GPS Timing Problem – Display of GPS Time Instead of UTC

The following description of a timing problem is important to users of the STVASTRO (Video time inserter by The Black Box Company) or other video time inserters based on GPS as well as for any observer, who is using a GPS for timing purposes.

The same timing error can happen with ANY GPS receiver!

A. The Situation:

Powering up my Garmin GPS35 HVS, I found the time displayed by the STVASTRO 13 seconds ahead of my DCF77 watch (taking into account my watch shows CET instead of UTC). The STVASTRO displayed the position accurately and there was NO warning message about a "BAD GPS" on the screen. Without my watch I would not have noticed the wrong time!

Nine minutes later the display changed to the correct time.

I contacted Geoff Hitchcox.

We monitored the bad timing with his KIWI timing software and came to the following result.

B. Conclusions and Advice:

B.1. What happened to the time display?

The GPS35 transmitted GPS Time instead of UTC to the video time inserter.

GPS time is currently 13 seconds ahead of UTC (status Dec 2004).
(For more information about the difference: http://maia.usno.navy.mil/)

I'm using the GPS35 for timing occultations only and I had not powered up the GPS for over two months. The internal rechargeable memory battery had not enough power to retain the almanac data, and so this data was lost. The almanac data includes the information about UTC offset compared to GPS Time.

Summary of our test:

1. The STVASTRO displayed GPS time instead of UTC because of the loss of stored almanac information in the GPS35.

2. The almanac data is transmitted by the GPS satellites as part of the normal navigation information, a complete almanac download takes about 12.5 minutes.
   If the almanac data is lost in the GPS receiver, the switch from GPS Time to UTC depends on when the UTC offset information is received by the GPS unit. If the reception of the transmitting satellite is interrupted (e.g. satellite goes below horizon or is blocked by a building), the almanac collection will be will started again.
   So worse case, the UTC offset information could take half an hour to be received by the GPS receiver. This means bad timing could occur for up to half an hour in very rare cases! Or you could be lucky and get the UTC offset in just a few seconds after powering up - in my case it was 9 minutes.

3. A correct position fix can be accomplished by the GPS receiver, even if the UTC offset information is missing.
   So the STVASTRO will show you NO warning “BAD GPS”, BUT THE TIME COULD BE “GPS TIME” AND NOT UTC!

4. The 1PPS signal is NOT affected. Timing information in parts of second is correct from the beginning. Only the display HH:MM:SS will be wrong.

5. Memory batteries are used in ALL GPS receivers. This timing problem can happen to all GPS units! It will be more common as the units (and the memory batteries) are getting older.

B.2. What can you do about it?

1. Be aware that this timing problem can happen!

2. Crosscheck your time display with another accurate clock or time signal every time you power up the GPS.

3. For OEM units: Give your memory battery a charge from time to time, if you store it without power for a long time.

4. For handheld units: Give the GPS time to download new almanac data, if it was stored for a long time without or with empty batteries.

5. If you haven’t done any charging of the memory battery or your memory battery is at the end of its lifetime, power up your GPS unit early before an occultation. Download of a complete new almanac data takes 12.5 minutes and sometimes even longer!

6. Take the difference of GPS Time and UTC into account if your time display still shows GPS Time during an occultation. For units with 1PPS output no correction has to be made at the level of parts of a second.

7. Be aware of “leap seconds”!
   The difference between GPS Time and UTC will change in the future. “Leap seconds” are announced officially, and the GPS almanac dataset does have information of an impending change - if the receiver has downloaded an almanac a few months prior to the UTC “leap” taking place.

MANY THANKS TO GEOFF!
WHO HAS SOLVED ANOTHER GPS TIMING MYSTERY!

Oliver Kloes
Eppstein-Bremthal
Germany

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