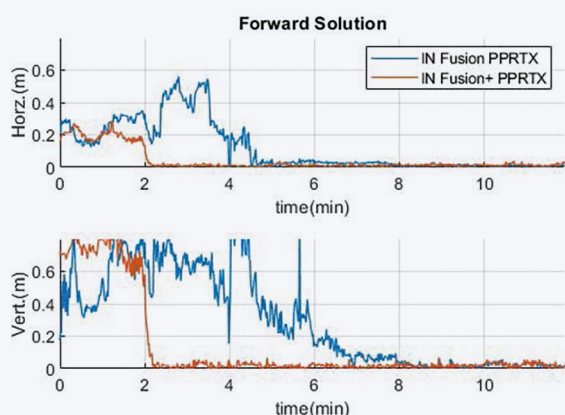


Fig 4: FWD convergence PP-RTX modes IN-Fusion vs. IN-Fusion+, global region

The convergence time **improves from 8 minutes down to 2 minutes** in this dataset, allowing the smoothed best estimated trajectory solution to create **centimeter level convergence-free positioning accuracy** over the entire mission time span.



The addition of the BeiDou-III satellites is the key factor here. They are used in the IN-Fusion+ PP-RTX mode vs. IN-Fusion PP-RTX and improve the convergence time significantly by reducing dilution of precision and making the residual atmospheric delay errors observable much faster. This makes the new IN-Fusion+ PP-RTX processing mode suitable for short uncrewed airborne missions in both the global region and in the fast region.

Furthermore, 66 short UAV datasets were used (equivalent to 25h of data) from the global RTX region to compare the accuracy results between IN-Fusion PP-RTX and IN-Fusion+ PP-RTX positioning with the improved convergence time. The reference in all cases was a single base station with a short baseline length to ensure 1 - 2 centimeter precision. As the results in Table 1 show, the position accuracy for short UAV trajectories in the global region has improved by 100 percent using the latest PP-RTX engine, lowering the 3D RMS from 12 cm down to 6 cm.

Component	RMS IN-Fusion PP-RTX	RMS IN-Fusion+ PP-RTX
North [cm]	4.4	1.2
East [cm]	2.3	0.9
Down [cm]	9.4	5.5

Table 1: NED RMS comparison IN-Fusion PP-RTX vs. IN-Fusion+ PP-RTX, global region, short trajectories



Conclusion

POSPac post-processed CenterPoint RTX (PP-RTX) as a worldwide cloud-based correction service is an adequate GNSS-inertial processing mode in POSPac Complete for various applications in open sky environments additionally to single base, Applanix SmartBase and multi-single base processing .

The BeiDou-III signals processed with the new IN-Fusion+ PP-RTX mode **improve the convergence time, robustness and quality,** which means short uncrewed airborne missions can now also be processed with high reliability outside the fast RTX region.

The new processing option also eliminates the need to upload trajectory information and can work on corrections logged in real-time if no internet connection is available.

For more information

Contact our [customer support team](#)

Or visit our [customer support portal](#).