Update on U.S. GNSS International Cooperation Activities

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Overview

- U.S. Space-Based PNT Policy
- GNSS and International Cooperation Objectives
- Bilateral Discussions
- Multilateral Discussions
- Summary

New U.S. National Space Policy

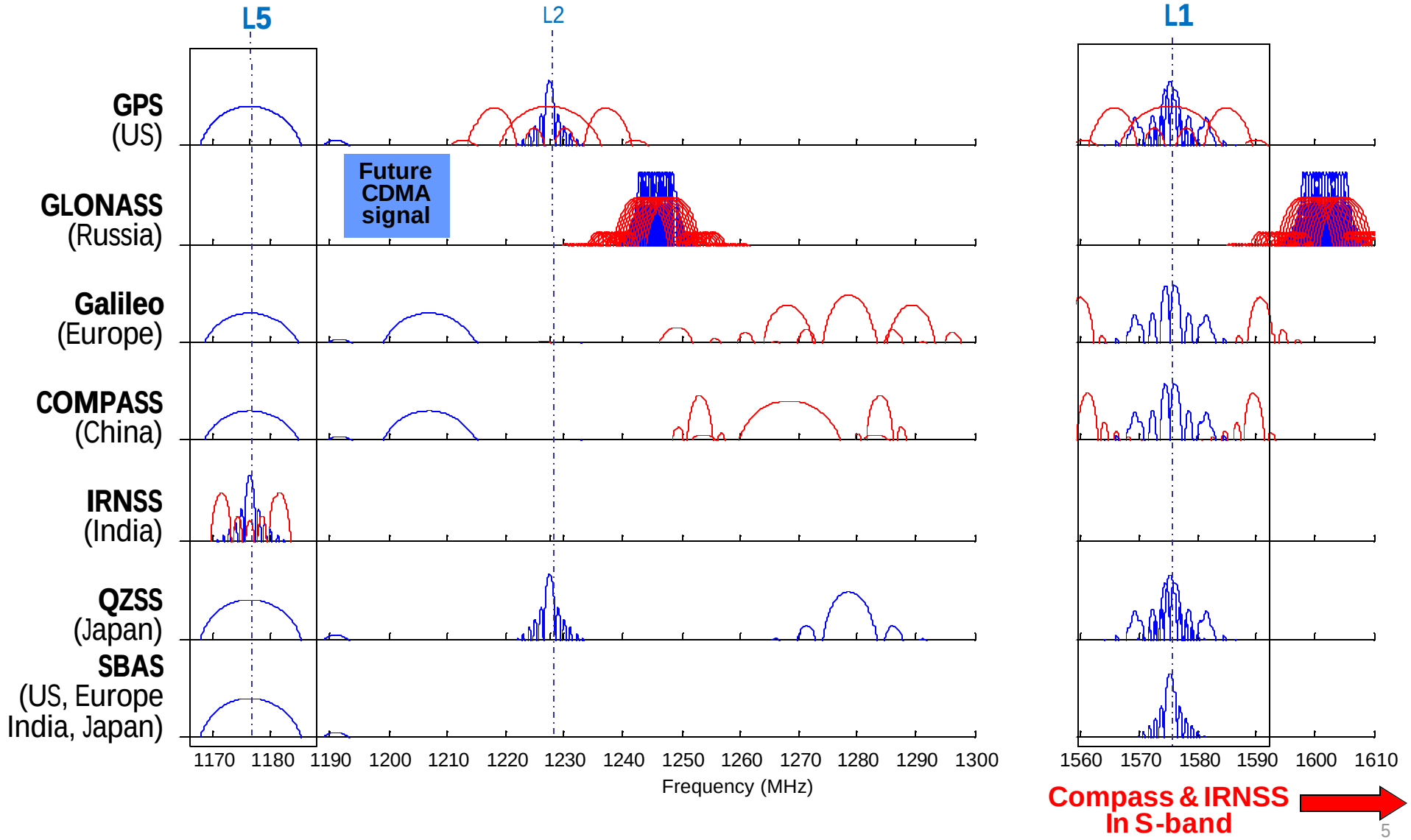
Space-Based PNT Guideline: Maintain leadership in the service, provision, and use of GNSS

