WAAS Technical Report
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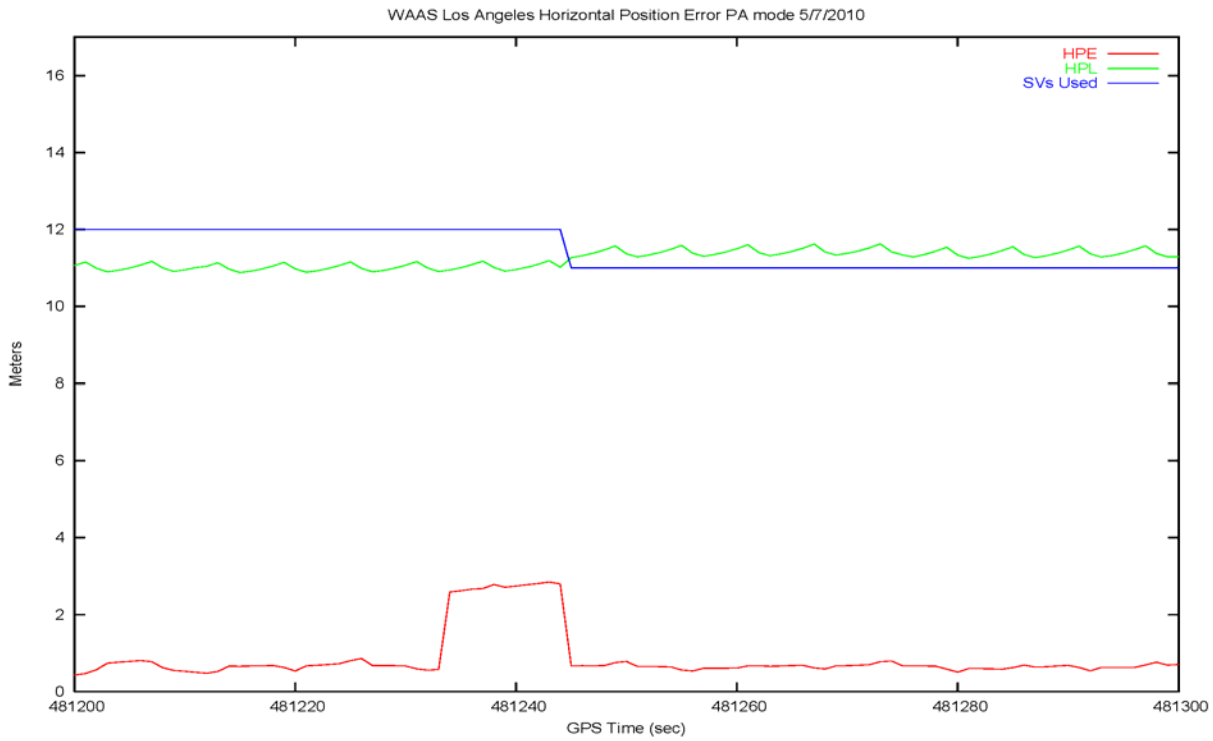
DR# 96: PRN 138 GEO Stream Caused Increased Position Errors and Ratios
GPS Week/Day: Week 1582 Day 5 (5/7/2010)

Discussion:

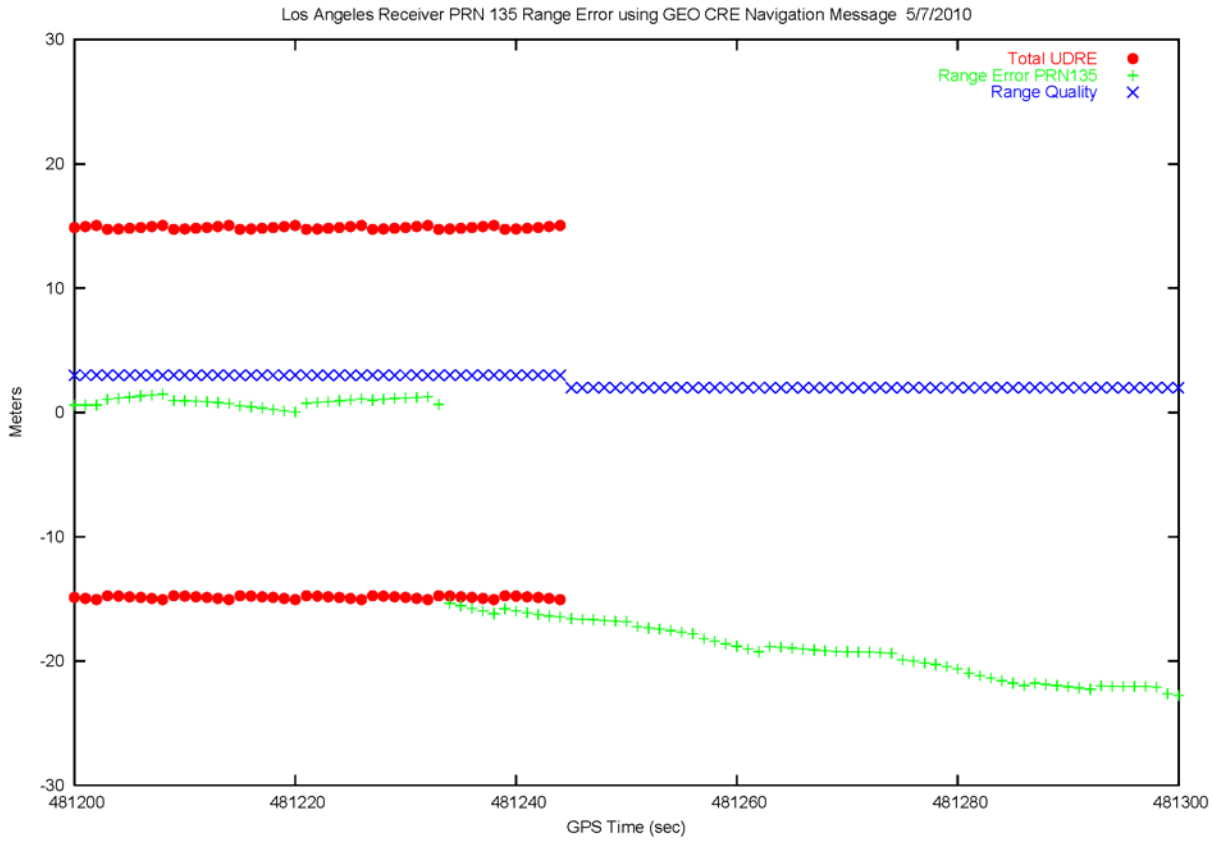
WAAS position accuracy was degraded for a short period of ten seconds for users that applied CRE navigation message on May 5, 2010 staring at 13:40:35 GMT (481235 GPS TOW). Horizontal position errors increased by approximately 2 meters at many locations within the WAAS service area. Vertical accuracy was not significantly affected, and Figure 1 shows the horizontal position error (HPE) and the horizontal protection level (HPL) at Los Angles during the event. As seen in Figure 1 the HPE decreased when satellite PRN 135 was removed from the navigation solution and the satellites used (blue trace) dropped from 12 to 11 precision approach (PA) quality measurements.

Figure 1 Horizontal Position Error Los Angeles



Satellite range errors (green trace) were computed for PRN 135 using corrections form GEO CRE navigation messages and are shown in Figure 2. The absolute value of PRN 135 range error increased from 1 m to 16 m at 13:40:35 GMT (481235 GPS TOW) temporarily exceeding the UDRE bounding (red trace) until the range quality was reduced to NPA use only at 13:40:45 GMT (481245 GPS TOW) indicated by the blue trace dropping from 3 to 2.

Figure 2 Satellite PRN 135 Range Error



WAAS users that applied satellite corrections from GEO CRW navigation messages did not experience any change in horizontal or vertical accuracy at the above times because PRN 135 satellite ranging was previously set to not monitored at 13:40:01 GMT (481201 GPS TOW) as shown in Table 1 (CRW Satellite Correction Messages). The PRN 135 UDREI's broadcast from GEO CRE, shown in Table 2, were not consistent with the UDREI's broadcast from GEO CRW, shown in Table 1. The GEO CRE broadcast UDREI for satellite PRN 135 was 10 at the time (481235 GPS TOW) of range error and position error increases, while the UDREI of satellite PRN 135 was 14 (Not Monitored) from GEO CRW.

