Global Positioning System

Constellation Update

Modernization and Policy

5rd GNSS Vulnerabilities & Solutions Conference

Baska, Krk Island, Croatia

24 May 2011

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DOT Liaison to Air Force Space Command

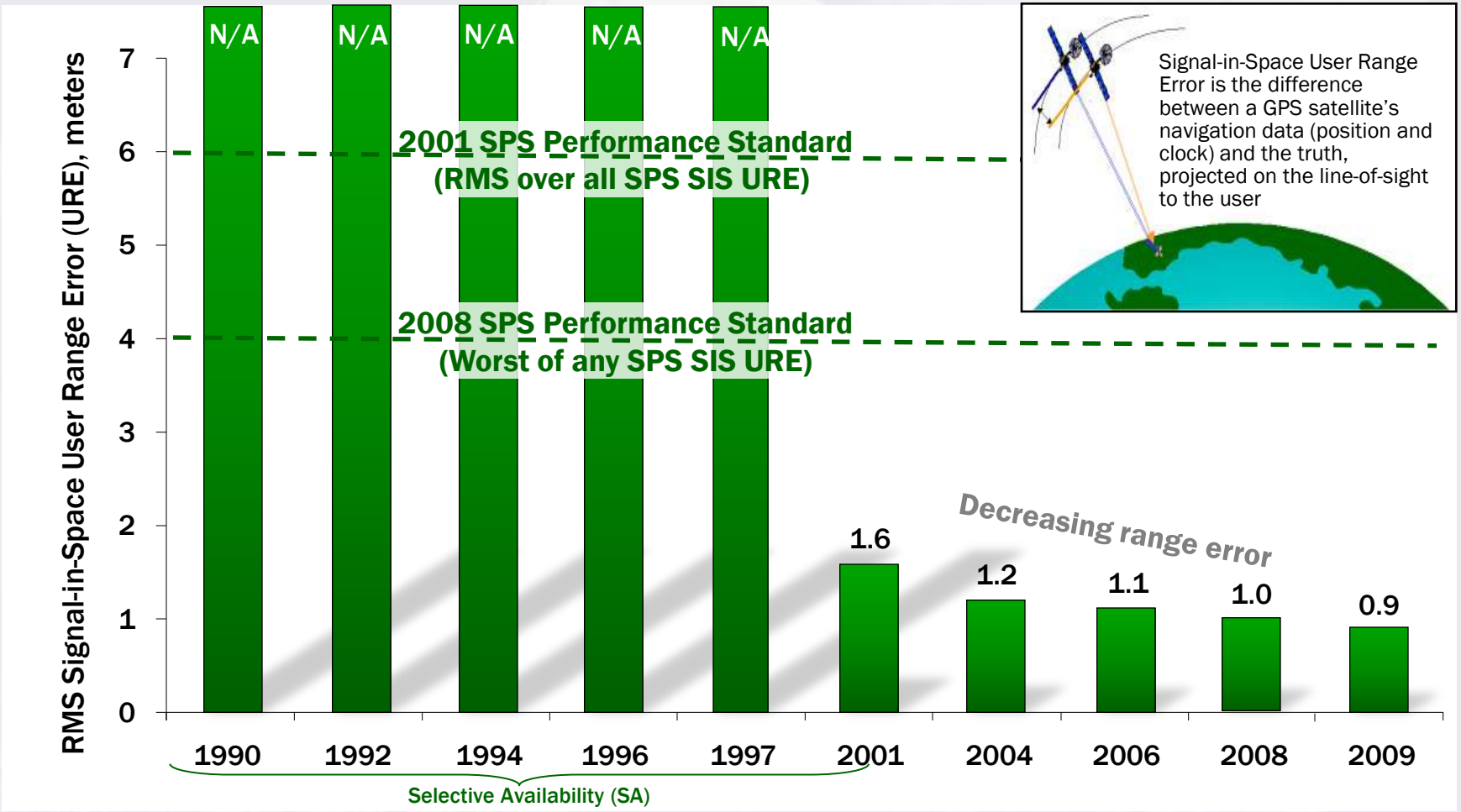
U.S. Department of Transportation

GPS Constellation Status

Baseline Constellation = "24 Expandable"

