# *WAAS Technical Report*

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***DR#91: CRE Broadcast UDRE Not Monitored for CRW after C&V Fault***
***GPS Week/Day: Week 1575 Day 4 (March 18, 2010) to Week 1577 Day 3 (March 31, 2010)***

On March 18, 2010 there was a PRN 138 GUS switch (Woodbine to Brewster) due to a ZDC C&V fault. The ZTL C&V was set as selected source for the CRE GEO, with Brewster as the primary GUS. Approximately six minutes later another GUS Switch (Brewster to Woodbine) occurred due to a ZTL C&V fault. ZLA was set as the new selected source for CRE GEO with Woodbine as the primary GUS. After the ZDC C&V was returned to normal mode, ZDC was set as selected source for the CRE GEO. There was no change in status for the CRW GEO, Littleton as the primary GUS with ZLA as selected source. After the C&V fault, the CRW orbit calculated by ZDC was different from the CRW orbit broadcast in the Type 9 message causing GEO UDRE internal threshold failures in the ZDC C&V. This resulted in the CRE broadcast UDRE for CRW being set to Not Monitored for an extended period as shown in Figure 1. Note that the reference to 'Precision Approach' on the y-axis of this figure refers to UDREs that are either 7.5 meters or 15 meters. According to the RTCA DO-229 MOPS, a satellite can be used for precision approach (i.e. vertical guidance in LNAV/VNAV or LPV) when the UDRE is less than or equal to 15 meters. For the GEO satellites, this means either 7.5 meters or 15 meters since the UDRE is floored at 7.5 meters for the CRE and CRW GEO satellites. The UDRE for GPS satellites can be lower than 7.5 meters.

