WAAS Technical Report
William J. Hughes Technical Center
Pomona, New Jersey
3/29/06

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DR# 31: Loss of Availability due to Extended Satellite Maintenance on SV 30 (NANU 2006020)
GPS Week/Day: Week 1365 Day 6 (3/11/06)

Discussion:

On GPS Week 1365 Day 3 NANU 2006020 was issued concerning satellite maintenance on SV 30. The contents of the NANU are listed below.

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2006020------------------------
NOTICE ADVISORY TO NAVSTAR USERS (NANU) 2006020
SUBJ: SVN30 (PRN30) UNUSABLE JDAY 070/0200 - UNTIL FURTHER NOTICE
1.     NANU TYPE: UNUSUFN
       NANU NUMBER: 2006020
       NANU DTG: 110204Z MAR 2006
       REFERENCE NANU: N/A
       REF NANU DTG: N/A
       SVN: 30
       PRN: 30
       START JDAY: 070
       START TIME ZULU: 0200
       START CALENDAR DATE: 11 MAR 2006
       STOP JDAY: UFN
       STOP TIME ZULU: N/A
       STOP CALENDAR DATE: N/A

2.  CONDITION: GPS SATELLITE SVN30 (PRN30) WILL BE UNUSABLE ON JDAY 070
    (11 MAR 2006) BEGINNING 0200 ZULU UNTIL FURTHER NOTICE.

3.  POC: CIVILIAN - NAVCEN AT 703-313-5900, HTTP://WWW.NAVCEN.USCG.GOV
    MILITARY - GPS OPERATIONS CENTER at
HTTP://WWW.SCHRIEVER.AF.MIL/GPSSUPPORTCENTER, DSN 560-2541,
    COMM 719-567-2541, gps_support@schriever.af.mil,
HTTP://WWW.SCHRIEVER.AF.MIL/GPS
    MILITARY ALTERNATE - JOINT SPACE OPERATIONS CENTER, DSN 276-9994,
   COMM 805-606-9994, SPACEAF.AOC@VANDENBERG.AF.MIL
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The “Type” of this NANU is listed as “UNUSUFN” which indicates (as explained in the second entry of the NANU) that SV 30 will be “unusable until further notice.” Typically this means that for navigational purposes, the satellite will be unusable for a period of time that cannot be definitively established for users.

A drop in WAAS LPV service availability was observed on the day that NANU 2006020 as issued, Week 1365 Day 6 (3/11/06). Figure 1 is the LPV coverage contour plot from this day.

Figure 1 – LPV Service Coverage Contour Plots, Week 1365 Day 6 (3/11/06)