- **Very robust constellation; exceeds user requirements**
  - **31 satellites** currently in operation
    - 11 GPS IIA
    - 12 GPS IIR
    - 7 GPS IIR-M
    - 1 GPS IIF
  - 4 additional satellites in residual status
  - IIF SV-2 scheduled to launch by July 2011
  - IIIA SV-1 scheduled launch 2014
- **Global GPS civil service performance commitment met continuously since December 1993**

Current GPS Accuracy



System accuracy exceeds published standard

GPS Modernization

Space Segment

1978 - 1985	1989 – 1997	1997- 2004	2005 - 2009	2010	~2014
Block I	**Block II/IIA**	**Block IIR**	**Block IIR-M**	**Block IIF**	**Block III**
11 (10) Satellites	28 Satellites	13 (12) Satellites	8 Satellites	12 Satellites	32 Satellites
Demonstration system	Basic GPS Provides Initial Navigation Capabilities		IIA/IIR Capabilities "Plus"	IIR -M Capabilities "Plus"	IIF Capabilities "Plus"

Backward Compatibility

• L1 (CA) Navigation signal • L1 & L2 (P Code) Navigation signal • 5 Year Design Life	• Standard Service •Single Frequency (L1) • C/A code navigation •Precise Service •Two frequencies (L1 & L2) • P (Y) -Code navigation • 7.5 Year Design Life	• 2nd Civil Signal L2 (L2C) • Earth Coverage M-Code on L1/L2 • L5 Demo • Anti-Jam Flex Power • 7.5 Year Design Life	• 3rd Civil Signal L5 • Reprogrammable Nav Processer • Increased Accuracy requirement • 12 Year Design Life	• Increased accuracy • Increased Earth Coverage power • 15 Year Design Life • 4th Civil Signal (L1C)

Increasing Space System Capabilities – Increasing User Benefits

GPS Modernization

Control Segment

- **Architecture Evolution Plan (AEP)**
  - Transitioned in 2007
  - Increased worldwide commanding capability
  - Increased capacity for monitoring of GPS signals
  - Modern distributed system replaced 1970s mainframes

- **Next Generation Control Segment (OCX)**
  - Controls more capable constellation, and monitors all GPS signals
  - $1.5B contract awarded 25 February 2010
  - Capability delivered incrementally to reduce risk
  - On track for Preliminary Design Review in June 2011
  - Full Capability by ~2016