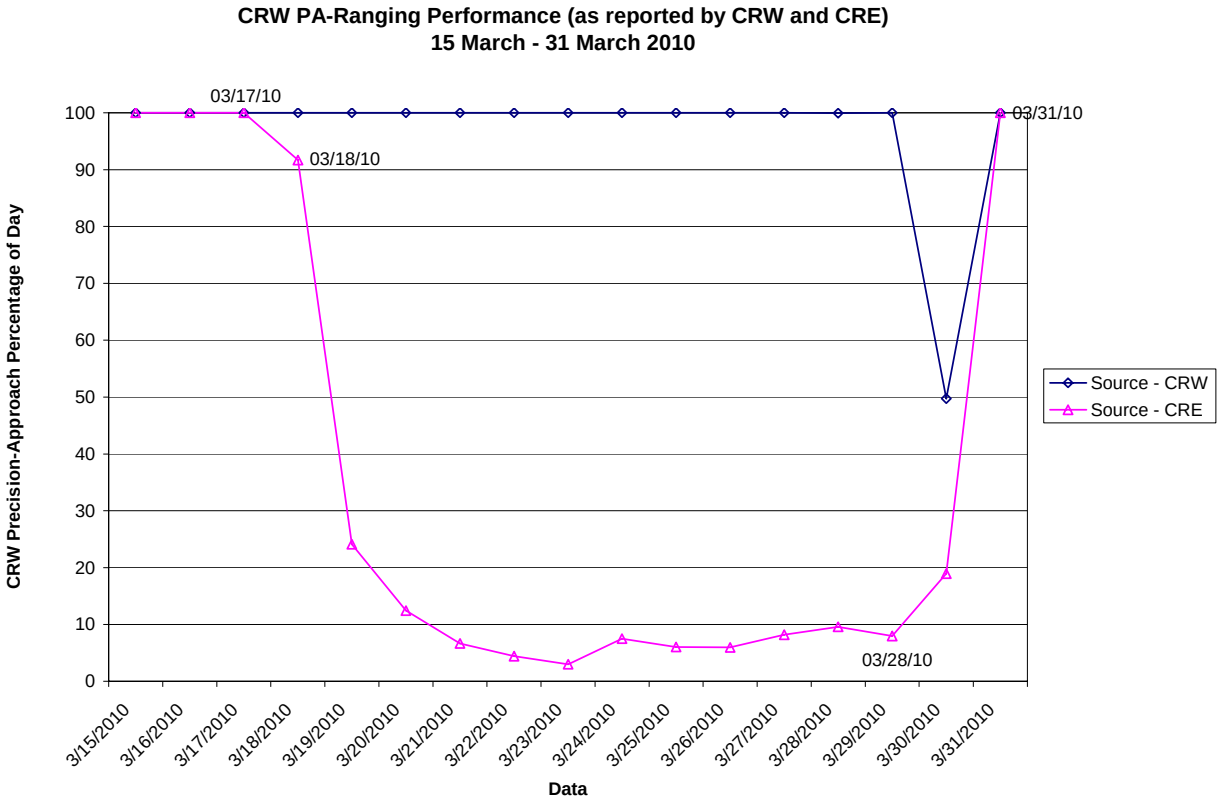


**Figure 1 – CRW Ranging Performance Reported by CRE and CRW**

This long period of GEO UDRE internal threshold failures is a result of running different selected sources for each GEO satellite when the calculated orbit is different for each selected source. Each C&V generates a fast correction based on its own orbit for each GEO satellite. However, the GEO UDRE internal threshold test uses the orbit broadcast by the GEO in the Type 9 message. If large enough differences exist between broadcast orbit from one C&V and the internally calculated orbit from a different C&V the UDRE internal threshold test will fail. This issue is scheduled to be fixed in a future modification to the WAAS software.

The start of this event was due to the ZDC C&V faulting followed soon after by the ZTL C&V faulting. Each C&V faulted for the same reason. The problem is that the message from correction processor 1 (CP1) and the message to correction processor 2 (CP2) did not match in the message validation check within the C&V. Specifically, the ordering of messages from WREs in CP1 and CP2 was different. That is, the order CP1 processed the message from each WRE was different from CP2. Additional investigation of the problem showed that the offending WRE is from the Gander WRS. A fix for this anomaly is planned for the next WAAS software modification. Until this modification is fielded the Gander WRS will be placed in verification mode, otherwise the possibility exists that another C&V fault will occur. This means that it will still send data over the WAAS network (for data collection and testing purposes), but the WAAS C&Vs will not process that data.

There is little impact to coverage by taking the Gander WRS out of the WAAS solution. Figure 2 shows coverage the day before the incident, March 17 2010. Figure 3 shows coverage the day after this anomaly, March 19 2010. As can be seen in these two figures the only area affected by not using the Gander WRS is in the Atlantic Ocean.

