



GPS Modernization Update



IEEE PLANS

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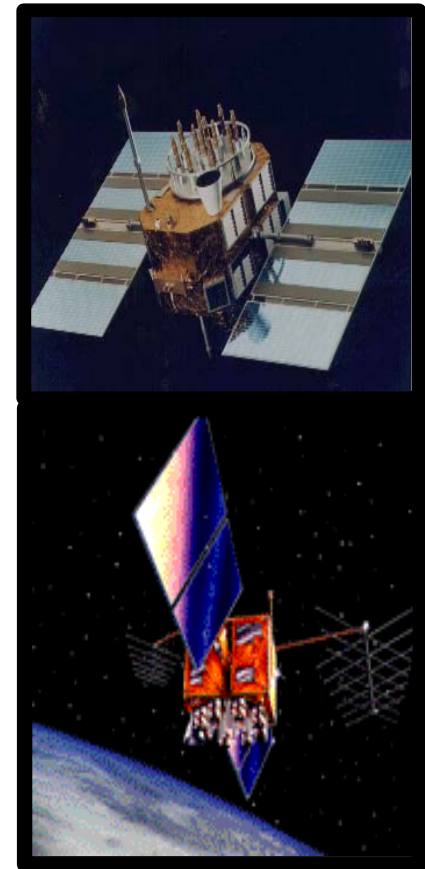
Overview



- **Constellation Status**
- **GPS IIR and IIF Modernization**
- **Control Segment**
- **New and Improved Clock and Ephemeris (NICE)**
- **Summary**

28 Satellites Set “Healthy”

- **18 Block II/IIA Satellites in Orbit**
- **10 Block IIR Satellites in Orbit**
 - Last launch 20 Mar 04 (IIR-11)
 - SVN59 launched to C3 node, set healthy 05 Apr 04
 - 10 of 21 Block IIR satellites available
 - Modernizing 8 Block IIR satellites
- **Next Scheduled Launches**
 - Jun 04 (IIR-12)
 - Sep 04 (IIR-13)
 - Mar 05 (IIRM-01) – available for launch in Dec04