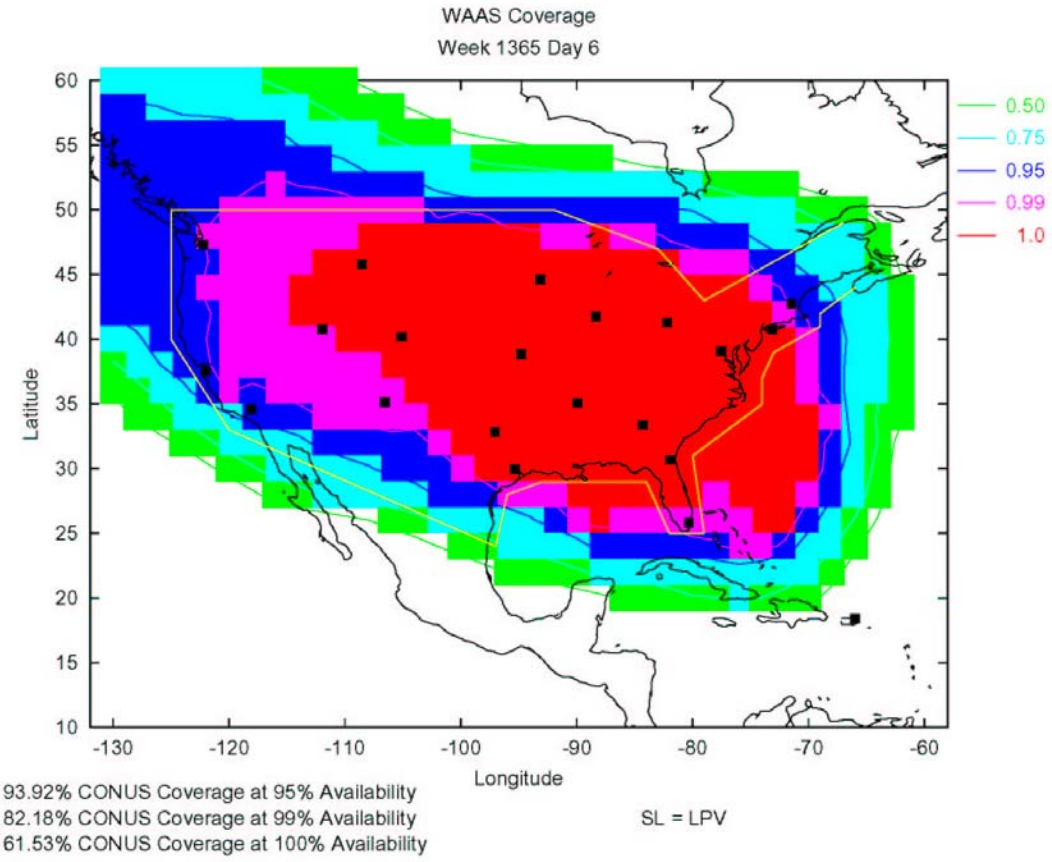


Figure 1 shows where the losses of LPV availability were most significant, namely in the Central Southwestern and Western regions of CONUS. Figure 2 is a plot of instantaneous LPV coverage over the CONUS service volume (30 sec sampling), providing an indication as to when the loss of LPV service occurred over the course of the day.

Figure 2 – Instantaneous LPV Coverage, Week 1365 Day 6 (3/11/06)

