

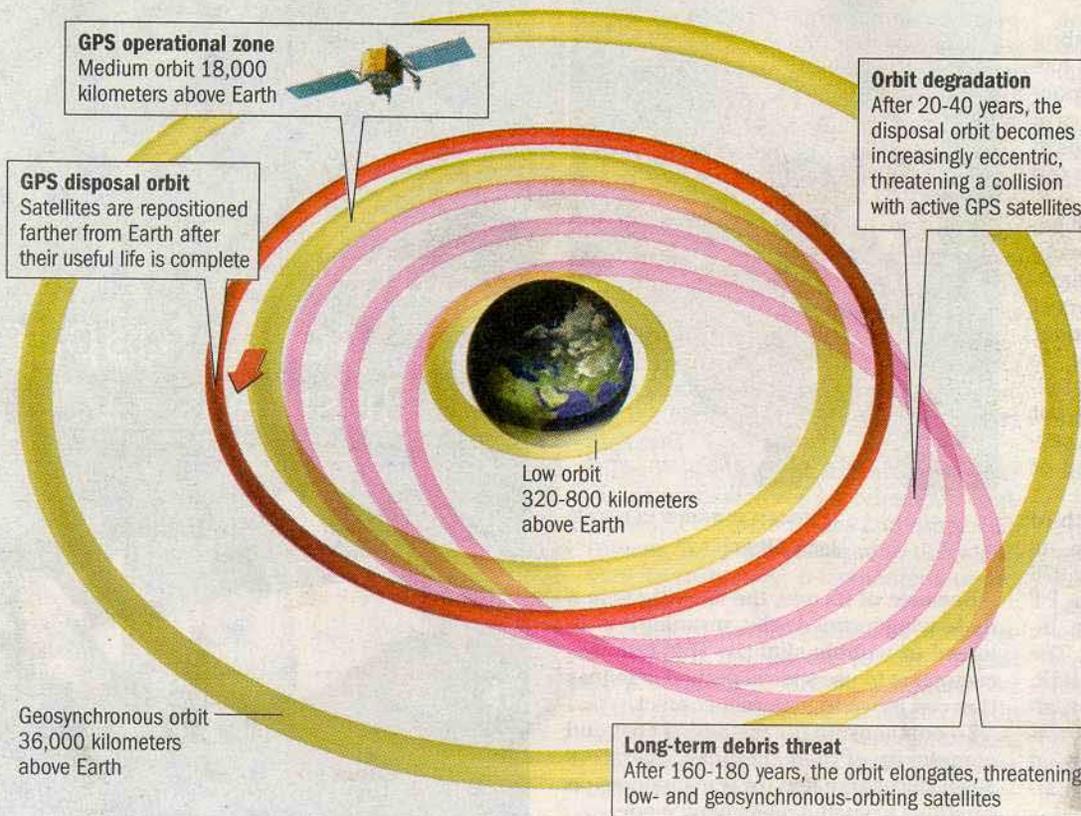
# Study Recommends New Plan For Retired GPS Craft

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## MITIGATING A LONG TERM THREAT

The orbits of retired U.S. Global Positioning System (GPS) satellites will degrade over time, creating a potential threat to operational GPS spacecraft and even spacecraft in geosynchronous and low orbits.



SOURCE: Space News research

SPACE NEWS GRAPHIC BY JOHN BRETSCHEIDER

Glonass navigation satellites also could one day cross paths with active GPS spacecraft, even though the Glonass craft are now some 1,000 kilometers lower.

The Aerospace Corp. study originally was commissioned to analyze the effects of moving GPS launches to a new series of rockets being developed under the Air Force's Evolved Expendable Launch Vehicle (EELV) program, Loverro said.

GPS satellites currently are launched on Boeing-built Delta 2 rockets which release the spacecraft in a low Earth orbit. The satellites are carried to medium-altitude orbit by auxiliary kick motors, which remain attached to the spacecraft, Loverro said.

When GPS satellites begin launching on EELV rockets in October 2005, they will be carried directly to medium Earth orbit. That means leaving spent upper-stage rocket motors in the neighborhood of the active GPS constellation, Loverro said.

Boeing and Lockheed Martin are developing similar families of EELV rockets dubbed Delta 4 and Atlas 5, respectively. The Delta 4 is slated as the first of the EELVs to carry GPS satellites to orbit.

In a written response to questions, Robert Villanueva, a spokesman for Boeing Expendable Launch Systems of Huntington Beach, Calif., said the company and the Air Force are studying ways to keep spent rocket stages away from the GPS constellation.

One option is placing the upper stages in a disposal orbit after spacecraft delivery, Villanueva said. A second option entails deploying the GPS spacecraft into an orbit slightly above their operational orbit, he said. The spent upper stages would remain in that orbit, while the satellites would use onboard thrusters to get down to their proper orbit, he said.

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The U.S. Air Force should adopt a more precise method for getting rid of decommissioned navigation satellites to minimize the threat they pose to the operational constellation, a new study has recommended.

Retired Global Positioning System (GPS) navigation satellites already are boosted into higher orbits, and experts previously thought this would keep them out of the way indefinitely. But according to the study, conducted by the Aerospace Corp. on behalf of the Air Force, the spent satellites over time will drift into highly elliptical orbits that cross paths with the active satellites.

Air Force Col. Douglas Loverro, director of the GPS Joint Program office at Air Force Space and Missile Systems Center in Los Angeles, said the chances of a collision between an active and a retired GPS satellite are extremely remote. "There is little here that is cause for excitement," he said. "It certainly could always happen, but the chances are so low you should worry about other things."

Nevertheless, Loverro said, the Air Force in the future may time the orbit-raising maneuver for decommissioned satellites more carefully to reduce the chances of a collision even further.

The GPS is a constellation of satellites that provide position-location, velocity and time information to users equipped with special receivers anywhere on the Earth's surface or in the air. The current constellation consists of 28 satellites operating in medium-altitude, circular orbits, about 18,000 kilometers above the Earth's surface.

Previously, scientists believed that objects in such orbits would remain there over long periods of time, and that by simply nudging retired GPS spacecraft upward they would eliminate the possibility of a collision. That no longer is

the prevailing wisdom, said George Chao, senior engineering specialist at the Aerospace Corp. of El Segundo, Calif., and the principal author of the report.

"GPS satellites placed in disposal orbits can eventually, perhaps in 20 to 40 years, encroach into the operating constellation," Chao said. "This doesn't mean every disposal orbit will be affected, but there is potential."

The report, "GPS Disposal Orbit Stability and Sensitivity Study" is the culmination of a series of studies dating back to 2000. Its findings and recommendations were released March 7.

"We want to make sure future disposed satellites will not come close to the constellation," Chao said in a telephone interview.

Some of the report's preliminary recommendations already have been adopted, Chao said. For example, the last five GPS satellites to be retired have been boosted into circular orbit at least 500 kilometers above their operational orbit, he said.

Previously, spent GPS satellites were not raised as high as 500 kilometers, said Dave Jonta, a spokesman for the Aerospace Corp.

Loverro said 14 GPS satellites

have been retired to date, and 19 to 20 are slated for replacement by the end of the decade. He said nothing can be done at this point to change the orbits of those satellites that already have been decommissioned.

The primary benefit of the Aerospace Corp. study, according to Loverro, is that it has yielded a new theory on what happens to objects in medium-altitude orbit over long periods of time.

"As space traffic increases, I think these kind of calculations will help us develop much better disposal means," Loverro said.

Chao said retired Russian