RT-2 L1TE

NovAtel's Single Frequency RTK Solution

Precise thinking

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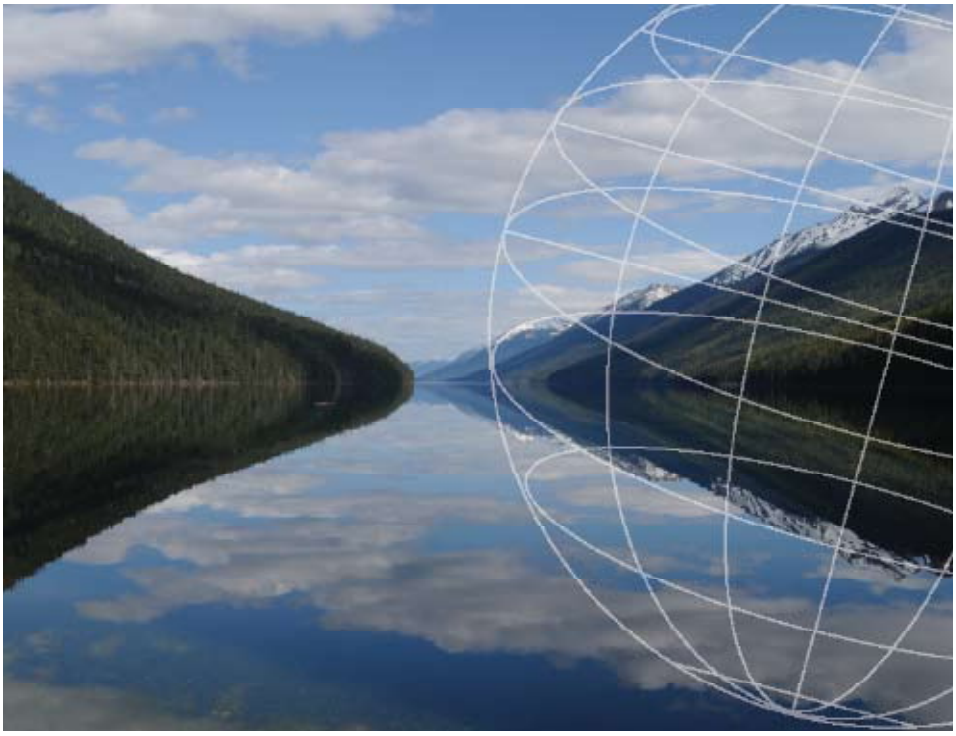

RT-2 L1TE:

NovAtel's Single Frequency RTK Solution

NovAtel® Inc.

Abstract

NovAtel's RT-2® L1TE feature is a fixed integer GPS+GLONASS+SBAS L1-only real time kinematic (RTK) solution. With this feature, centimetre-level accuracy is possible with fix times lower than 60 seconds, depending on visibility and number of satellites. Because it is an L1-only solution, to minimize ionospheric errors, the operational baseline is limited to 3 km. This feature is particularly useful for surveyors and geographic information system (GIS) data users interested in an affordable RTK solution.

Introduction

NovAtel's new RT-2® L1TE feature is an L1-only RTK solution specifically for NovAtel's OEMV-1G products. RT-2 L1TE is for people working on limited baselines who are looking for a low cost RTK solution.

The RT-2 L1TE solution offers an advantage over the majority of competitive solutions because it is based on combined measurements from GPS+GLONASS constellations, as well uses SBAS for extra solution availability. Similar competitive products only use GPS+SBAS measurements, which drastically limits the number of satellites visible especially in forests and urban canyons. Without the use of the GLONASS constellation, competitive solutions are limited to a maximum of two additional satellite measurements in addition to GPS measurements if the user is working within an area with SBAS satellite coverage. NovAtel's RT-2 L1TE solution uses GLONASS satellites, which have global coverage and many more satellites in the constellation. The advantage of GPS+GLONASS is that a fixed solution will be possible in more conditions where visibility of the sky is limited.

This paper outlines competitive analysis conducted on NovAtel's RT-2 L1TE solution, against a similar competitor product.

Methodology

Competitive testing was done by Cottrell Navigation Services.

All tests were static, on short baseline lengths of 1 m to baseline lengths of 1.7 km. A receiver from Competitor A was tested along with NovAtel's OEMV-1G receiver. NMEA logs from Competitor were collected and used for processing and plotting. NovAtel's 702-GG antenna was used for all testing.