- 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 augment and strengthen the resiliency of 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

Planned GNSS

- Global Constellations
  - **GPS (24+)**
  - GLONASS (30)
  - Galileo (27/22)
  - Compass (30 global and 5 regional satellites)
  - GINS (Global Indian Navigation System)
- Regional Constellations
  - QZSS (3)
  - IRNSS (7)
- Satellite-Based Augmentations
  - **WAAS (2+1)**
  - MSAS (2)
  - EGNOS (3)
  - GAGAN (2)
  - SDCM (2)

Current International Signal Plans

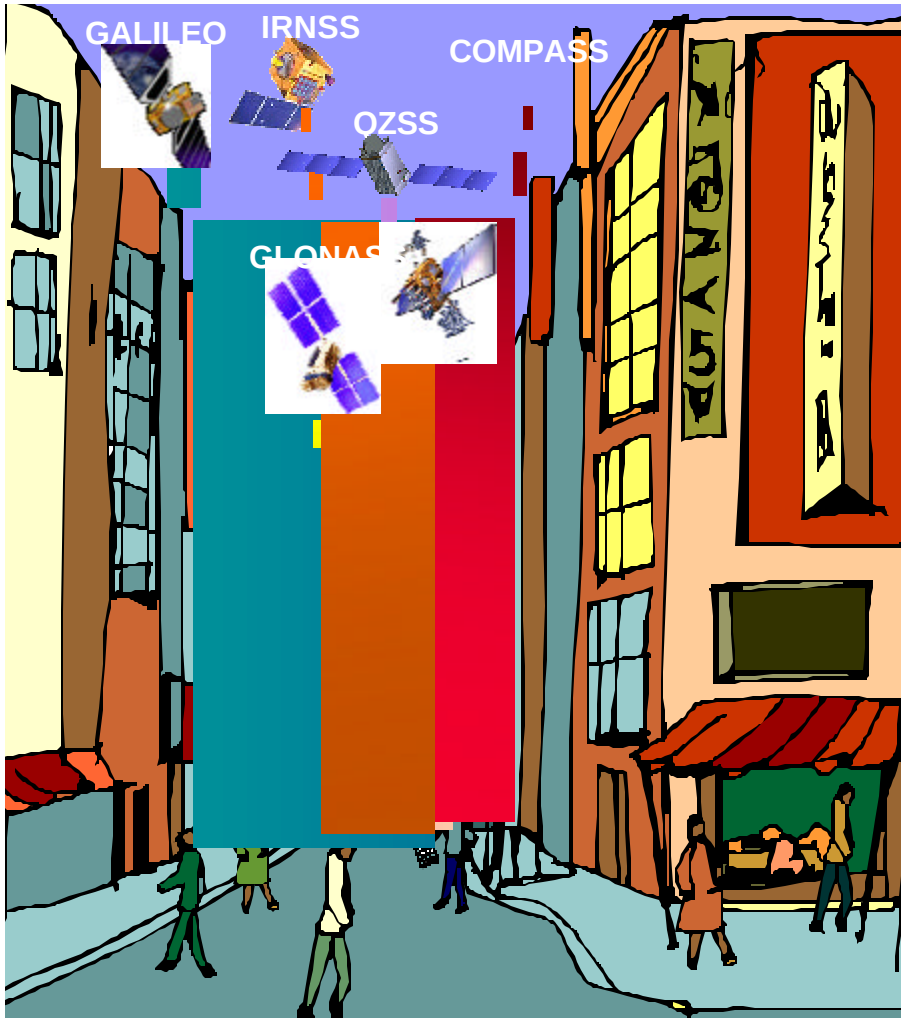


U.S. Objectives in Working with Other GNSS Service Providers

- Ensure **compatibility?** ability of U.S. and non-U.S. space-based PNT services to be used separately or together without interfering with each individual service or signal
  - Radio frequency compatibility
  - Spectral separation between M-code and other signals
- Achieve **interoperability** – ability of civil U.S. and non-U.S. space-based PNT services to be used together to provide the user better capabilities than would be achieved by relying solely on one service or signal
- Promote fair competition in the global marketplace

