UNITED NATIONS
Office for Outer Space Affairs

International Committee on
Global Navigation Satellite Systems

# United Nations/Nepal Workshop on the Applications of Global Navigation Satellite Systems, 12 – 16 December 2016, Kathmandu

## International Committee on Global Navigation Satellite Systems (ICG)

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# International Committee on GNSS (ICG): Mission Statement

- Promote voluntary cooperation on matters of mutual interest related to civil satellite-based positioning, navigation, timing, and value added services
- Contribute to the sustainable development of the world
- Encourage coordination among GNSS Providers to ensure greater **compatibility, interoperability, and transparency**
- Promote the introduction and utilization of GNSS services in developing countries, by assisting with the integration into their infrastructure
- Assist GNSS users with their development plans and applications, by encouraging coordination and serving as a focal point for international information exchange

*ICG-8 Meeting, 2013, Dubai, United Arab Emirates*

# Background

- 2001 – 2004: Action Team on GNSS (Italy and the United States) – *in implementation of the recommendations of UNISPACE-III, 1999, Vienna*
  - An international framework to support operational coordination and exchange of information among system operators and national and international user communities would be important
  - The assumption was that current and future system operators would soon move from a competitive to a collaborative mode where there is a shared interest in the universal use of GNSS services regardless of the system
- 2005: Establishment of the ICG (noted by UNGA 61/111 of 14 December 2006)
  - Promote the use of GNSS and its integration into infrastructure, particularly in developing countries;
  - Encourage compatibility and interoperability among global and regional systems
- Main challenge is to provide assistance and information for those countries seeking to integrate GNSS into their basic infrastructure, including at governmental, scientific and commercial levels

# Membership

- Members: 9 nations and the European Union
- Current and future core, regional or augmentation systems providers: China (BeiDou), EU (Galileo/EGNOS), Russia (GLONASS/SDCM), United States (GPS/WAAS), India (IRNSS/GAGAN), and Japan (QZSS/MSAS)
- State Members of the United Nations with an active programme in implementing or promoting a wide range of GNSS services and applications: Italy, Malaysia, United Arab Emirates
- Associate Members and Observers: 21 organizations
- International & regional organizations and associations dealing with GNSS services and applications: UN system entities, IGOs, NGOs

*ICG participation is open to all countries and entities that are either GNSS providers or users of GNSS services, and are interested and willing to actively be engaged in ICG work*

# Annual Meetings

- UNOOSA (2006), India (2007), United States (2008), Russian Federation (2009), Italy & European Union (2010), Japan (2011), China (2012), United Arab Emirates (2013), European Union (2014), United States (2015), Russian Federation (2016), **Japan (2017),** China (2018), India (2019), Vienna (2020)
- 2006: Terms of Reference and Workplan
- **Systems, Signals and Services (United States & Russian Federation):** Focused discussion on compatibility and interoperability, encouraging development of complimentary systems; Exchange detailed information on systems and service provision plans
- **Enhancement of GNSS Performance, New Services and Capabilities (India, China and European Space Agency):** Focused discussion on system enhancements (multipath, integrity, interference, etc.) to meet future needs
- **Information Dissemination and Capacity Building (UNOOSA):** Focused on education and training programmes, promoting GNSS for scientific exploration (space weather specifically)
- **Reference Frames, Timing and Applications (IAG, IGS & FIG):** Focused on monitoring and reference station networks

# Providers' Forum

- 2007: **Establishment**
- Members: Current and future global and regional satellite navigation systems and Satellite-based Augmentation Systems (SBAS) providers
- PF provides ways and means of promoting communication among system providers on key technical issues and operational concepts such as the GNSS spectrum protection, orbital debris, and orbit de-confliction
- Scientific and Technical Subcommittee of UNCOPUOS (UN GA Res. 62/217 of 1 February 2008) started consideration of an agenda item "Recent developments in GNSS"
- 2008: **Terms of Reference and Workplan**
- Agreement that all GNSS signals and services must be compatible and open signals and services should be interoperable to the maximum extent possible in order to maximize benefit to all GNSS users;
- Consensus reached on Principle of transparency - every GNSS provider should publish documentation that describes the signal and system information, the policies of provision and the minimum levels of performance offered for its open services
- 2016: **Seventeenth meeting, 6 – 11 November, Sochi, Russian Federation**
- Open Service Information Dissemination, Open Service Performance, Spectrum Protection (interference detection and mitigation)

# Working Groups: Recommendations/Observations

- **Interference Detection and Mitigation (IDM)**
  - To continue addressing the need for worldwide GNSS spectrum protection
  - To establish a multi-year agenda item focused on national efforts to protect RNSS spectrum, and pursue GNSS IDM in member states
- **Interoperable GNSS Service Volume (SSV)**
  - Providers will develop a booklet defining the characteristics of a fully **interoperable space service volume**