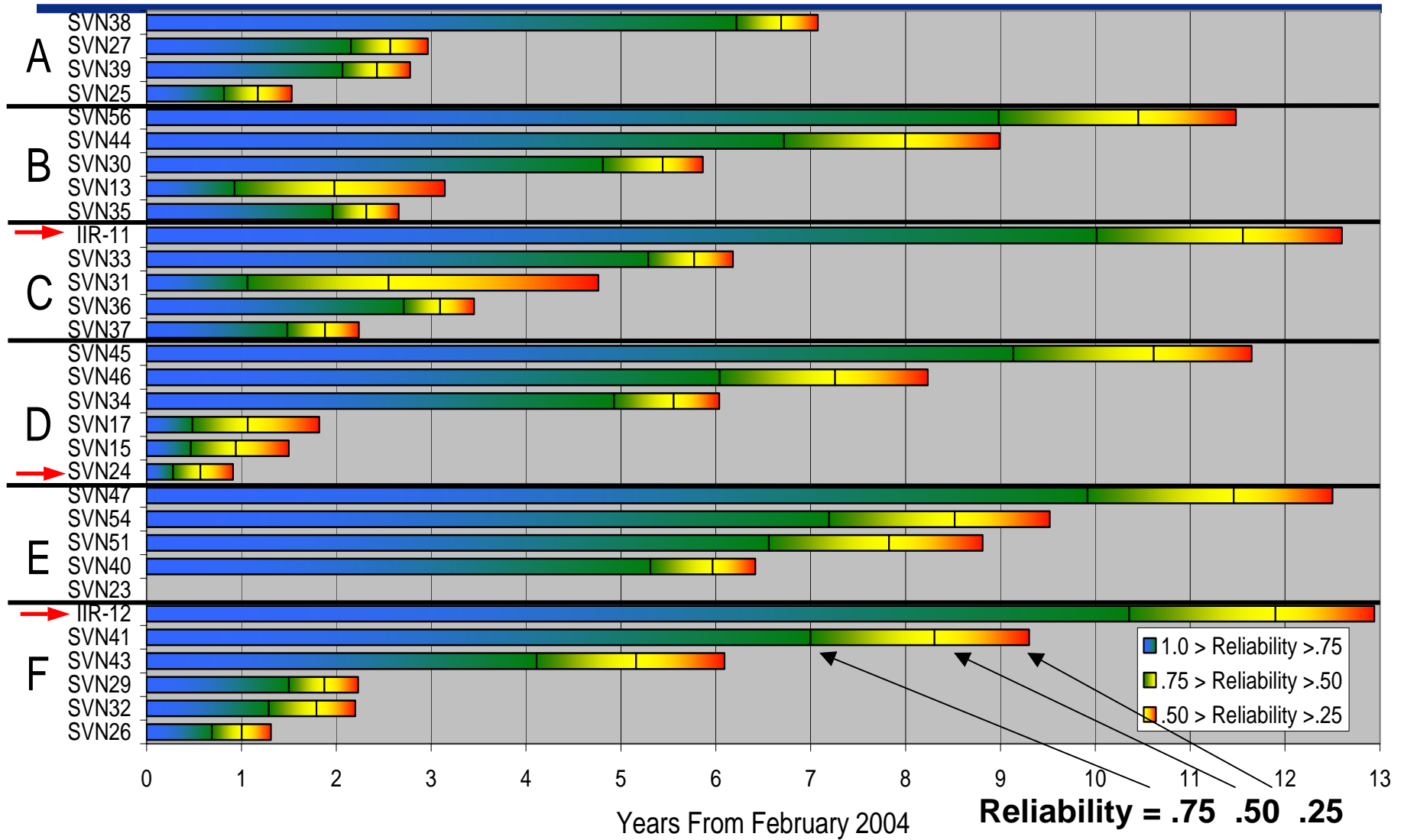


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GPS On-orbit Satellite Reliability