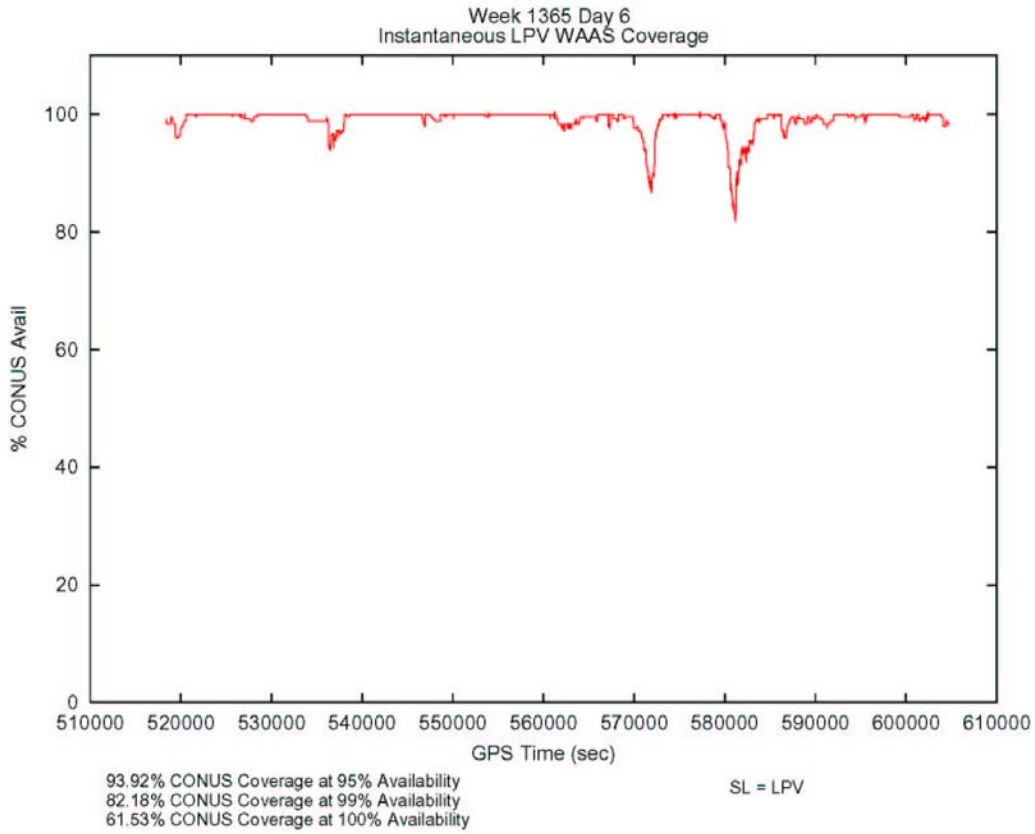
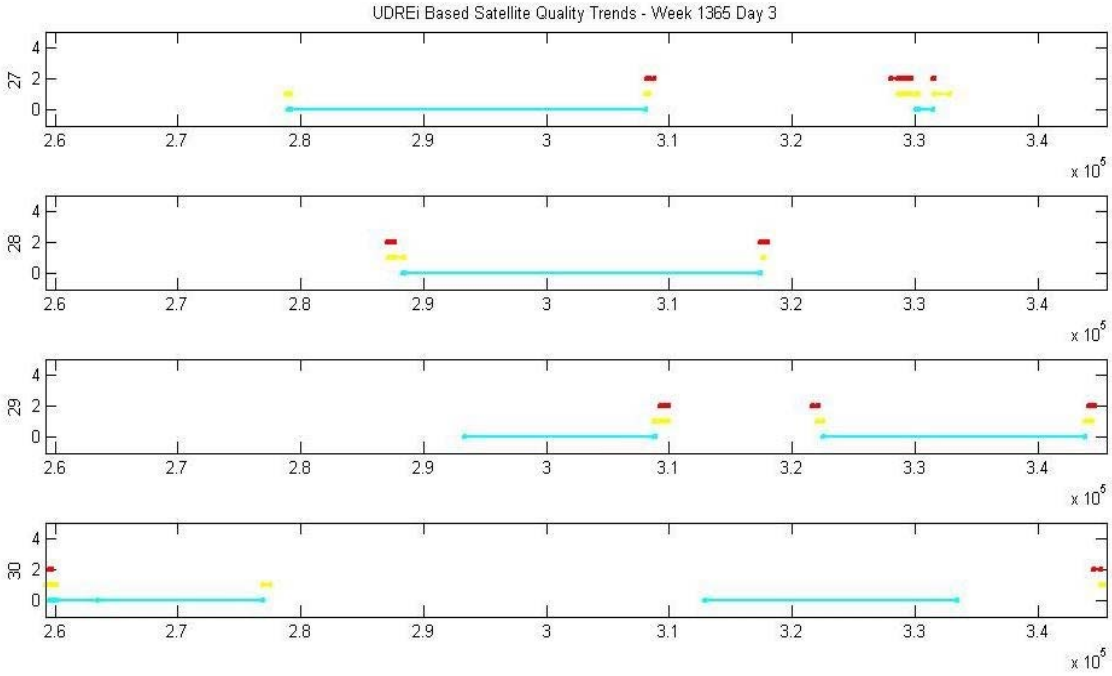


Figure 2 shows that the most serious losses of LPV service over CONUS occurred later in the GPS day. The loss of SV 30 as a PA ranging source is suspected as a likely cause for these drops in availability.