GPS Improvements

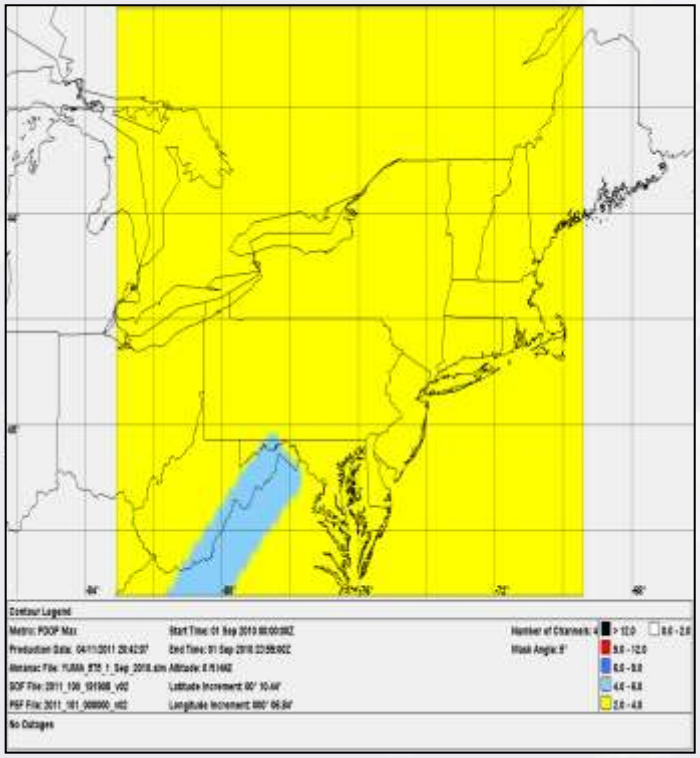
"Expandable 24" Constellation

- **Optimize GPS constellation assets to improve operational effectiveness for global users & terrain challenged environments**
  - Increases the number of satellites in view for better global coverage
- **Consistent with the current Standard Positioning Service Performance Standard**
  - Adjust position of satellites in 3 of 6 orbital planes
  - Provides better Global coverage
  - Coordinated with international community
- **Estimated completion date: June 2011**