Tests

The tests conducted include the following:

Static testing of NovAtel and reacquisition data was collected on 1 m baseline under an open sky environment. This data includes NovAtel's OEMV-1G with SBAS assistance and without SBAS. These tests display the differences in 2D position accuracy and reacquisition times between the GPS+GLONASS+SBAS and GPS+GLONASS systems.

A similar set of tests were run in a moderate foliage survey environment (see Figure 1) with NovAtel's RT-2 L1TE with SBAS assistance against Competitor A, at 1 m and 1.7 km baseline lengths. For the competitor testing, NovAtel's matched logs were used to compare with Competitor A's performance. These logs represent positions that have been computed from time matched base and rover observations. These logs were used because their output have the most comparable values based on the method Competitor A outputs logs.

Figure 1: Partial Foliage

Test Results

The position accuracy and performance results for the RT-2 L1TE with and without SBAS assist are shown in Figures 2 and 3. The results of position accuracy and performance of NovAtel RT-2 with SBAS assist against Competitor A are shown in Figures 4 - 7.

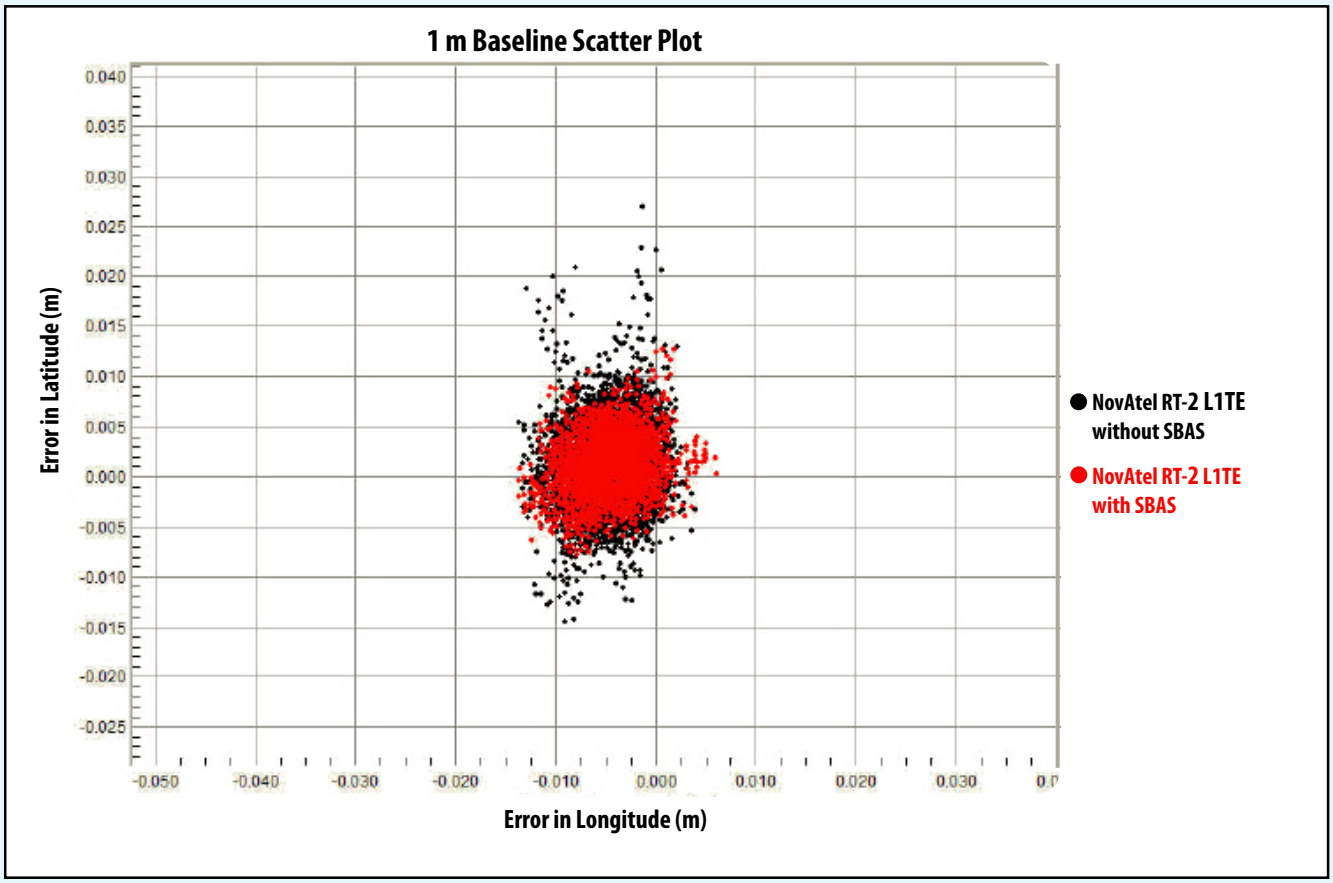

Figure 2: 1 m Baseline Scatter Plot of NovAtel's OEMV-1G with and without SBAS

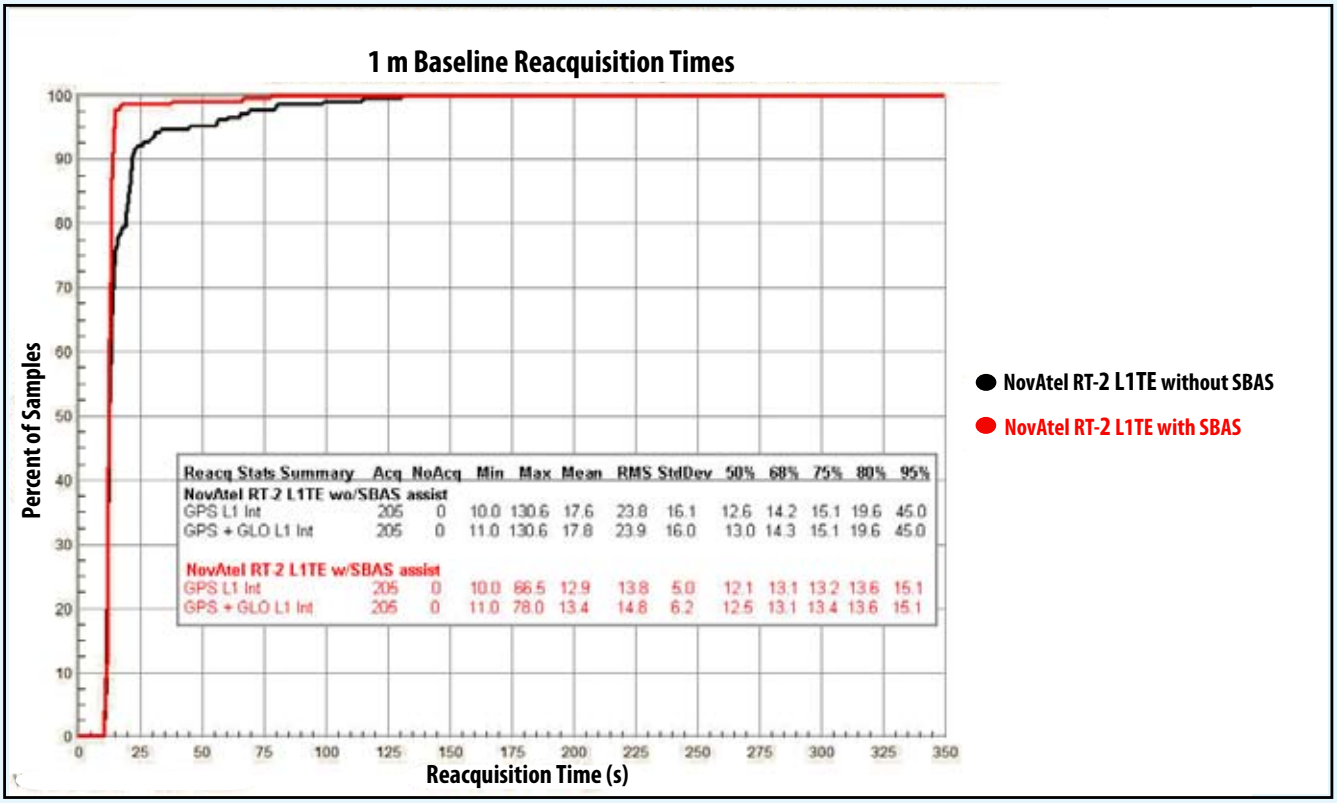

Figure 3: 1 m Baseline Reacquisition Times of NovAtel's OEMV-1G with and without SBAS

NovAtel OEMV-1G with SBAS assistance and without

Position Accuracy

Data was collected on a very short baseline (1 m) for nearly 20 hours. Figure 2 shows that for both cases position accuracy is sub-centimetre, however, a minor improvement in accuracy is realized with SBAS assistance.

