

GPS to Galileo Time Offset Operations

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The Galileo Program is expected to announce Early Services by the end of 2014. GNSS users could benefit from this new set of GNSS satellites when used in combination with GPS and GLONASS. This improved satellite visibility and reduced dilution of precision (DOP) will be particularly useful in an urban canyon environment where sky visibility is challenged. Each GNSS system broadcasts synchronizing clock corrections linked to their independent navigation time scale. These independent GNSS navigation time scales are typically traceable to UTC (module whole seconds) to better than 50 nanoseconds. To be useful for a precision navigation solution, this error needs to be reduced to below 5 nanoseconds. Therefore in 2004, GPS and Galileo have agreed to develop and jointly broadcast a GPS-to-Galileo Time Offset (GGTO) message, which user receivers may use for system-to-system navigation timing traceability.

Working in cooperation, USNO (GPS) and ESA (Galileo) have agreed upon several methods to compute and coordinate the GGTO values. During the initial stages of the coordination, and throughout Galileo's IOV campaign, the different methods will provide validation to the GGTO computations, ensuring a robust and accurate solution. GGTO is now being broadcast from Galileo. GPS has been conducting a series of CNAV message demonstrations during which a GGTO message is being broadcast.

Two techniques to estimate GGTO are being employed. The first technique uses the connected clock approach which establishes traceability between GPS and Galileo navigation time scales by physical measurement between terrestrial reference clocks. The second and more accurate technique will utilize a GPS/Galileo combined receiver. This paper will report the status of GGTO development, performance expectations and initial results.

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