



Military Communications & Positioning, Navigation, and Timing

GPS - Civil Applications

17 September 2024

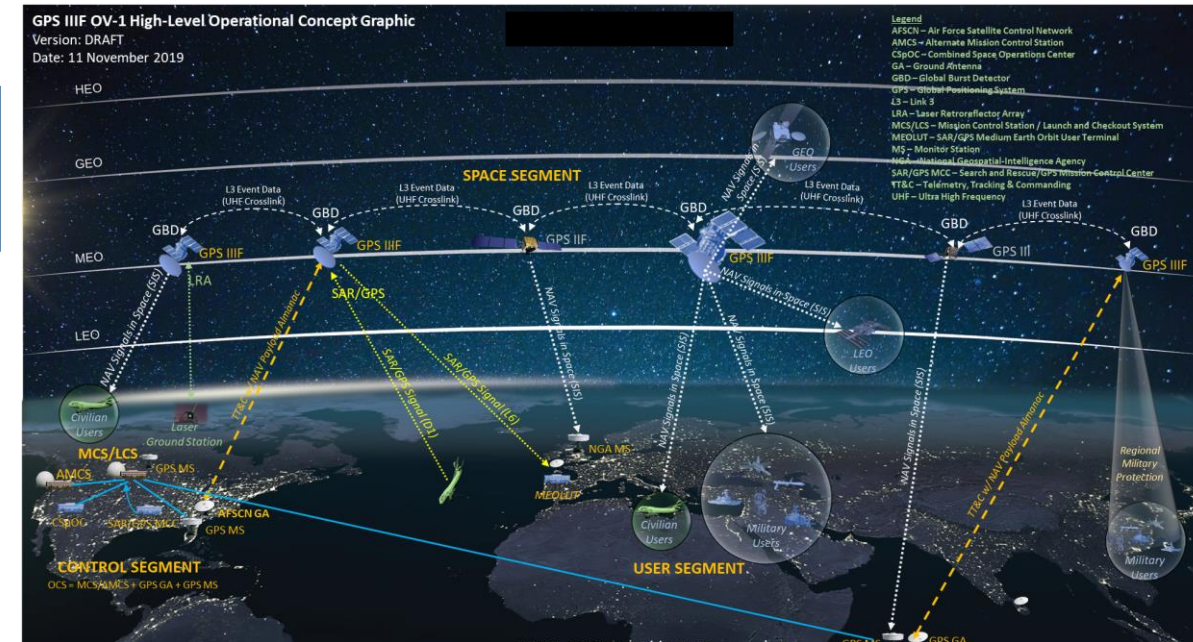
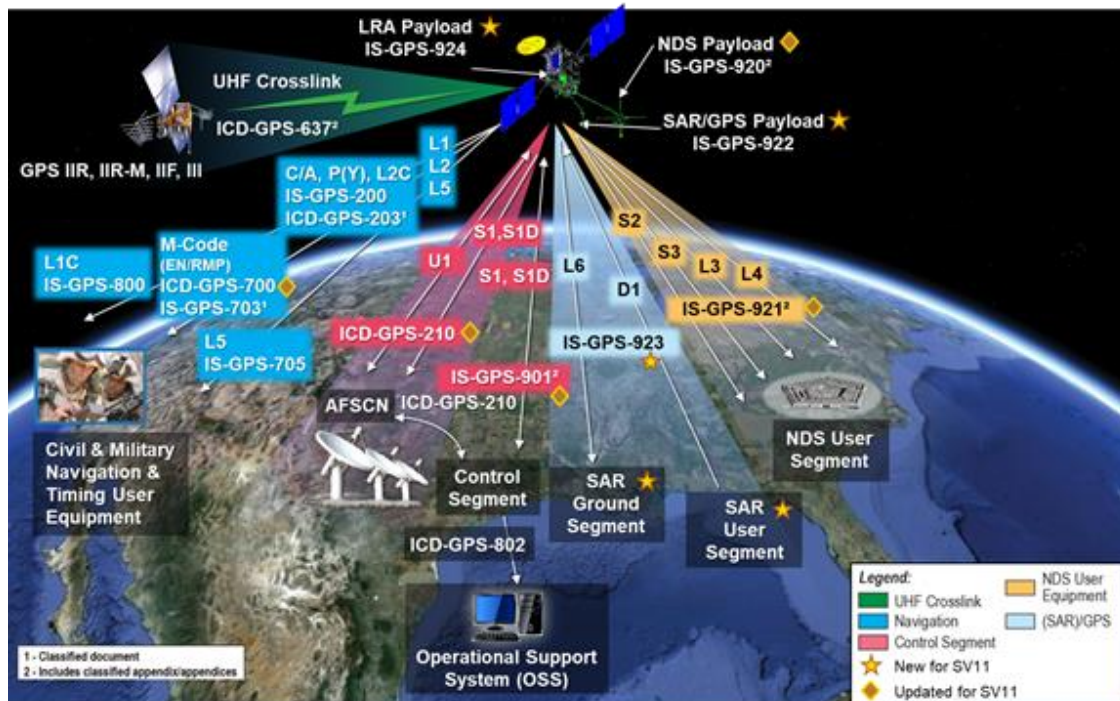
Mr. Eddy Emile, USSF
Positioning, Navigation, and Timing System Delta