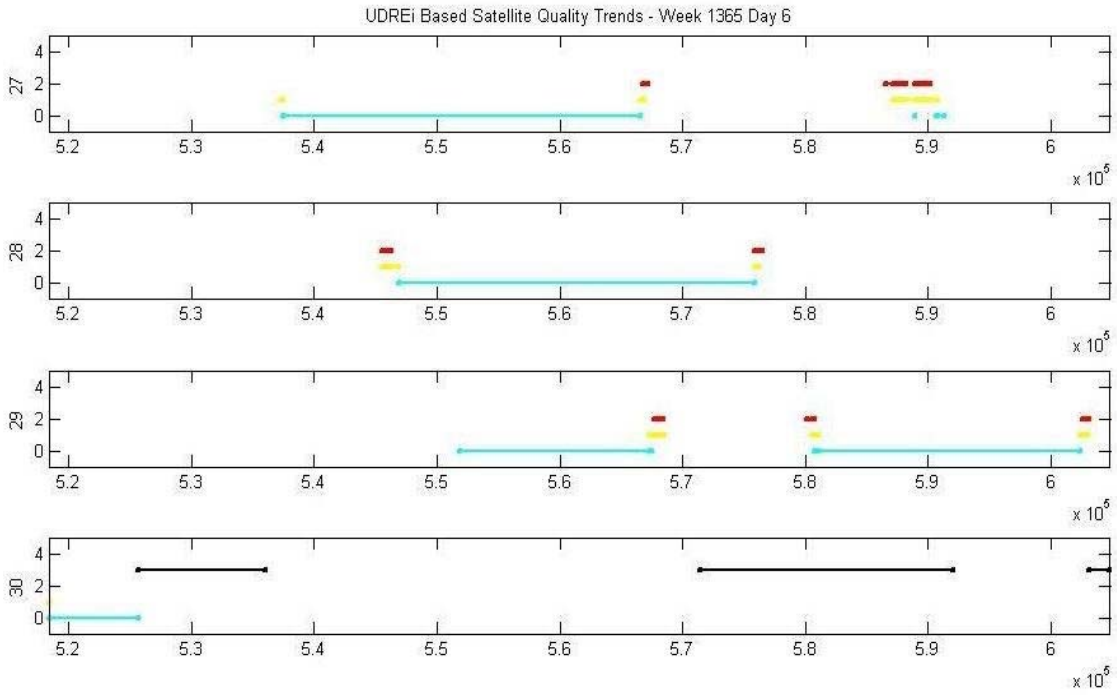
Figure 3 is a plot of UDREi-based satellite quality trends for several satellites, including SV 30, over the course of Week 1365 Day 3, a day during which SV 30 was both healthy for the entire day and during which no serious losses of coverage were observed. The colors on this plot each correspond to a general level of range quality. Blue indicates PA quality, yellow NPA, red Not Monitored, and black corresponds to Do Not Use.

Figure 3 – UDREi Quality of SVs 27-30, Week 1365 Day 3 (3/8/06)



Comparisons between Figures 2 and 3 show that during the time period for which losses of LPV service on Day 6 were most notable, SV 30 was of PA quality on Day 3, a day during which no significant losses of LPV service observed. Consider Figure 4, a plot of UDREi-based satellite quality trends for Day 6.

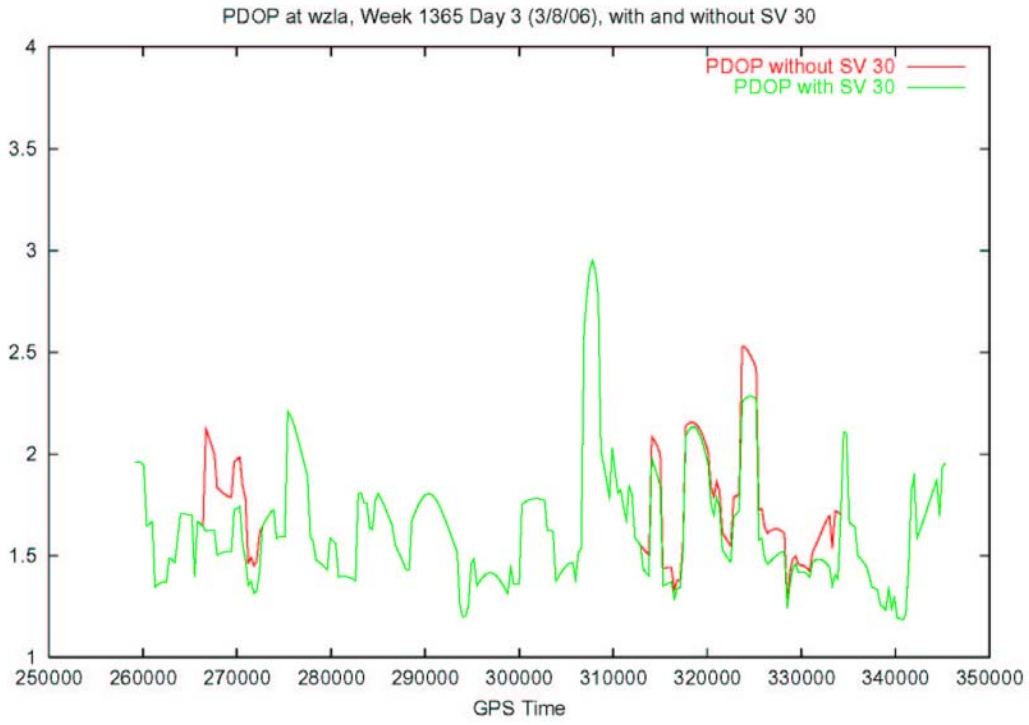
Figure 4 – UDREi Quality of SVs 27-30, Week 1365 Day 6 (3/11/06)