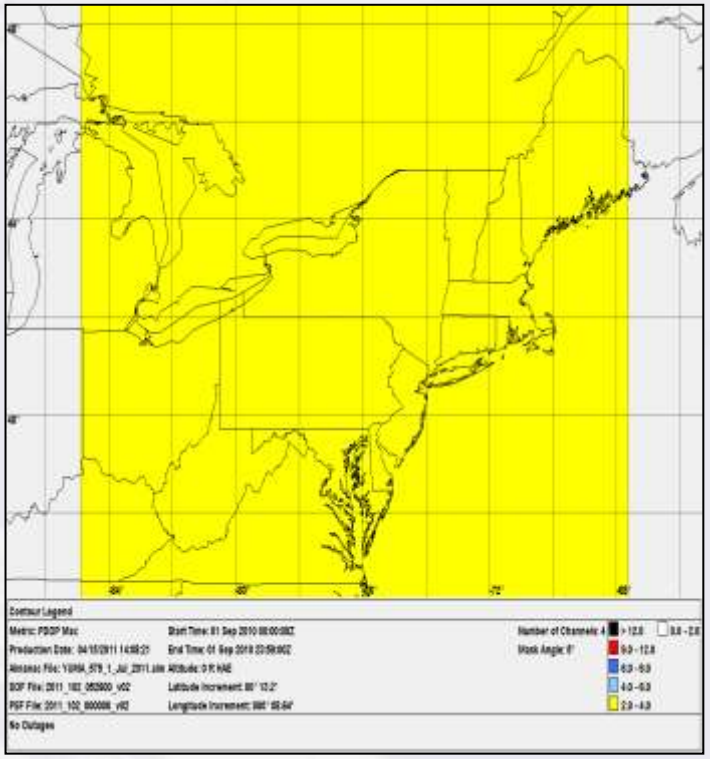
GPS Improvements

"Expandable 24" Constellation

Current Operations



Expandable 24 Constellation

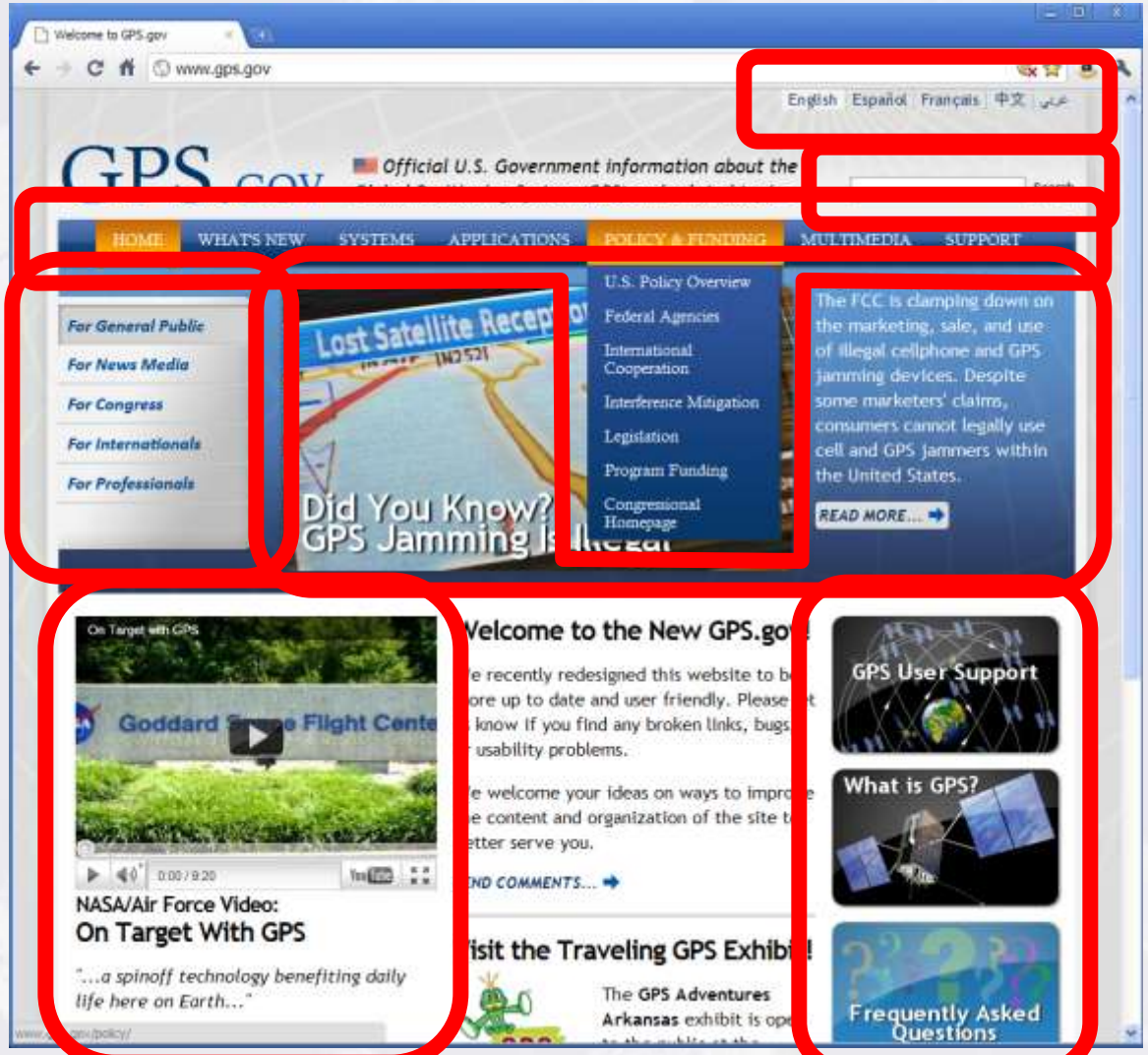


- > 12.0
- 9.0 - 12.0
- 6.0 - 9.0
- 4.0 - 6.0
- 2.0 - 4.0
- 0.0 - 2.0

Lighter Colors = Less Positional Error

GPS User Support Improvements

Keeping you informed "GPS.GOV"