Pursue through Bi-lateral and Multi-lateral Cooperation

Civil GNSS Interoperability



- Ideal interoperability allows navigation with **one signal each** from four or more systems **with no additional receiver cost or complexity**

Interoperable = Better Together than Separate

International Cooperation Venues

- Bilateral to include:
  - Japan
  - Europe
  - Russia
  - India
  - China
  - Others (Australia)
- Multilateral:
  - Asia Pacific Economic Cooperation
  - International Committee on GNSS

Bilateral Cooperation

- 1998 **U.S.-Japan** Joint Statement on GPS Cooperation
  - Annual Plenary Meetings
  - Quasi Zenith Satellite System (QZSS) designed to be fully compatible and highly interoperable with GPS
  - Bilateral agreements to set up QZSS monitoring stations in Hawaii and Guam
- **U.S.-EU** GPS-Galileo Cooperation Agreement signed in June 2004
  - Four working groups were set up under the agreement
  - Improved new civil signal (MBOC) adopted in July 2007
  - First Plenary Meeting successfully held in October 2008

Bilateral Cooperation (continued)

- **U.S.-Russia** Joint Statement issued December 2004
  - Working Groups on compatibility/interoperability, search and rescue
- **U.S.-India** Joint Statement on GNSS Cooperation in 2007
  - Technical Meetings focused on GPS-India Regional Navigation Satellite System (IRNSS) compatibility and interoperability held in 2008 and 2009

Bilateral Cooperation (continued)

- **U.S.-China** operator-to-operator coordination under ITU auspices
  - Bilateral Meetings in 2007, 2008 and 2009
- **U.S.-Australia** Joint Delegation Statement on Cooperation in the Civil Use of GPS in 07
  - Cooperation expands upon efforts to ensure augmentation system interoperability
  - USCG NAVCEN posts a daily PDOP report in response to concerns over planned GPS outages

APEC GNSS Implementation Team

- Established in 2000 by the APEC Transportation Working Group
- Mission – promote regional GNSS augmentation systems to enhance intermodal transportation by:
  - Expediting the implementation of GNSS in all economies
  - Seeking expertise to ensure the success of GNSS implementation
  - Advancing an Asia Pacific approach to GNSS cooperation that will enhance safety and efficiency
  - Cooperating with non-APEC organizations as necessary to provide for seamless implementation
- U.S. hosted the 14th APEC GIT meeting 21-24 June 2010 in Seattle, WA
  - Strategy adopted to include GNSS technology in the development of seamless transportation systems in the 2010-2015 time period
- Next meeting tentatively scheduled for Brisbane, Australia in May 2011

International Committee on Global Navigation Satellite Systems (ICG)

- Emerged from 3rd UN Conference on the Exploration and Peaceful Uses of Outer Space July 1999
  - Promote the use of GNSS and its integration into infrastructures, particularly in developing countries
  - Encourage compatibility and interoperability among global and regional systems
- Members include:
  - **GNSS Providers** (U.S., EU, Russia, China, India, Japan)
  - Other Member States of the United Nations
  - International organizations/associations

http://www.unoosa.org/oosa/en/SAP/gnss/icg.html

ICG Providers Forum

- Six space segment providers listed previously are members
- Purpose:
  - Focused discussions on **compatibility and interoperability**, encouraging development of complimentary systems
  - Exchange detailed information on systems & service provision plans
  - Exchange views on ICG work plan and activities
- Providers have agreed that all GNSS signals and services must be compatible and open signals and services should also be interoperable to the maximum extent possible
  - Working definition of **compatibility** includes respect for spectral separation between each system's authorized service signals and other systems' signals
  - **Interoperability** definition addresses signal, geodetic reference frame realization, and system time steerage considerations

U.S. Participation in the ICG

- U.S. strongly supports the ICG and Providers Forum
  - U.S. hosted ICG-3 in Pasadena, California, December 2008
  - U.S. contributes to UNOOSA as the ICG Secretariat to support ICG meetings and activities
  - U.S. Actively participates in ICG working groups
- U.S. pleased with progress made at ICG-4 at St. Petersburg, Russia
  - Adoption of new **principle on transparency** for open services: ***Every provider should publish documentation that describes signal and system information, policies of provision and minimum levels of performance for its open services***
- ICG-5 to be held in October 2010 in Turin, Italy