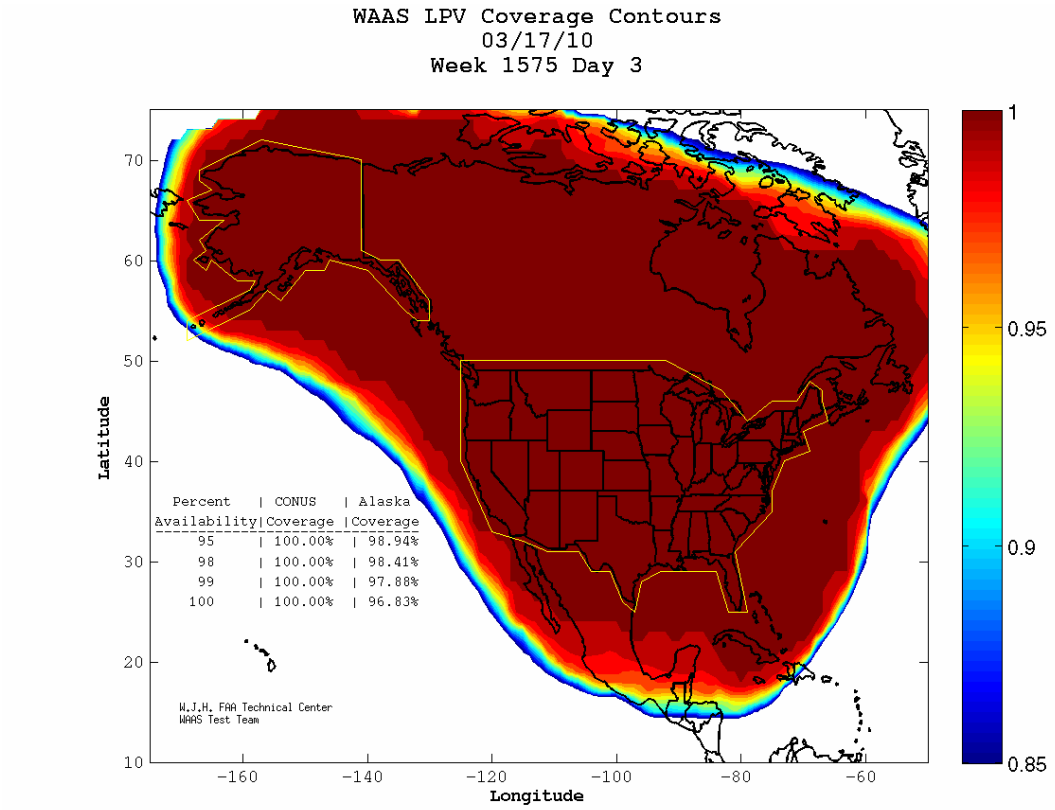


**Figure 2 – North American WAAS Coverage – March 17, 2010**

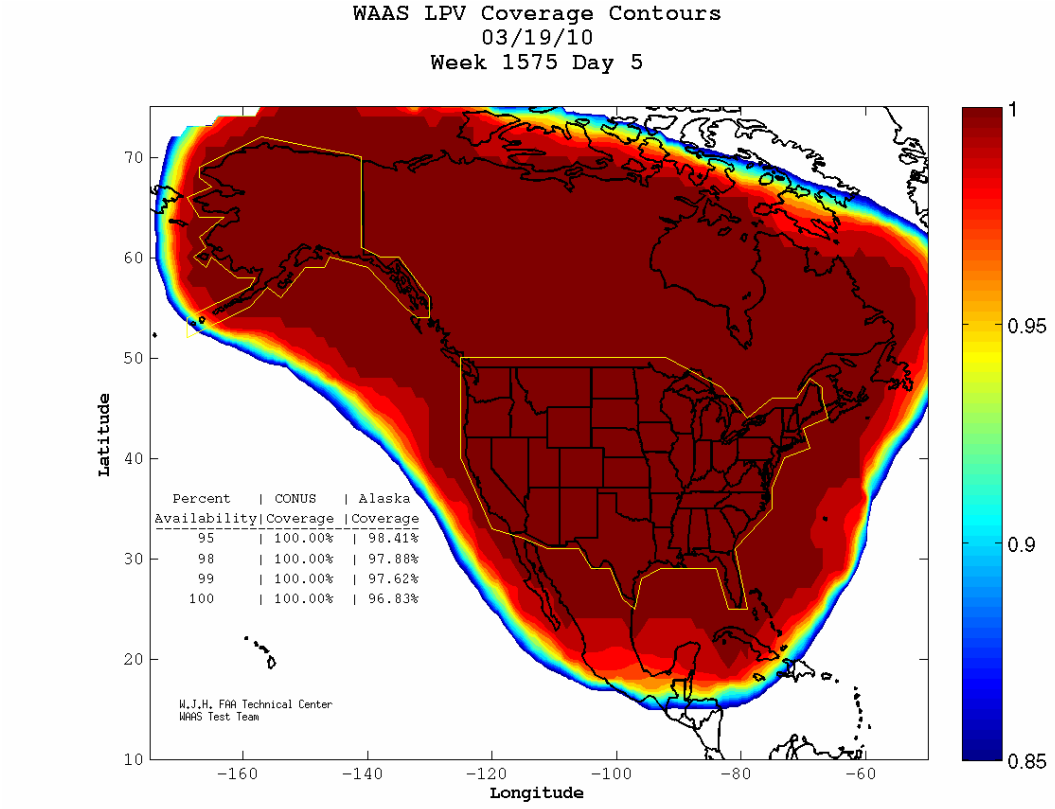


**Figure 3 - North American WAAS Coverage – March 19, 2010**

Time line of events:

3/18/10

20:05:16 - ZDC C&V faults
20:05:17 – ZTL becomes selected source for the CRE GEO satellite
20:11:00 – ZTL C&V faults
20:11:01 – ZLA becomes selected source for the CRE GEO satellite
21:59:55 – ZDC is placed in normal mode
22:05:47 – ZDC becomes selected source for the CRE GEO satellite. After ZDC returns to service, the calculated orbit for CRW fails the internal UDRE test compared to the CRW orbit broadcast in the Type 9 message. The CRW UDRE reported by CRE is set high and CRW ranging performance is degraded.

3/18/10 to 3/31/10
The CRW UDREs are set “Not Monitored” for most of this period (see Figure 1). ZDC is the selected source for CRE

3/28/10
The selected source for CRE is changed from ZDC to ZTL, this action returns the CRW back to precision approach quality UDRE.