

Expert Advice: Surveyors Ask About Civil P(Y) Sunset

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GPS World

My October 28 live web seminar *Is Dual-Frequency GPS As We Know It Becoming Obsolete?* was the most well-attended webinar to date for GPS World! I really enjoyed it and look forward to the next one in February 2009. The October webinar focused on the Department of Defense decision to discontinue supporting P(Y) on GPS L1 and L2 for civilian users after December 31, 2020.

You can view the full archived presentation. This column presents a selection of the questions asked by webinar participants, with my answers, ones that we weren't able to get to during the broadcast.

Col. Mark Crews (ret.), former GPS Chief Engineer, was kind enough to comment on some of the questions that were submitted during the webinar, along with Don Jewell, GPS World's Military and Government editor, and Richard Langley, the magazine's Innovation editor.

It is possible the U.S. government might be able to create a work-around before 2021 so that the Civil P(Y) sunset date becomes a non-issue. In other words, your legacy dual-frequency GPS receivers may end up operating past December 31, 2020, without any problems. I will stay on top of this issue and keep you up-to-date on any changes regarding Civil P(Y) sunset.

Question 5: Will the new codes be better under heavy canopy or forested areas?

Eric Gakstatter (EG): L2C and L5 should improve operation in and around trees, but that's not necessarily a good thing. Don't be fooled into thinking you can operate reliably at the centimeter level under heavy tree canopy. That will never happen with only GPS. As I stated in the webinar, the real solution for that environment is the integration of other technologies such as pseudolites, inertial navigation, gyros, lasers, etc. I think those technologies will eventually be small and cheap enough to integrate into a GPS/GNSS receiver to allow seamless operation in GPS-impossible environments at the centimeter level.

Also, more help than L2C and L5 would be the addition of more satellites via GLONASS and Galileo. In this case, I believe that quantity trumps quality. Yes, L2C and L5 are better, but it doesn't matter how good they are if the receiver can't track them because of obstructions.

Question 10: Will this change have any effect on our equipment before 2010?

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EG: No. The semi-codeless sunset date is set for December 31, 2020. The only changes happening before 2010 are that a couple more Block IIR-M satellites will be launched. The IIR-M broadcasts L2C in addition to L1 C/A. Also, in 2009 the first Block IIF satellite will be launched. The Block IIF will broadcast L2C and L5 in addition to L1 C/A.

Question 13: I had read an article that basically stated more frequencies would yield higher accuracies, especially vertical, over more satellites. Is this an accurate statement?

EG: I don't believe just adding more signals to the same number of satellites will significantly improve accuracy. I believe that more satellites (thus improved satellite geometry) is the best way to improve accuracy, especially vertical. With a full constellation of GPS, GLONASS, and Galileo, the number of satellites in view and the PDOP numbers would be incredibly good for high-precision users.

Richard Langley: Recall that $v = \text{VDOP} \times p$ where p is the measurement accuracy (pseudorange or carrier phase), if we can reduce p , then we can also reduce v . So yes, reducing VDOP with more satellites will help more but improvements in signal structure and receiver technology will also help. L5 signals, for example, should have lower multipath contamination and also less noise at low elevation angles.

Question 22: What happens to the old satellites? Do they just burn up as their orbit degrades and they approach Earth?

Don Jewell and Col. Mark Crews (ret.): There are definitely some people who believe that we should de-orbit all our satellites, but unless the satellite is just a few hundred miles above us in a Low Earth Orbit (LEO), it is simply not possible. The GPS satellites orbit in the Medium Earth Orbit (MEO) regime which is 20,200 kilometers (~12,000 miles), on average, above the surface of the Earth. When a satellite becomes too old or fails for some reason, it is boosted into a slightly higher orbit plane which puts it out of the way of any operational GPS satellites.

In recent years, through solid engineering and strategic thinking, some of the GPS satellites that were still functional, but would have normally been boosted up to a higher orbit, have been left in the operational MEO orbit plane and put to sleep or in standby mode for future use. Just recently some of these older GPS satellites have been reactivated. If we were to allow the satellites orbit to naturally decay from MEO, we will have been in our graves for thousands of years by the time they reach the Earth's atmosphere, where they would burn-up on reentry.

Richard Langley: There is also the potential for collisions of dead satellites from different constellations (GPS, GLONASS, Galileo, etc.) as a result of the satellites drifting out of their assigned orbit bands over the next 100 years or so. The GLONASS folks are studying this and it was mentioned during Sergey Revnivkykh's presentation at the ION GNSS 2008 CGSIC meeting.

Question 23: Are there receivers on the market now anticipating the change?

EG: Yes, there are many survey receivers on the market right now that can utilize L2C and are prepared for L5. They are typically the premium-priced receivers offered by the manufacturers.

Question 29: Do you have any recommendations for a small startup land survey company? Wait for the new technology to come out or purchase what's out there now?

EG: It's more of a business issue than a technology issue. I'll make a bunch of assumptions when answering. Personally, I'd try to keep your capital investment as low as possible at this point.

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If you only need post-processing, then a pair of L1-only static receivers is a relatively small investment (well under \$10,000). Or, one GPS dual-frequency receiver will do, and use an online positioning service such as OPUS.

If you need RTK (real-time, centimeter-level positioning for staking/topo), then the price tag goes up. Do you have access to an RTK network? If so, then you only need an RTK rover and a data plan from a wireless provider such as Sprint, AT&T, T-Mobile, etc. If you need RTK and no RTK network access, then you'll need a RTK reference station also. Again, the price tag goes up. Another piece of equipment to consider (maybe in lieu of GPS) would be a robotic total station.

It all depends on what kind of projects your company will be involved in the majority of the time.

Question 41: How much is the difference between maintaining the legacy signals and not maintaining the signals?

Don Jewell and Col. Mark Crews (ret.): I assume you are talking about the difference in costs here, but this is really not a question pertinent to this issue, as we are currently not planning on doing away with any current signals. Both the L1 and the L2 signal structure, coded and codeless, will still be broadcast for the foreseeable future. The issue is that, after December 31, 2020, the flex-power capability may cause temporary problems in codeless and semi-codeless civilian receivers for periods of time while the satellites are in flex-power mode.

However, your question is pertinent in the general sense, as there are new GPS signals and frequencies coming on board, and there are those who believe that some of the old signal structures should be abandoned for the newer, more capable signals. So far, there have been no decisions made to abandon any of the current signals, only to make them stronger and more robust, with more anti-jam and anti-interference capabilities, which is one of the functions of flex-power that serves the warfighter.

There is also the possibility that flexible power mode will be modified by 2021 in such a way that it will not cause an L2 phase shift and affect civilian receivers that are using semi-codeless techniques.