Summary

- **International cooperation** in the context of National Space Policy and Space-Based PNT Policy is a **top priority** for the U.S. Government
- The U.S. is actively engaged in **bilateral, and multilateral cooperation** on satellite navigation issues
- As new regional and global navigation satellite systems are emerging, **interoperability** is the key to **"success for all"**

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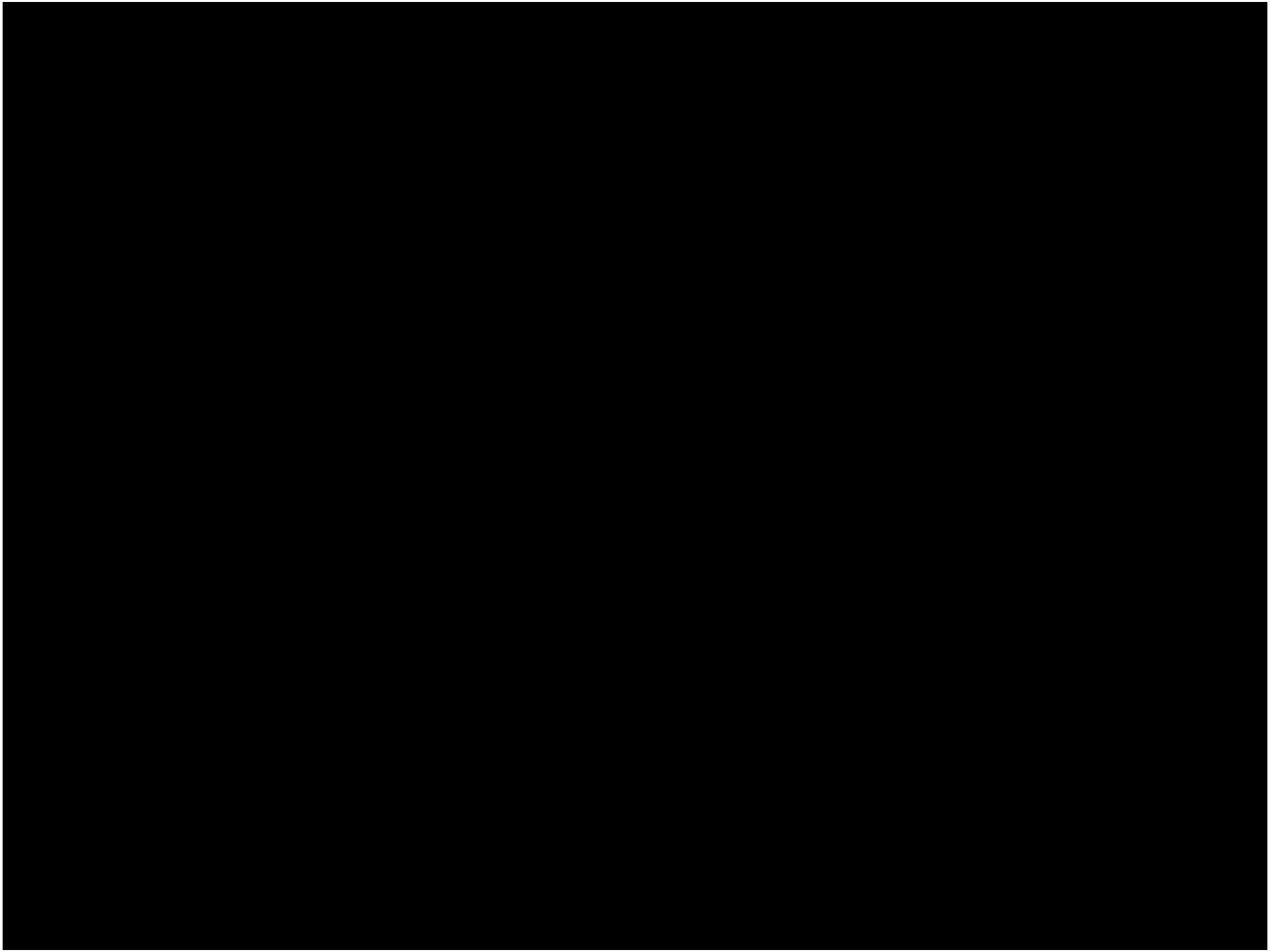