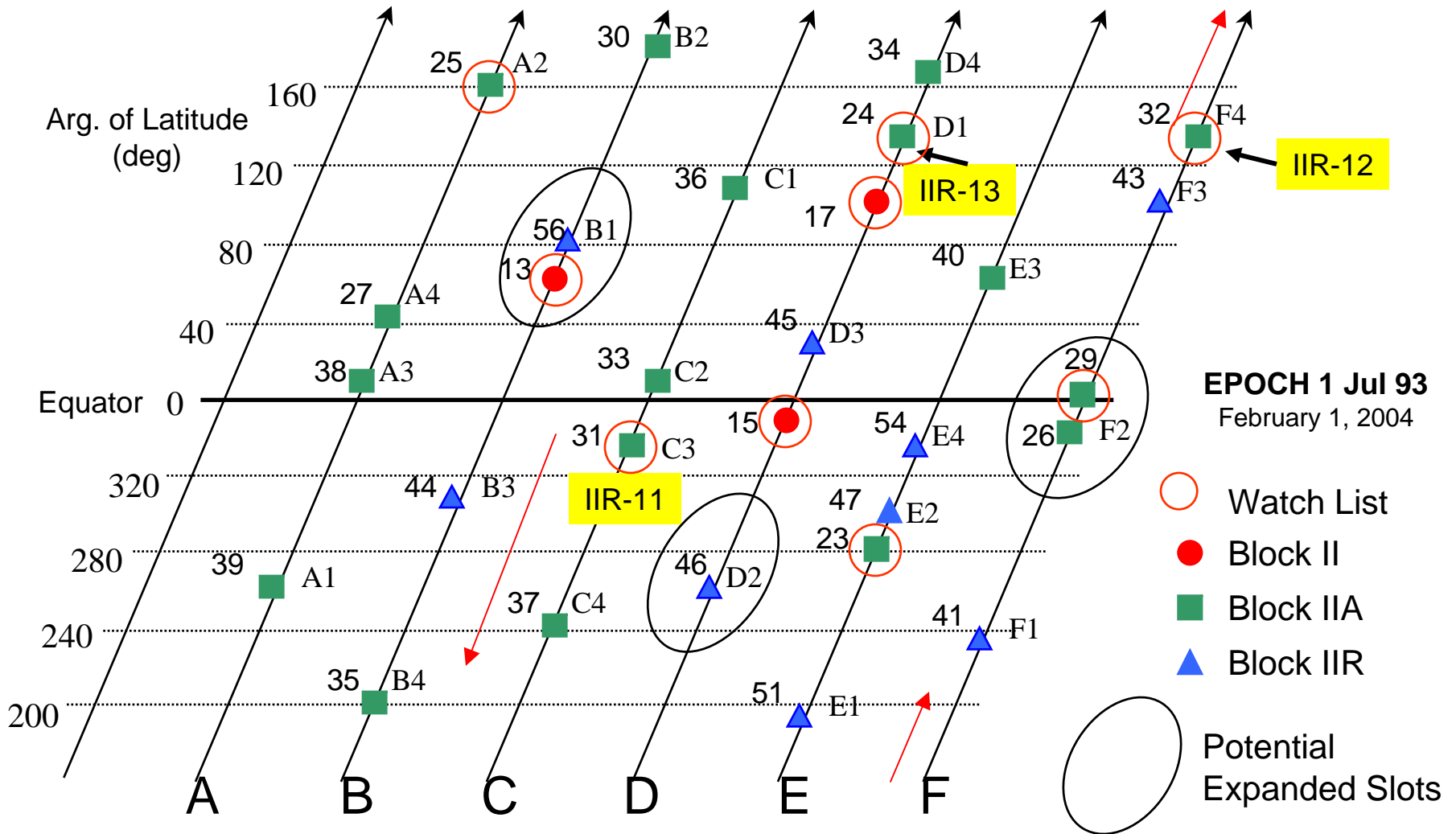
Includes Mission IIR-11, IIR-12. SVN-23 Out-of-Service. (Oct 2003 Reliability)