Reacquisition Testing

Data for reacquisition times were also collected on very short baselines (1m) for almost 20 hours (see Figure 3).

Results show that the OEMV-1G with and without the use of SBAS are comparable as well, with the SBAS assisted solution showing a slightly faster reacquisition time. Figure 3 demonstrates how initialization time is improved significantly with the addition of SBAS satellites to the RTK solution. Users can expect to wait less than 15 seconds on average to achieve a fixed solution with SBAS assisting, where as on average it would take 18 seconds to achieve a fixed solution with only GPS and GLONASS satellites.

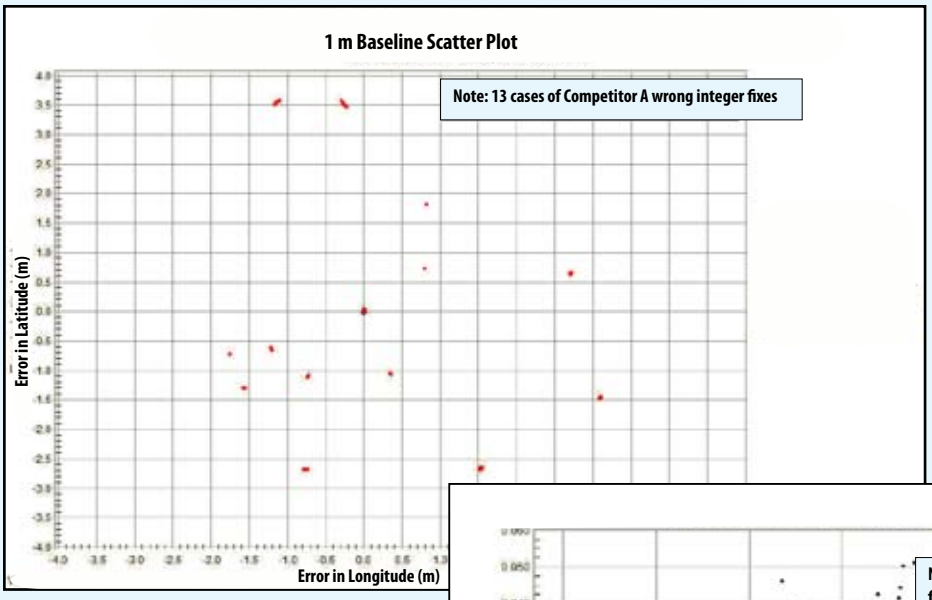

Figure 4: Competitor A Wrong Integer Fixes

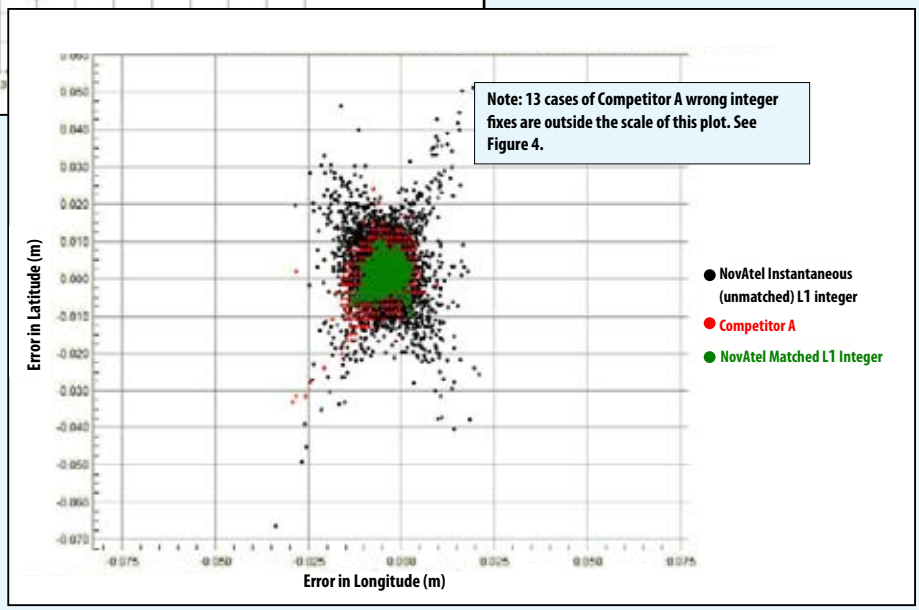

Figure 5: NovAtel & Competitor A Scatter Plot

NovAtel and Competitor A

Position Accuracy - NovAtel and Competitor A

In a very short baseline (1 m) open sky environment, data collected using RT-2 L1TE proves to be of sub-centimetre accuracy. The RTK solution of Competitor A was not as accurate and contained 13 wrong integer fixes (see Figure 4). Of the correct fixes NovAtel's RT-2 L1TE solutions show a higher degree of accuracy over that of Competitor A (see Figure 5).