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GPS Mission Overview

- **The Space Segment (SS)** or satellite constellation provides signals in space (SIS) that enable GPS users equipped with a GPS receiver to precisely determine time and their 3-D position and velocity.
- The **Control Segment (CS)** or ground/control monitoring network provides command, control, comm and monitoring of GPS SVs.
- **User Equipment (UE)** Segment consists of UE deployed worldwide with Military and Civilian users for receipt of P, N, and T signals.



- Mission Architecture improvements from GPS III to GPS IIF
 - Updated Primary Payload: Added Regional Military Protection (RMP)
- Added/Modified Secondary Payloads
 - Upgraded NDS (NuDet Detection System) Payload
 - Added Search and Rescue (SAR/GPS)
 - Added Laser Retroreflector Array (LRA)
- Other
 - Uses Direct Injection Launch Vehicle to Medium Earth Orbit (MEO)



GPS IIF SAR/GPS Mission

Beacon UHF Uplink



2

All GPS IIF satellites IVO beacon signal receive UHF uplink and convert signal to L6 downlink



SAR L6 Downlink

1

Isolated Personnel on land or sea activate Sarsat beacon



3

GPS IIF satellites transmit L6 signal to SAR Local User Terminal; Rescue personnel dispatched for rescue operation



SAR Local User Terminals

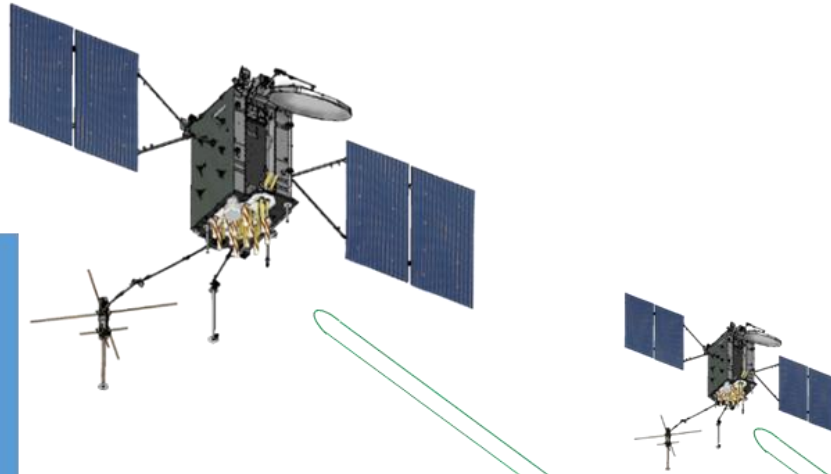




GPS III LRA Mission

1

International Laser Ranging Service (ILRS) sites send time-tagged optical pulses to GPS IIIIF satellites



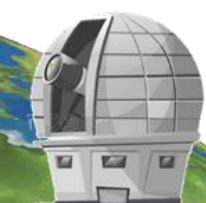
2

The GPS IIIIF LRA reflect the low-power laser signals back towards the ground site.