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GPS Locations





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Block IIR Modernization



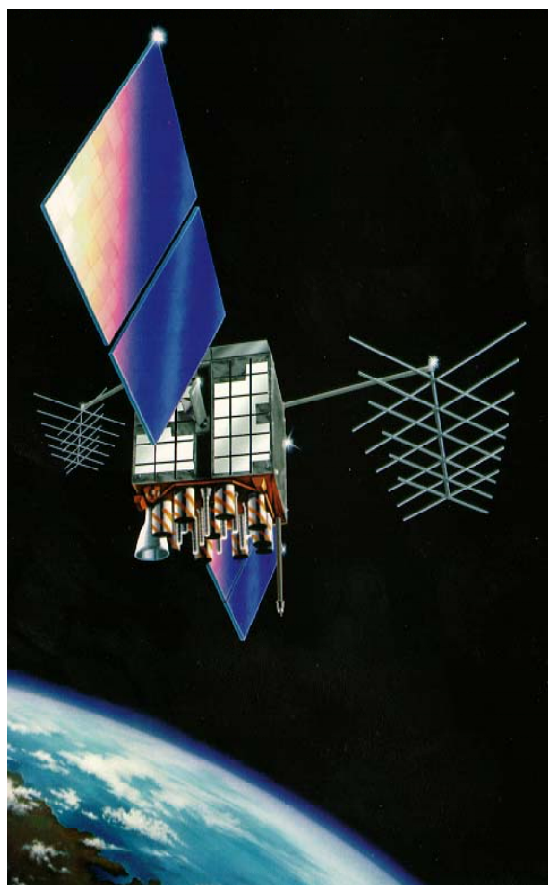
Pre-Modernization

■ Heritage Signals

- L1 C/A
- L1, L2 P(Y)

■ Design Life

- 10 Years*



Post Modernization

■ Modernized Signals

- Higher Power
- L1 C/A, L2C
- L1, L2 P(Y)
- L1, L2 M-Code
- L1, L2 Pseudo M-Code

■ Design Life

- <10 Years*

*Design Life/MMD analysis under review. Actual heritage design life likely longer than 10 years. Modernized Satellites will have a shorter life than current IIR design.



