

## **New Boeing GPS Satellites To Use Advanced NRL Atomic Clocks**

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The next generation of Boeing-built Navstar Global Positioning System (GPS) satellites will feature a substantial upgrade to the cesium atomic clock technology that forms the heart of the world's most accurate navigation system. The improvement is the latest result of long-standing development work on frequency standard technologies by the U.S. Naval Research Laboratory (NRL), Washington, D. C.

The upgrade involves converting the GPS cesium clocks from analog to digital -- the first-ever use of the commercially available digital cesium standard technology on a spacecraft. The processor-controlled cesium clocks, provided by Frequency and Time Systems, Inc., Beverly, Mass. (a Datum, Inc. company), continuously optimize their performance by adjusting internal parameters and compensating for environmental effects. They also will be capable of performing self-checkout diagnostics.

Rich Arras, Boeing North American Space Systems Division vice president and programs director for GPS Programs, said the digital cesium clocks will provide improved performance and give the U.S. Air Force GPS control segment greater visibility into the health of the units.

"The digital cesium standard represents the next step in the evolution of frequency standards in space and promises to result in better accuracy for military and civilian GPS users alike, not to mention improved time transfer capabilities," he said.

Ron Beard, head of NRL's Space Applications Branch, said the Boeing application of NRL's frequency standard work to GPS IIF is the latest example of NRL's success in working with industry to get technology out of the laboratory and into the hands of those who need it. "Developing technologies, transferring them to industry and fostering their use on programs such as GPS is a goal we continually strive for," he said.

The GPS IIF spacecraft will have four frequency standards composed of both cesium and rubidium technologies. These extremely accurate GPS atomic clocks can keep time to within 8 nanoseconds a day.

Navstar GPS is a constellation of half-geosynchronous satellites that instantaneously provide precise, three-dimensional navigation information under all weather conditions around the world. The system became fully operational in March 1994. Boeing North American Space Systems Division is the prime contractor for the Air Force's Navstar GPS Block I, II, IIA and IIF satellites.

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