Table 1 GEO CRW Satellite Correction Messages

PRN	TOV Fast	UDREI	UDRE	Fast Corr	TOE	IODE
135	481124	10	7.5	-0.88	481062	51
135	481130	10	7.5	-1	481062	51
135	481136	10	7.5	-0.5	481062	51
135	481142	10	7.5	-0.62	481062	51
135	481148	10	7.5	-0.88	481062	51
135	481154	10	7.5	-0.62	481151	51
135	481160	10	7.5	-0.38	481151	51
135	481166	10	7.5	-0.75	481151	51
135	481172	10	7.5	-0.5	481151	51
135	481178	10	7.5	-0.38	481151	51
135	481179	12	50	0.5	481151	51
135	481185	12	50	6.25	481151	51
135	481186	12	50	7.25	481151	51
135	481187	12	50	8.38	481151	51
135	481188	12	50	9.38	481151	51
135	481189	12	50	10.5	481151	51
135	481195	12	50	17	481151	51
135	481201	14	175	24	481151	51
135	481207	14	175	29	481151	51
135	481213	14	175	28.75	481151	51
135	481219	14	175	28.75	481151	51
135	481225	14	175	29.12	481151	51
135	481231	14	175	28.88	481151	51
135	481237	14	175	28.5	481234	192
135	481243	14	175	28.62	481234	192
135	481249	14	175	28.88	481234	192
135	481255	14	175	28.62	481234	192
135	481261	14	175	28.38	481234	192
135	481267	14	175	28.75	481234	192

Table 2 GEO CRE Satellite Correction Messages

PRN	TOV Fast	UDREI	UDRE	Fast Corr	TOE	IODE
135	481125	10	7.5	-0.88	481062	51
135	481131	10	7.5	-1	481062	51
135	481137	10	7.5	-0.5	481062	51
135	481143	10	7.5	-0.62	481062	51
135	481149	10	7.5	-0.75	481062	51
135	481155	10	7.5	-0.5	481151	51
135	481161	10	7.5	-0.38	481151	51
135	481167	10	7.5	-0.75	481151	51
135	481173	10	7.5	-0.62	481151	51
135	481179	10	7.5	-0.5	481151	51
135	481185	10	7.5	-0.62	481151	51
135	481191	10	7.5	-0.5	481151	51
135	481197	10	7.5	-0.62	481151	51
135	481203	10	7.5	-0.25	481151	51
135	481209	10	7.5	-0.5	481151	51
135	481215	10	7.5	-0.88	481151	51
135	481221	10	7.5	-0.5	481151	51
135	481227	10	7.5	-0.38	481151	51
135	481233	10	7.5	-0.88	481151	51
135	481239	10	7.5	-0.75	481234	192
135	481245	12	50	-0.5	481234	192
135	481251	12	50	-0.62	481234	192

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135   481257      12    50    -1    481234      192
135   481263      12    50    -0.75 481234      192
135   481269      12    50    -0.5  481234      192
135   481275      12    50    -0.75 481234      192
135   481281      12    50    -1.12 481234      192
135   481287      12    50    -1.12 481234      192
135   481293      12    50    -0.75 481234      192
135   481299      12    50    -0.88 481234      192
135   481305      12    50    -1    481234      192
135   481311      12    50    -0.62 481234      192
135   481317      12    50    -0.88 481234      192
135   481323      12    50    -1.12 481318      193
135   481329      12    50    -0.75 481318      193
135   481335      12    50    -0.75 481318      193
135   481341      12    50    -0.88 481318      193
135   481347      13    150   -1    481318      193
135   481348      14    175   -0.75 481318      193
135   481349      14    175   -0.62 481318      193
135   481350      14    175   -0.62 481318      193
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Conclusion

The UDREI of 10 for satellite PRN 135 transmitted from GEO CRE caused the satellite range measurement to be incorporated into the PA user navigation solution and increase position errors. This also caused PRN 135 range errors to exceed their bounding threshold until the UDREI for the satellite was increased to 12. Horizontal position errors at most locations increased approximately 2 meters but never exceeded the HPL. The ratio of HPE/HPL , which indicates WAAS safety margin , remained below 0.3 at all locations.