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Block IIF Modernization



Pre-Modernization

- **Heritage Signals**
 - L1 C/A, L2C
 - L1, L2 P(Y)
- **Design Life**
 - 15 Years*
- **1 Rubidium and 2 Cesium Clocks**
- **33 Satellite Production Run**



Post Modernization

- **Modernized Signals ****
 - Similar Power
 - L1 C/A, L2C
 - L1, L2 P(Y)
 - L1, L2 M-Code
 - L5 New Civil Signal
- **Design Life**
 - 12 Years*
- **2 Rubidium Clocks and 1 Cesium**
- **12-16 Satellite Production Run**

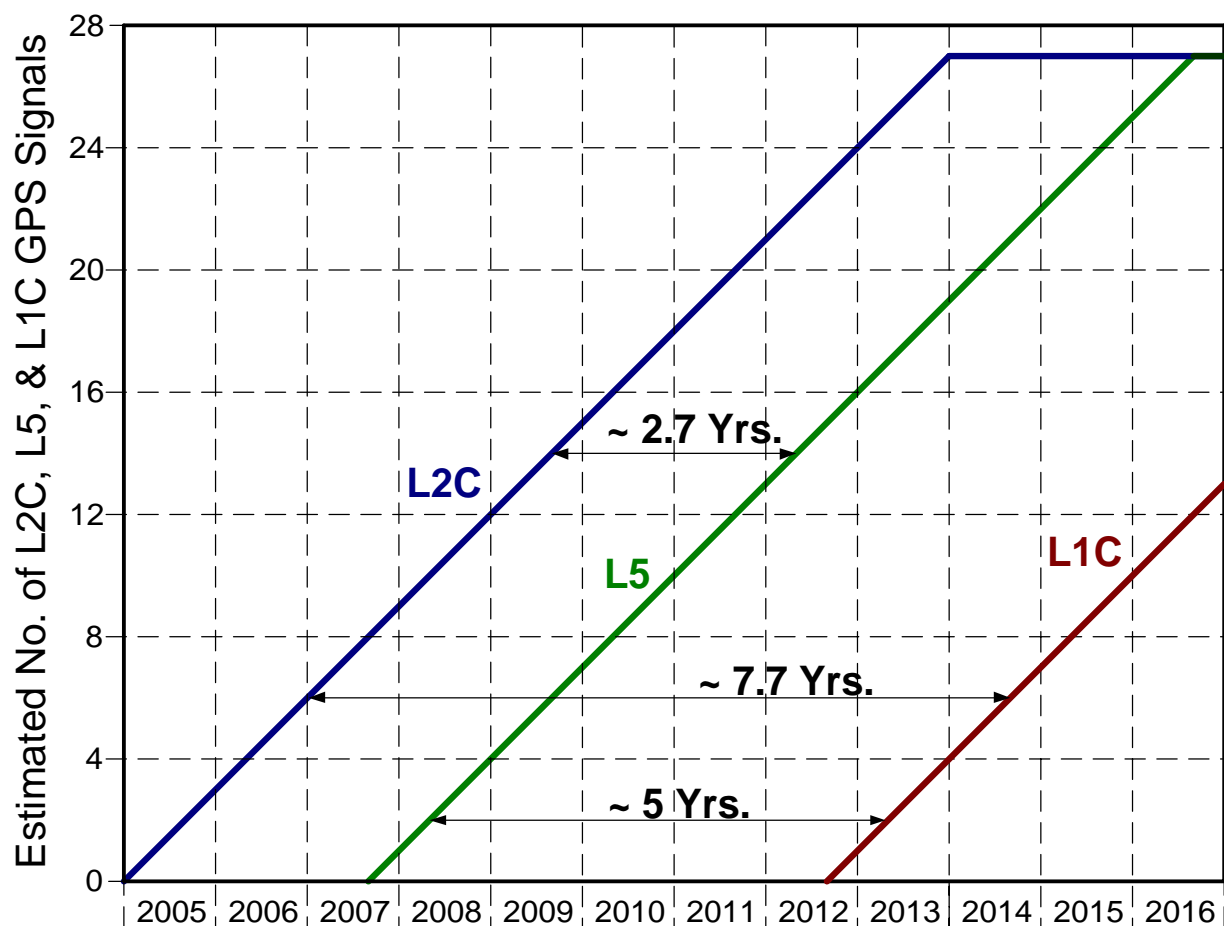
*Design Life/MMD analysis under review. Modernized Satellites will have a shorter life than current IIF design.