U.S. - Japan Cooperation

- Japan's status as a world leader in GPS applications and user equipment makes it an important partner
- Regular policy consultations and technical meetings on GPS cooperation began in 1996 and led to the 1998 Clinton-Obuchi Joint Statement
- Both countries have benefited from the close relationship:
  - QZSS is designed to be compatible and highly interoperable with GPS
  - U.S. signed agreements with Japan to set up QZSS monitoring stations in Hawaii and Guam

U.S. - Europe Bilateral Cooperation

- 2004 U.S.-EU agreement provides foundation for cooperation
- Four working groups were set up under the agreement:
  - Technical, trade, next generation systems and security working groups
- Improved new civil signal (MBOC) adopted in July 2007
- Technical working group meetings, May 2010 in Brussels

Oct. 22, 2008 , EU-U.S. Plenary delegations meeting under the auspices of the GPS-Galileo Cooperation Agreement

Signing ceremony for GPS-Galileo Cooperation Joint Statement, Oct. 23, 2008
(Michel Bosco, European Commission;
Kenneth Hodgkins, U.S. Department of State)

U.S. - Russian Federation Cooperation

- U.S.- Russia Joint Statement issued in December 2004
- Negotiations for a U.S.-Russia Agreement on satellite navigation cooperation have been underway since late 2005
- Several very productive technical working group meetings have been held:
  - Active exchange of information regarding future signal designs
  - GLONASS signal architecture still under discussion within the Russian Government

U.S. - India Cooperation

- Policy and technical consultations on GPS cooperation underway since 2005
  - One aim is to ensure interoperability between GPS augmentation system WAAS and India's planned GAGAN augmentation system based on GPS
  - Another aim is to improve solutions for ionospheric effects
- U.S.-India Joint Statement on GNSS Cooperation issued in February 2007 in Washington
  - Bi-lateral meeting held in Bangalore in September 2007
  - Technical Meetings focused on GPS-IRNSS compatibility and interoperability held in January and July 2008, and January 2009

U.S. Bilateral Cooperation with China

- Operator-to-operator coordination under ITU auspices
  - Geneva, Switzerland - June 2007
  - Xian, China - May 2008
  - Geneva, Switzerland - October 2008
  - Hainan, China – December 2009
  - Next meeting scheduled for Chengdu, China in September 2010
- U.S. is interested in engaging in further bilateral discussions with China on civil GNSS services and applications

ICG Providers Forum Definition of Compatibility

Compatibility refers to the ability of global and regional navigation satellite systems and augmentations to be used separately or together without causing unacceptable interference and/or other harm to an individual system and/or service

- **The International Telecommunication Union (ITU) provides a framework for discussions on radiofrequency compatibility. Radiofrequency compatibility should involve thorough consideration of detailed technical factors, including effects on receiver noise floor and cross-correlation between interfering and desired signals.**
- **Compatibility should also respect spectral separation between each system's authorized service signals and other systems' signals. Recognizing that some signal overlap may be unavoidable, discussions among providers concerned will establish the framework for determining a mutually-acceptable solution.**
- **Any additional solutions to improve compatibility should be encouraged.**

ICG Providers Forum Definition of Interoperability

Interoperability refers to the ability of global and regional navigation satellite systems and augmentations and the services they provide to be used together to provide better capabilities at the user level than would be achieved by relying solely on the open signals of one system

- **Interoperability allows navigation with signals from different systems with minimal additional receiver cost or complexity.**
- **Multiple constellations broadcasting interoperable open signals will result in improved observed geometry, increasing end user accuracy everywhere and improving service availability in environments where satellite visibility is often obscured.**
- **Geodetic reference frames realization and system time steerage standards should adhere to existing international standards to the maximum extent practical.**
- **Any additional solutions to improve interoperability are encouraged.**