ILRS sites measure the time interval required for the pulse emitted by a laser to travel to the satellite and return to the transmitting site. A range to the satellite can be calculated.

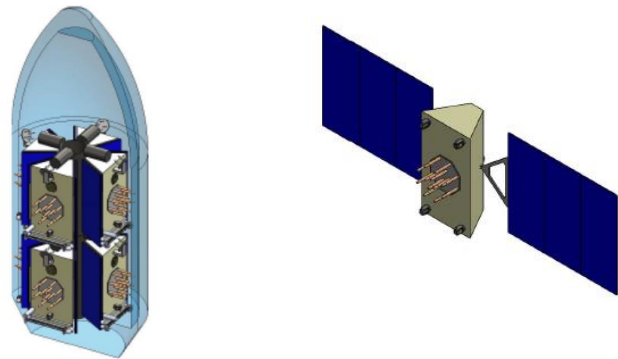
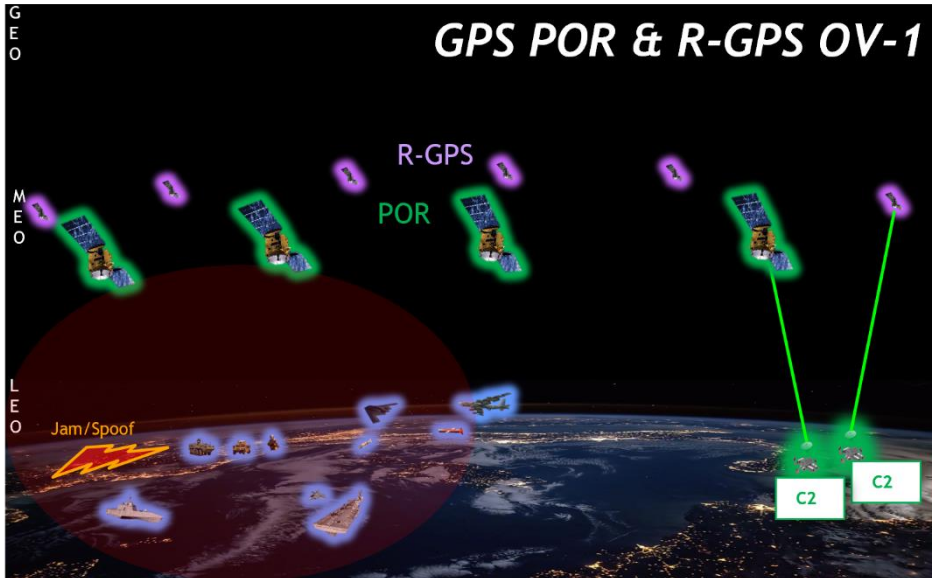
Measurements are then used for precise orbit determination < 1 cm accuracy.

US & International Laser Ranging Service (ILRS) Ground Sites





Resilient GPS (R-GPS)



- Resilient GPS augments & provides resilience to current GPS constellation by providing proliferated small satellites transmitting core GPS signals
 - 1 of 2 Department of the Air Force programs leveraging new FY24 NDAA “Quick Start” Authority
- Strategy leveraging both traditional and non-traditional vendors
 - Phase 0: Up to 5 vendors to executable design concepts in early 2025
 - Phase 1: Up to 2 vendors to Full Design and Payload Demo in 2026
 - Phase 2: Up to 2 vendor(s) build up to 8 satellites for launch in 2028
 - USSF Affordability Goal: \$50 - \$80M per SV
- Transmit core GPS signals providing resilience to Million+ military (DoD & Allied) and Billion+ worldwide civilian users
 - “YMCA” signals: L1 C/A, P(Y), and M-Codes

Resilient GPS is the most viable and cost-effective solution to add Military and Civilian PNT Resiliency as soon as 2028