

Re: Trouble aboard latest Global Positioning System satellite

Source: <http://sci.tech-archive.net/Archive/sci.geo.satellite-nav/2009-06/msg00091.html>

- *From:* Mike Jr <n00spam@xxxxxxxxxxx>
 - *Date:* Sat, 20 Jun 2009 11:23:53 -0700 (PDT)
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On Jun 20, 4:59 am, Mike Jr <n00s...@xxxxxxxxxxx> wrote:

On Jun 19, 11:01 pm, Sam Wormley <sworml...@xxxxxxxxxxx> wrote:

Mike Jr wrote:

On Jun 17, 11:47 pm, "Wolfgang S. Rupprecht"
<wolfgang.rupprecht
+gnus200...@xxxxxxxxxxx> wrote:

The Air Force has identified
the cause of signal
anomalies for PRN01
and will attempt to work
around the problem. If they
can do that
PRN01 might be set usable
this fall.
<http://www.insidegnss.com/node/1573>

While I'm really happy that the military
provides the GPS for our use,
the announcements they issue read like a bad
joke about military
intelligence. I've read about a dozen reports
now that "a signal
anomaly has been detected and they think
they can correct it", but the
reports all stop there. If they really know
what is going wrong why
isn't there a proper explanation in that press
release?

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–wolfgang

Wolfgang S. Rupprecht Android 1.5
(Cupcake) and Fedora-11

What you have is the data. Follow the link to be found here,
see page
35.

http://groups.google.com/group/sci.geo.satellite-nav/browse_thread/th...

Now think. They bolted on an L5 transmitter but it feeds a
single
phased array antenna, the same phased array antenna feed by
the L1
transmitter. The IIRM birds were not designed with an extra
connector
ready made for a new transmitter. I am guessing that the
interface to
the phased array antenna had to be changed and changed in a
hurry.
Somebody at ITT (I am guessing) made a judgment about
swapping in a
new interface that did have a new connector. Clearly that
new
interface didn't work as expected.

The wing has limited funds. I am guessing that a decision
was made to
not spend the money needed to do near and far field testing.
What
kind of technical advice the wing got and what they did with
it is
unknown.

You lay down your money and you take your chances.

—Mike Jr

Pretty good Mike Jr!

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The SVN-49 Story: What Went Wrong, How It Got Found and Fixed
<http://sidt.gpsworld.com/gpssidt/content/printContentPopup.jsp?id=605179>

Jun 19, 2009
By: Don Jewell

During a very reassuring teleconference today with Colonel David Madden (GPSW/CC) and Colonel David Buckman (AFSPC – GPS Command Lead), we learned the true story of exactly what happened to SVN-49, aka IIR-20(M), launched March 24, and why it has not been set to a healthy status. This teleconference should put an end to all the speculation concerning SVN-49 and its future status. In sum, there is nothing wrong with the L1, L2, or L5 signal transmitters, and they will not have to undergo expensive re-testing.

According to Colonel Madden, when the previous attempts to orbit a GPS vehicle with the L5 payload all failed due to delays in various programs, the decision was made to place a demonstration-only L5 payload on SVN-49 to accomplish three goals:

- 1) Place an L5 signal in orbit to prove that the L5 signal, which has a different signal structure, would not interfere with the legacy signals being broadcast from the satellite.
- 2) To allow the L5 user equipment developers to see the L5 signal from space so that they could proceed in their development of L5 receivers.
- 3) reserve the L5 spectrum, according to ITU specifications, for the US to use at a later date.

While initially it appeared to most observers that the first test was not met, in that it was originally thought that the L5 signal was interfering with the legacy GPS signals, this turns out not to be the case. Colonel Madden explained that when the decision was made to place the L5 signal payload on the SVN-49 vehicle, the decision

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was also made to integrate with the satellite through an auxiliary payload port already built into the satellite bus that was not being used on this particular mission. While the installation and checkout appears to have proceeded normally, there was not really an opportunity to test the satellite signals from a distance without a significant delay in the program and launch schedule, and the drop-dead date for the ITU signal requirements was rapidly approaching.