The time during which LPV service losses were most significant on Day 6, as seen in Figure 2, correspond very closely to the time during which SV 30 should have been of PA ranging quality. It was instead set to Do Not Use, as announced by NANU 2006020.

The specific effects of the loss of SV 30 as a PA ranging source can be illustrated by examining the impact it has on satellite geometry in a region that appear to have been significantly affected. Figure 5 is a plot of PDOPs at the WRS located in Los Angeles, wzla. Both trend lines on the plot are of the PDOP as calculated at wzla over the course of Day 3 (300 second sampling). However, one trend is the result of a simulation for which SV 30 was removed from the Almanac, simulating its loss as a PA ranging source.

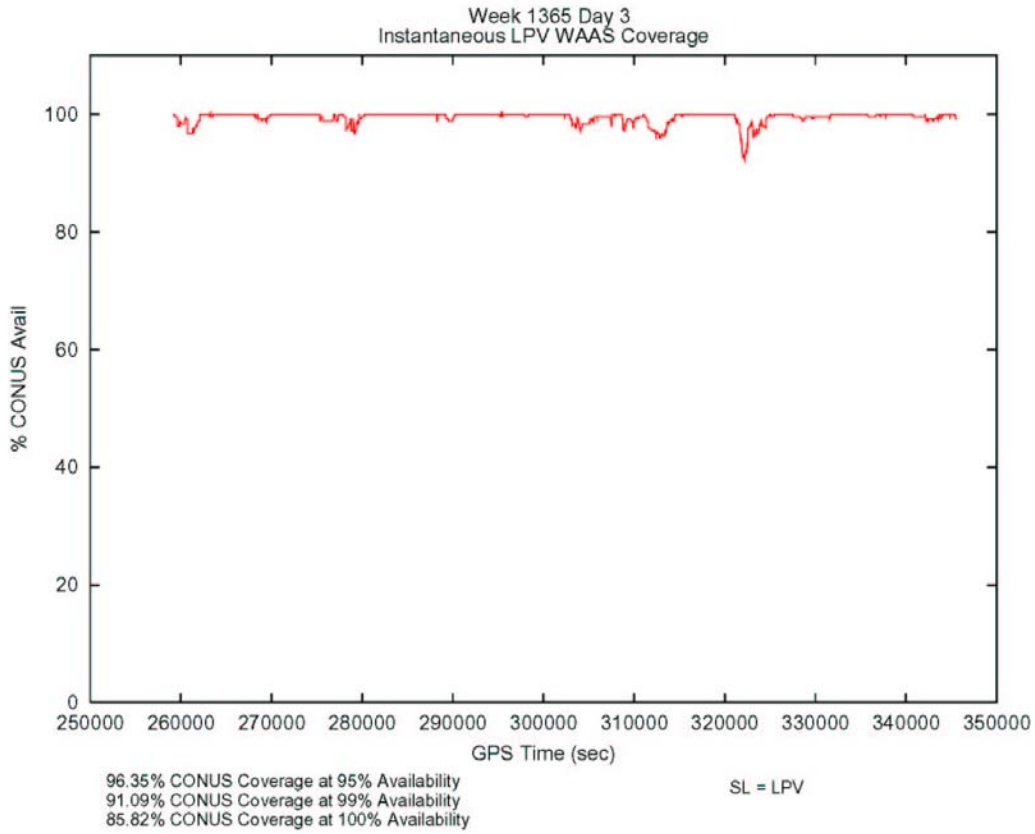
Figure 5 – PDOP at wzla, Actual and Loss of SV 30 Simulated, Week 1365 Day 3 (3/8/06)



