

Scheduled Leap Second Event Lassen iQ/SQ Timing Applications

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COMPONENT TECHNOLOGIES

Summary

The International Earth Rotation Service (IERS) announced, in July 2005, the introduction of a time step to occur at the end of December 2005. This pending or future leap second change was announced through the GPS system in the system almanac on August 3, 2005.

The Lassen[®] SQ and Lassen iQ have both applied this leap second incorrectly: The leap second is to be applied on December 31, 2005 at midnight, but Lassen iQ and SQ have already applied it now. This might affect Lassen iQ or SQ customers, who use these modules for timing applications.

Trimble is developing a software patch for Lassen SQ and iQ to fix this issue. The patch will be a new downloadable version of SQ and iQ firmware that customers who require an immediate fix to the incorrectly applied leap second problem may load into their Lassen SQ or iQ receiver. The software fix will not be released into standard Lassen SQ and iQ production units until the next software major release currently planned for first half 2006.

Background

Coordinated Universal Time (UTC) lags behind GPS time by an integer number of seconds. This is known as the GPS UTC offset or leap seconds.

$$(\text{GPS time}) - (\text{UTC time}) = \text{GPS UTC Offset (leap second)}$$

The current (August 18, 2005) GPS UTC Offset reported by the system almanac is 13 seconds.

GPS time is continuous from the start of GPS time. GPS time started on Jan 6, 1980. GPS system time is not modified by the insertion of leap seconds, as is UTC, an attribute that is critical to the operation of the GPS system.

In the past, leap second events have occurred once every 18 months. However, the last leap second event occurred on December 31, 1998. These leap seconds are reported to the GPS user community by the GPS system in the system almanac.

On 4 July 2005, the International Earth Rotation Service (IERS) decided it was time to announce another leap second to be inserted into the system at the end of December 2005. Based on this announcement, UTC will be retarded by one additional second (1.0s) at the end of December 2005. The leap second is to change from 13 to 14 seconds on midnight UTC time on December 31, 2005.



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The current leap second (18 August 2005), before the leap second insertion:

GPS-UTC = +13 (GPS is ahead of UTC by thirteen seconds)

After the leap second insertion at Midnight time on 31 December 2005:

GPS-UTC = +14s (GPS will be ahead by fourteen seconds)

On August 3, 2005, the GPS system administrators announced the insertion of this leap second into the system through the GPS System almanac. There is a section in the almanac which tells the user community about pending (future) leap second events, their value, and when they will occur. This information is typically added to the almanac a few weeks before the event is to occur, but in this particular case was added to the almanac 20 weeks before the event.

The issue

Both Lassen SQ and iQ after collecting the almanac misinterpreted the UTC broadcast information transmitted by the GPS satellites in such a way that they applied a scheduled leap second event at the time of broadcast rather than at the scheduled time.

The leap second is to be applied in December 31, 2005 at midnight, but Lassen SQ and iQ have inserted the additional leap second today. They are one second off from the actual UTC and indicate the GPS UTC offset of 14 seconds instead of 13.

Affected packets

In packets/sentences that report UTC time, this time is now retarded by 1 second from the correct time. In packets/sentences that report the UTC offset, this offset is now reported as 14 seconds rather than 13 seconds. Here are the affected packets:

TSIP Protocol Users

The report packet 0 x 41 – GPS Time is directly affected by the leap second issue. This packet reports the incorrect GPS UTC offset.

In Packet 0 x 35, the Time Type can be selected. For the users who have selected the option GPS time, no other TSIP packets other than 0 x 35 will be affected.

For the users who have selected the option UTC time, the following TSIP packets will report the incorrect UTC time:

0 x 42
0 x 43
0 x 4A
0 x 56
0 x 83
0 x 84
8F-20

NMEA Protocol Users

The following NMEA packets are affected by the leap second issue and report incorrect time:

GGA
GLL
RMC
ZDA

TAIP Protocol Users

For the TAIP customers the TM – Time/Date packet will be directly affected.

Solution

Trimble has identified the root cause of the problem and has designed a fix for this issue. We are in the process of creating a software patch for Lassen SQ and iQ to fix the leap second issue affecting timing customers. The patch can be loaded into the Lassen iQ or SQ module. The firmware loading program will be provided.

This will be an optional and non-production patch for the timing applications where an urgent fix is required. We do not expect any other timing changes occur through this patch.

The patch will be released by the end of September 2005; it will be available by contacting your sales person or Technical Support.