Therefore, the system tests were limited, and since the additional L5 payload was primarily made-up of a space-certified but modified L2 transmitter package left over from the IIRM line, no hardware problems were expected. After several weeks of testing SVN-49 performance on orbit the GPS Wing, Lockheed Martin (LMCO) and the 2nd Space Operations Squadron (2SOPS), have now determined that the observed signal anomaly is not with the L5 payload or the L5 signal itself. Indeed the anomaly is such that once the demo L5 payload is turned off, the signal errors will still exist, and the navigation parameters fix will continue to be implemented for the useful life of the satellite which could be as many as 16 years.

Colonel Madden explained that after a full-scale root-cause analysis was run at the LMCO facility in Denver, Colorado, the real problem was determined to be the way the L5 payload is integrated through the auxiliary payload port that causes reflected energy from the L1 and L2 signals to be reflected back into the broadcast antenna. This reflected signal causes a phase shift between the L1 and L2 signals, which affects how they are being formed and transmitted. The physical manifestation of the problem for users is that the resultant phase-center bias makes the satellite appear to be up to 150 meters closer to the Earth than is actually the case. This of course disrupts the ephemeris calculations of

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the satellite and makes the clock appear to also be in error.

Therefore, the broadcast navigation message parameters have been modified to reflect that the SVN-49 satellite phase center location is corrected by 150 meters and the relative clock offset has been corrected, meaning that the satellite position will appear to be nominal for receivers on the Earth. This means that the satellite which currently is broadcasting a position accuracy in the 6-meter range, depending on the latitude, when set to healthy should be broadcasting a position that is within the normal 2-4 meter accuracy range, with hopes that it might be closer to the current constellation average of .75 meters, the best that it has ever been since the inception of the GPS program.

Since we currently have 30 operating GPS satellites in orbit with another three residual satellites that can be reactivated in about 10 days to two weeks, there is no need to rush SVN-49 into service, so a little more time testing and adjusting the correction parameters is the prudent way to go. Currently the Wing expects the 2 SOPS at Schriever to set the satellite to healthy status sometime in the September-October 2009 timeframe. This is around the same time that IIRM-21 should be set healthy as well, if all goes according to plan.

For those of you paying attention to launch schedules, this should have been about the same time that the first IIF satellite would have been launched, but it looks like that will now not take place until the January-February timeframe in 2010. This fits well with my earlier predictions that we would not see a IIF launch in 2009. But as I am sure we would all agree, it is better to get it right than just launch on schedule and have a failure. Besides, according to Colonel Madden, launch-vehicle availability is really the culprit for the delayed IIF launch; but I am sure Boeing appreciates the extra

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time.

The news comes at a welcome time for all the rest of us as well, alleviating some of the current concerns about the GPS modernization program.

This also allows everyone, including LMCO and Boeing, to breathe a sigh of relief because it means there is nothing wrong with the L1, L2 or L5 signal transmitters and they will not have to undergo expensive re-testing.

My hat s off to the folks at LMCO, the GPS Wing, and the operators at Schriever for keeping at this task until they uncovered the real problem, and for continuing to provide the best PNT system in the world today.

I didn't mean to be sexist (see correction below).

Interesting. So they did have a spare connector just one not designed exactly for the purpose that it was put to. The wing needed to preserve the L5 frequency which they accomplished. The price was higher than they wanted.

I wonder where you make the fix? In the Kalman Filter? I hope the wing has some *really* smart people around to help with that.

Alfred Sloan could run GM in the 1920's by just looking at the financial numbers because he had people in the various divisions looking at how to make cars. Problem is, every one wanted Sloan's job so everybody began looking only at the financial numbers. Look how well that turned out.

GPS *is* rocket science.

--Mike Jr

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