Subtle differences in satellite geometry can have a significant effect on protection levels at a particular location. Simulating the loss of SV 30 on day 3 degraded the geometry for wzla at the same time of day that LPV service was lost on day 6. And again, Figures 3 and 4 show that this is the time of day during which PA ranging via SV 30 would otherwise be available.

Incidentally, SV 30 is typically available at a time of day during which the geometry of the GPS constellation is not ideal with respect to the CONUS service volume, as shown below in a Figure 6, a trend of instantaneous coverage (30 sec sampling) from day 3. The loss of SV 30 appears to have added significantly to this effect.

Figure 6 – Instantaneous LPV Coverage, Week 1365 Day 3 (3/8/06)



Conclusions:

The loss of SV 30 as a ranging source is the likely cause of reduced availability over the CONUS service volume on Week 1365 Day 6 (3/11/06) and continuing (similar coverage numbers reported each day since, see below). Satellite geometry at Los Angeles was noticeably impacted during the time at which SV 30 would otherwise be available for PA ranging.

SV 30 returned to service on Week 1368 Day 1. Below are the contents of NANU 2006028, announcing the return of SV 30 from maintenance.

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NOTICE ADVISORY TO NAVSTAR USERS (NANU) 2006028
SUBJ: SVN30 (PRN30) UNUSABLE JDAY 070/0200 - JDAY 086/2129
1.     NANU TYPE: UNUSABLE
       NANU NUMBER: 2006028
       NANU DTG: 272132Z MAR 2006
       REFERENCE NANU: 2006020
       REF NANU DTG: 110204Z MAR 2006
       SVN: 30
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PRN: 30
START JDAY: 070
START TIME ZULU: 0200
START CALENDAR DATE: 11 MAR 2006
STOP JDAY: 086
STOP TIME ZULU: 2129
STOP CALENDAR DATE: 27 MAR 2006

2. CONDITION: GPS SATELLITE SVN30 (PRN30) WAS UNUSABLE ON JDAY 070 (11 MAR 2006) BEGINNING 0200 ZULU UNTIL JDAY 086 (27 MAR 2006) ENDING 2129 ZULU.

3. POC: CIVILIAN - NAVCEN AT 703-313-5900, HTTP://WWW.NAVCEN.USCG.GOV
MILITARY - GPS OPERATIONS CENTER at
HTTP://WWW.SCHRIEVER.AF.MIL/GPSSUPPORTCENTER, DSN 560-2541,
COMM 719-567-2541, gps_support@schriever.af.mil,
HTTP://WWW.SCHRIEVER.AF.MIL/GPS
MILITARY ALTERNATE - JOINT SPACE OPERATIONS CENTER, DSN 276-9994,
COMM 805-606-9994, SPACEAF.AOC@VANDENBERG.AF.MIL

Figure 7 is a trend of LPV coverage at 99% availability from Week 1364 Day 6 to Week 1368 Day 3 with a yellow line showing the time during which SV 30 was unavailable as a PA ranging source.

Figure 7 – LPV CONUS Coverage for 99% Availability, Week 1364 Day 6 – Week 1368 Day 1 (3/4/06-3/29/06)