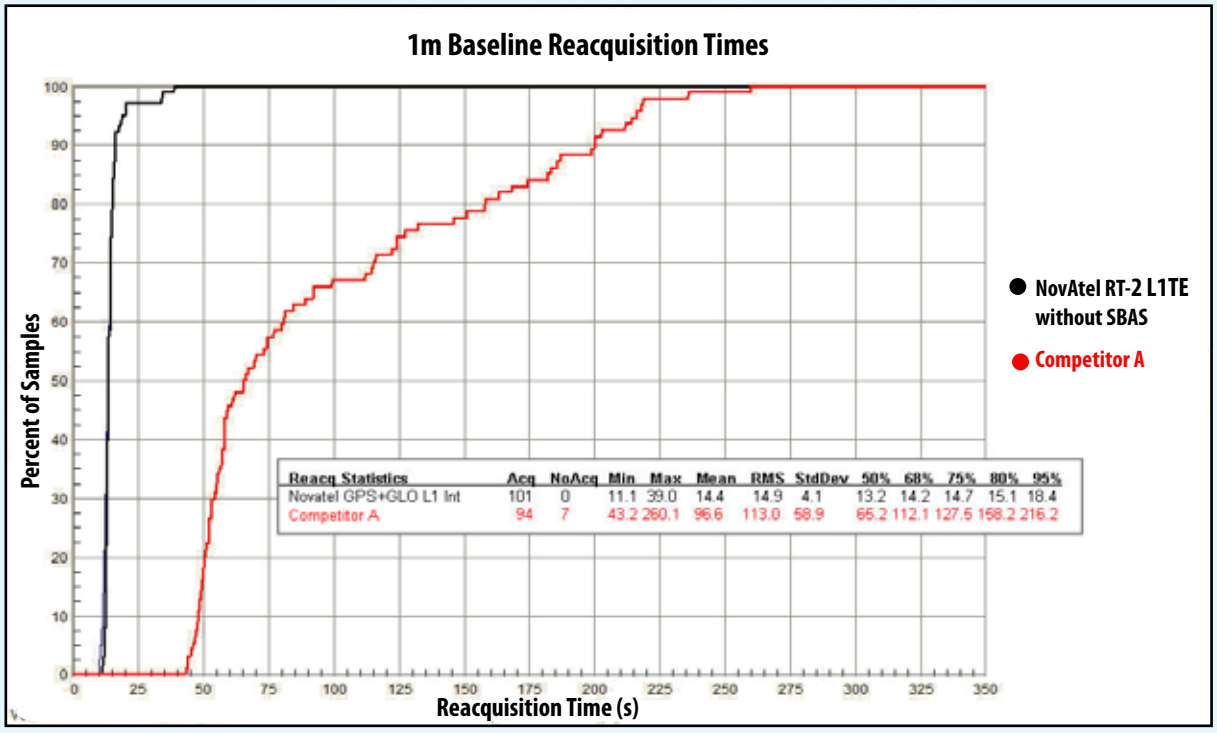

Figure 6: 1 m Baseline Reacquisition Times NovAtel & Competitor A

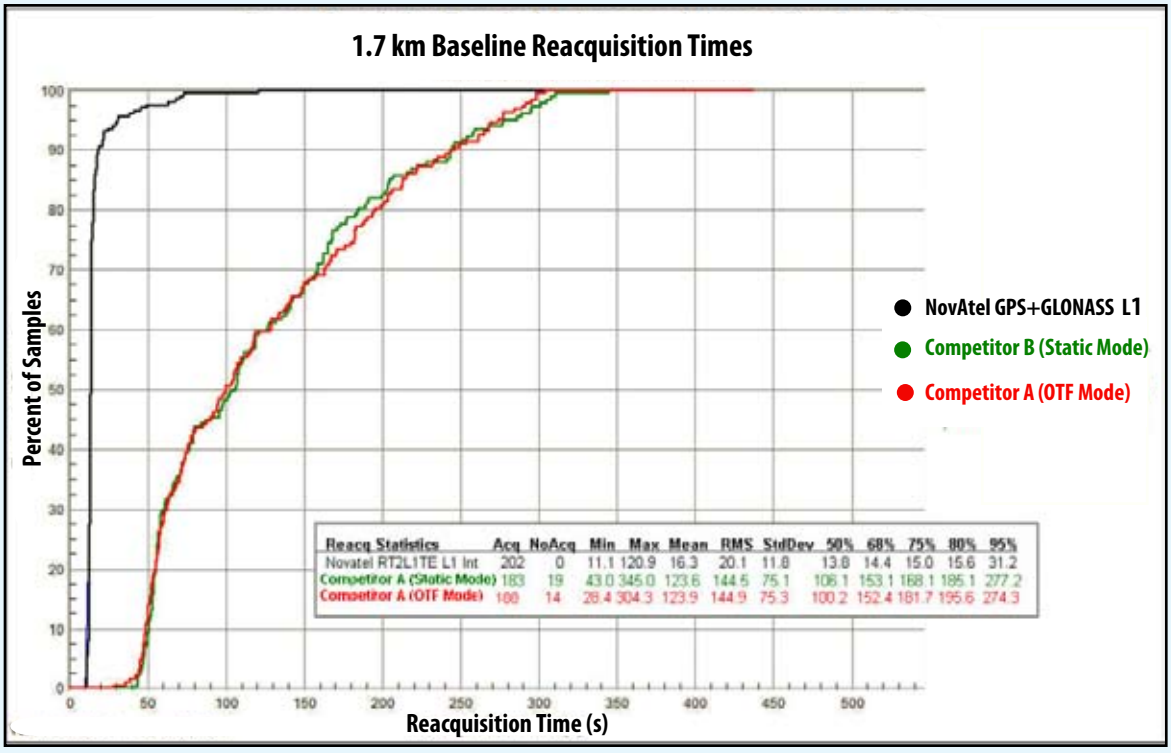

Figure 7: 1.7 km Baseline Reacquisition Times NovAtel & Competitor A

Reacquisition Testing

As shown in Figure 6, NovAtel fixes its ambiguities significantly faster than Competitor A. 68% of the time, NovAtel shows approximately 14 second re-initialization time versus Competitor A at 112 seconds. 95% of the time, NovAtel shows 18 second re-initialization versus Competitor A, at over 3 minutes. 13 iterations on Competitor A also failed to re-initialize (see Figure 5).

On longer baselines (1.7 km) NovAtel also shows significantly faster re-initialization times than competitor A. 13 iterations on Competitor A also failed to reacquire (see Figure 4).

On longer baselines (1.7 km) NovAtel also shows significantly faster reacquisition times than Competitor A (see Figure 7). **75% of the time, NovAtel shows approximately 15 second on-the-fly re-initialization time versus Competitor A at over 2.5 minutes. 95% the time, NovAtel shows 31 second reacquisition time versus Competitor A at over 4 minutes.**

To speed up initialization the competition recommends that a static initialization be performed. Static initialization improved Competitor A's initialization time from 195 to 185 seconds at 80% confidence, however, still does not parallel the on-the-fly initialization performance of RT-2 L1TE at 16 seconds.

Conclusion

The results of this testing show that NovAtel's RT-2 L1TE provides sub-centimetre accuracy with and without the use of SBAS satellites. The use of SBAS satellites reduces the initialization time, however, even without SBAS assistance the RTK solution still initializes in 18 seconds or less on average. As a result, RT-2 L1TE may be used anywhere; even in areas without SBAS coverage.

Compared to its competition RT-2 L1TE performs with higher accuracy and initializes significantly faster in typical survey conditions. Due to its combined use of GPS+GLONASS+SBAS satellites, RT-2 L1TE's solution involves many more observations than the competition to produce no incorrect fixes ensuring a highly accurate solution every time. Additionally, the use of GPS+GLONASS+SBAS satellites also improves solution accuracy and availability in unfavorable GNSS conditions, such as in forests and urban canyons. RT-2 L1TE users can also be confident that initialization can be achieved quickly and easily on-the-fly without performing any special initialization routines.