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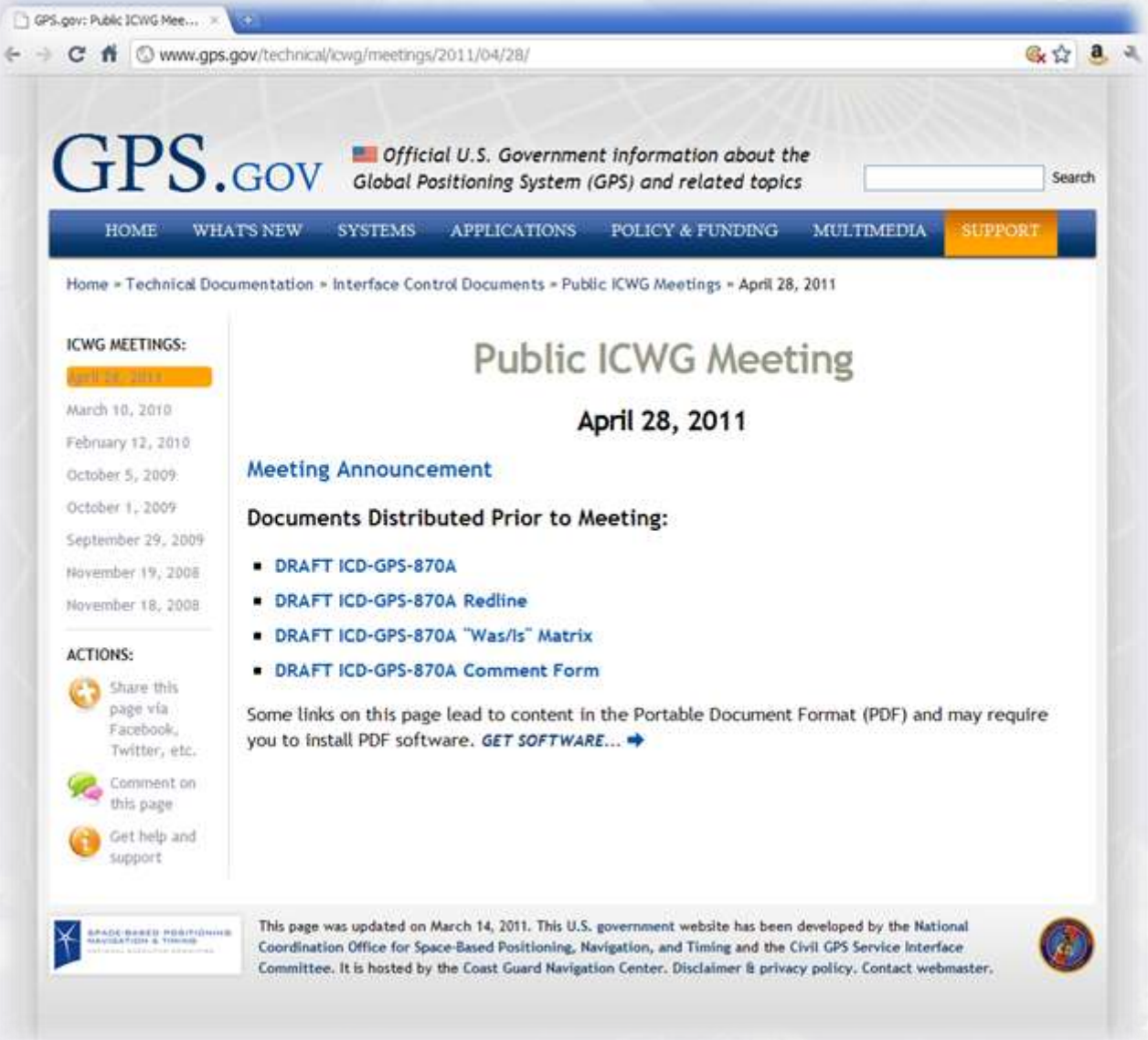