**Signal specifics still undergoing changes prior to PDR



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Estimated Signal Availability



Assumes eight IIR-M satellites and average of three successful launches per year

Not Official



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Operational Control Segment Future System Description



- GPS Monitor Stations
- ◆ NIMA Monitor Stations
- ▲ GPS Ground Antennas

- **New Master Control Station (NMCS)** ■
 - Improved operator interfaces
 - IIR-M and IIF capabilities
- **Alternate Master Control Station (AMCS)**
- **Integrated Mission Ops Support Center**
- **Operational Support System**
- **GPS Support Facility**
- **Launch and Early Orbit, Anomaly Resolution and Disposal Operations (LADO) System**
- **NIMA Monitor Station interfaces**
- **AFSCN Remote Tracking interfaces**
- **System Simulator**



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Overview

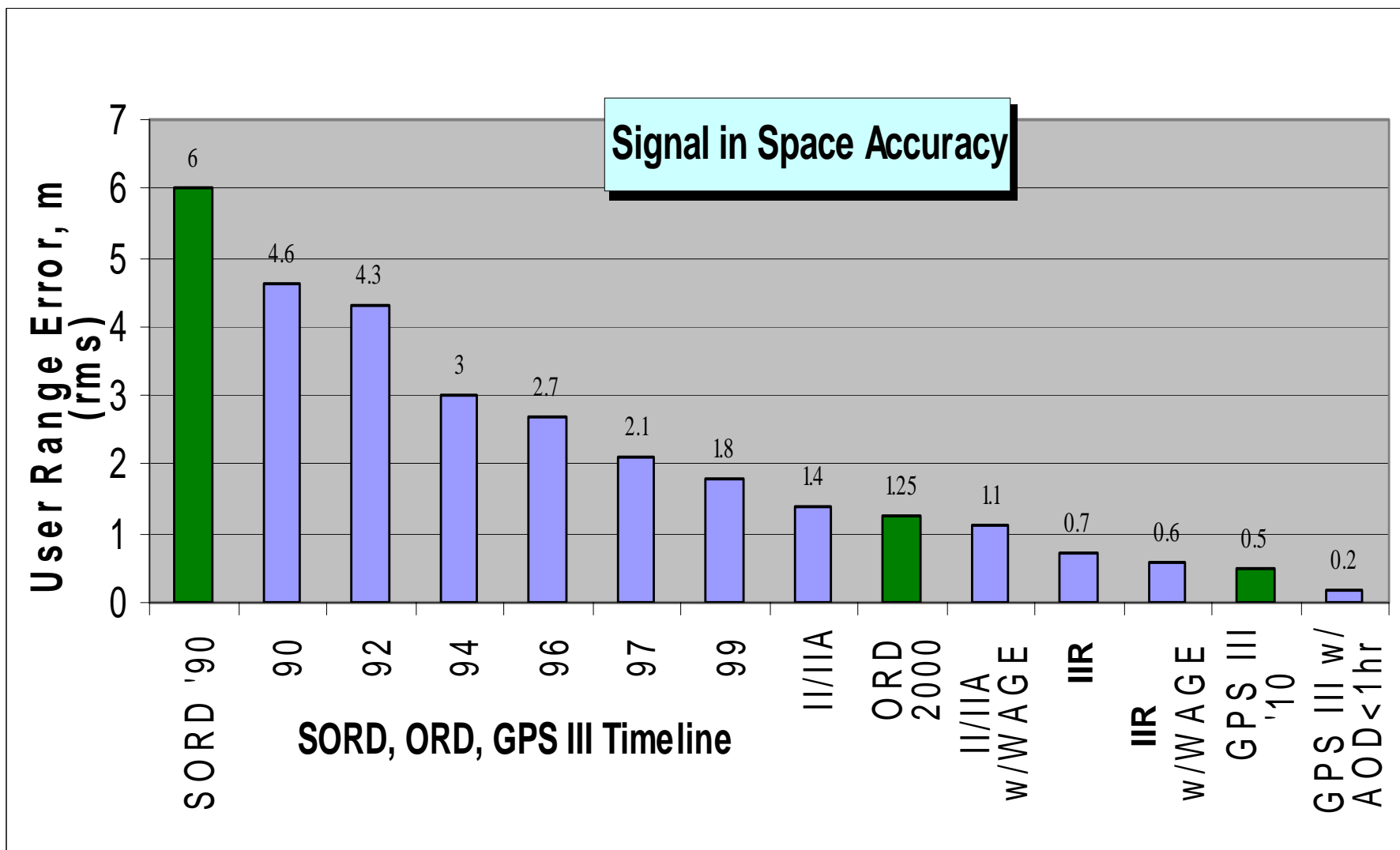


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System Accuracy Improvements





NICE Approach



- **NICE Overcomes Limitations of Current NAV Message**
 - ~ 40 cm resolution for legacy NAV messages
 - ~ 1 cm resolution for NICE messages
 - Message assurance
- **NICE Accomplishes this by:**
 - Shortening the curve-fit interval
 - Tweaking the NAV message
 - Improving resolution of the LSBs
 - Adding some new second-order terms
 - Adding the Inter-Signal Corrections (ISCs)
 - Employing FEC, CRC, and SV ID for message assurance



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Initial CNAV Content



Subframe 1

- Satellite Clock Offset
- Reserved Bits

Subframes 2/3

- Satellite Ephemeris

Subframe 4

- Iono Model Terms
- GPS-UTC Offset
- Special Message Text
- Almanacs (25-32)
- Reserved Bits

Subframe 5

- Almanacs (1-24)

Messages 1/2

- Satellite Clock Offset
- Satellite Ephemeris

Message 3

- Iono Model Terms
- GPS-UTC Offset
- **Inter-Signal Corrections**

Message 4

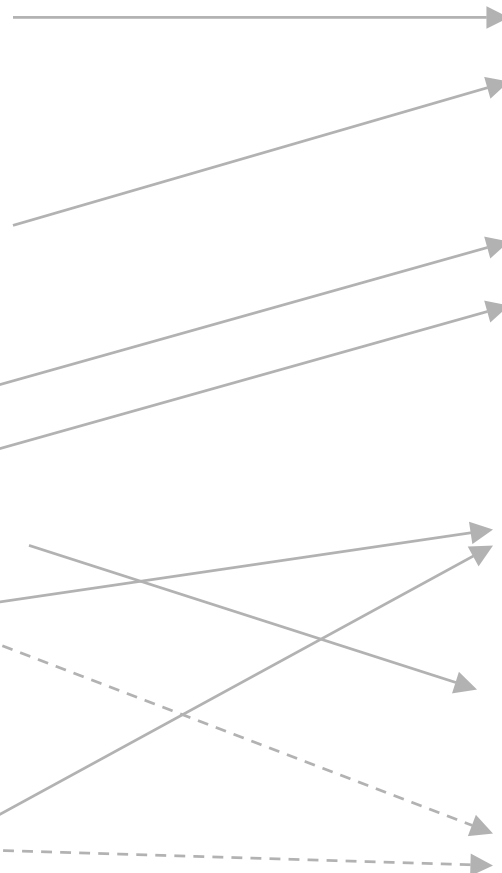
- Almanacs (1-**64**)

Message 5

- Special Message Text

Message 6

- **Mini-Almanacs (7 per)**





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Summary



- **GPS is Healthy**
 - Satellites lasting longer than expected
 - Future launches are being re-phased
- **Sustaining current GPS service for civil and military users is our first priority**
- **Constellation Modernization efforts proceeding**
 - GPS IIR and IIF modernized signals
- **NICE provides**
 - Better and additional clock & ephemeris information
 - Inter-signal corrections (ISCs) for new signals
 - Message assurance
 - Path to future accuracy improvements
 - Slightly faster Time-to-First-Fix (TTFF)