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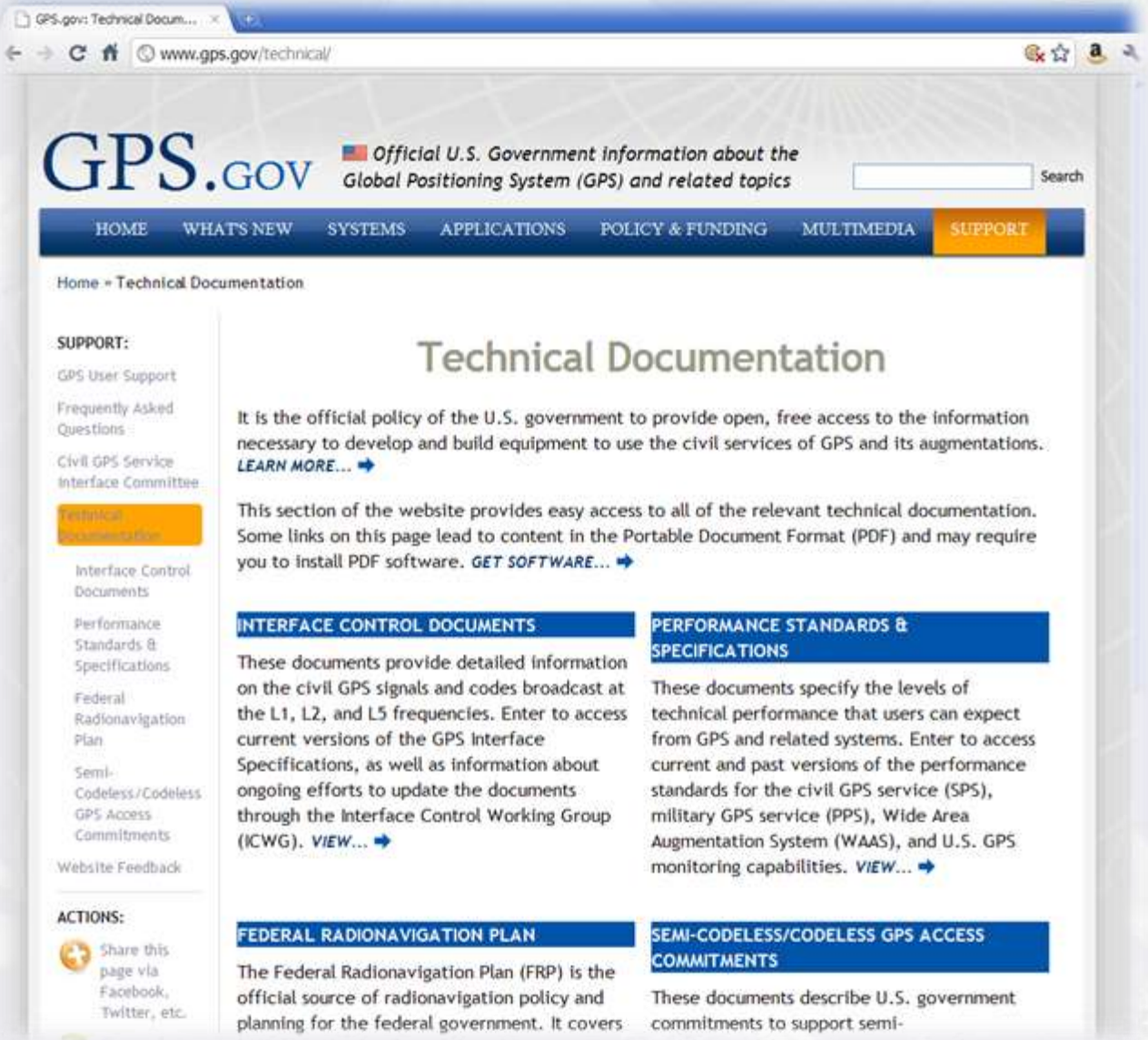

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U.S. National Space Policy

Space-Based PNT Guideline: Maintain leadership in the service, provision, and use of GNSS

- **Provide civil GPS services, free of direct user charges**
  - Available on a continuous, worldwide basis
  - Maintain constellation consistent with published performance standards and interface specifications
  - Foreign PNT services may be used to complement services from GPS
- **Encourage global *compatibility* and *interoperability* with GPS**
- **Promote transparency in civil service provision**
- **Enable market access to industry**
- **Support international activities to detect and mitigate harmful interference**

Summary

- **GPS performance is better than ever and will continue to improve**
  - GPS continues to meet or exceed U.S. performance commitments to worldwide users
  - New civil GPS signal available now
  - Many additional upgrades scheduled
- **U.S. policy encourages worldwide use of civil GPS and augmentations**
- **International cooperation is a priority**
  - Compatibility and Interoperability are critical

Contact Information

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