***ICG-11 Meeting, 2016, Sochi, Russian Federation: Joint Statement***

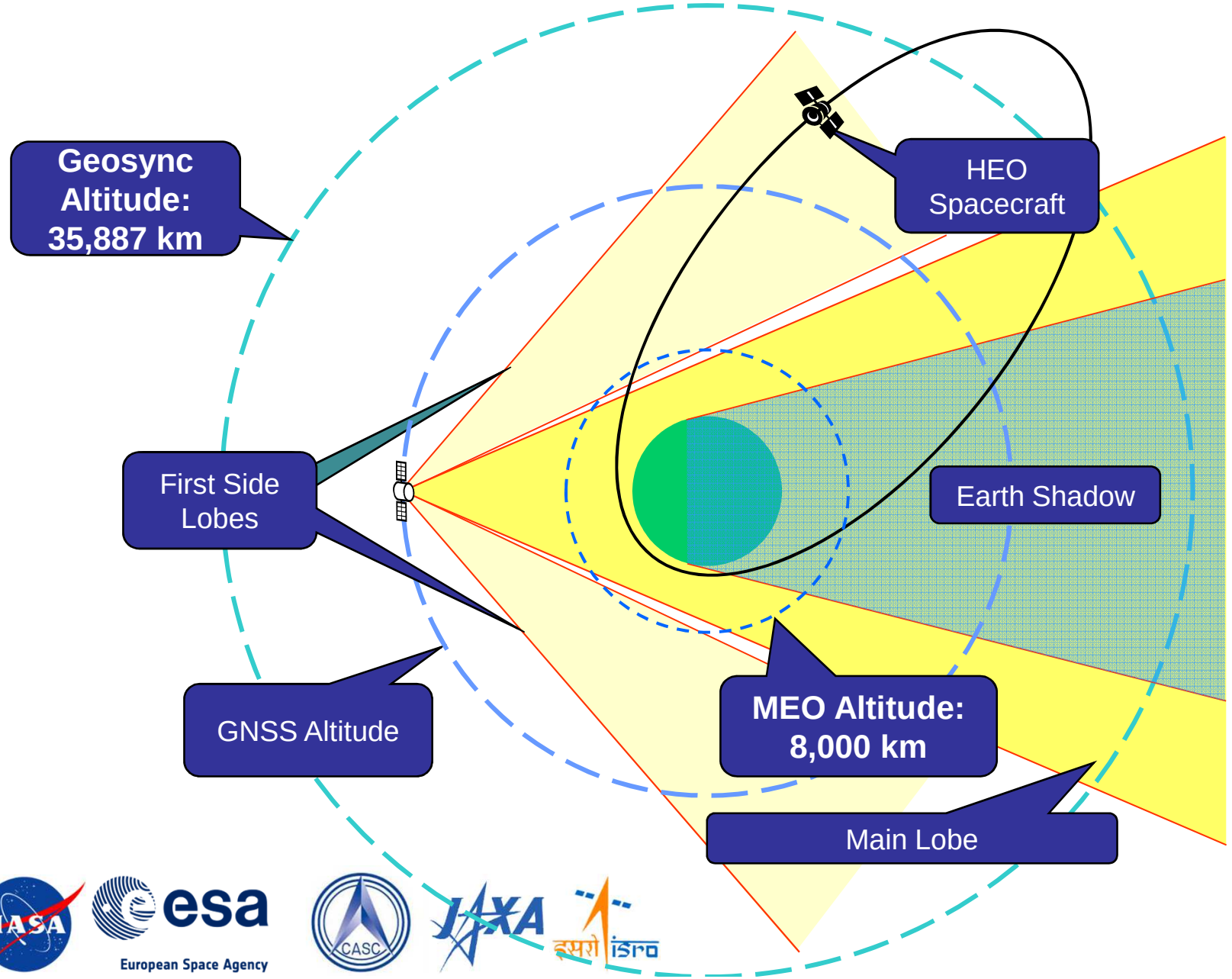
# The Interoperable GNSS SSV

## Established Definition of SSV

The GNSS Space Service Volume (SSV) is the region of space extending to approximately the geostationary altitude or even beyond where terrestrial GNSS performance standards may not be applicable. The SSV defines GNSS system performance for space users by specifying at least three parameters:

1. Pseudorange Accuracy
2. Received Power and
3. Signal Availability

# Reception Geometry for GNSS Signals in Space



# Working Groups: Recommendations/Observations

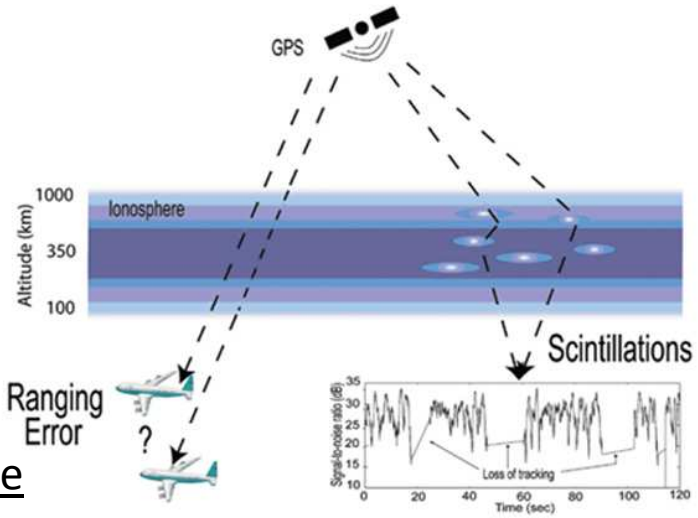
- **Advanced Receiver Autonomous Integrity Monitoring (ARAIM)**
  - Future integrity concepts based on Advanced Receiver Autonomous Integrity Monitoring (ARAIM) will continue to be studied with the objective of exploiting the interoperability between the different systems for safety of life applications.
- **Space Weather**
  - Space Weather aspects will continue to be addressed showing improvements that are achievable by advanced ionospheric modelling and receiver technologies

**ICG Information Portal:** http://www.unoosa.org/oosa/en/ourwork/icg/working-groups.html

***ICG-11 Meeting, 2016, Sochi, Russian Federation: Joint Statement***

# Ionospheric Effects on GNSS

- **Range Error - TEC**
  - Due to a change in the speed of the signal
    - Group Delay of the signal modulation (absolute range error)
    - Carrier Phase advance (relative range error)
  - Proportional to Total Electron Content
    - Range Error $= {}_{+/-} \frac{40.3\ TEC}{f^2}$
  - Varies from 1 to ~100m
- **Scintillation**
  - Due to rapid fluctuations in the amplitude and phase of the signal
  - May induce loss of lock – navigation errors
  - Rare at mid-latitudes
  - Can be severe after local sunset in the equatorial regions, especially near the peak of solar cycle
- **Other Effects**
  - Faraday Rotation, Absorption, Doppler Shift, Waveform Distortion and Refraction, Diffraction




**Varies with location, local time, season, geomagnetic and solar activity.**

# Programme on GNSS applications

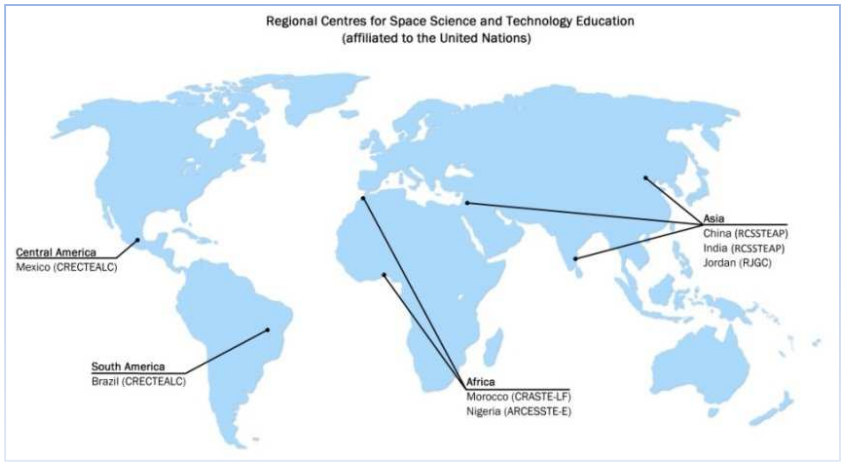
- **United Nations Regional Workshops/training courses on the use and applications of GNSS**
  - These activities increase awareness among decision and policy makers of the benefits of GNSS, and develop regional and national pilot projects on GNSS applications
  - These activities bring together a large number of experts, including those from developing countries, to discuss and act on issues that are also of high relevance to the ICG
- United Nations/Nepal Workshop on GNSS, 12 – 16 December 2016, Kathmandu
  - To focus on identifying the needs of users with respect to the compatibility and interoperability of global and regional systems, and space-based augmentations providing and planning to provide GNSS service
  - To incorporate useful user and application sector views and inputs into the Working Groups work plans
  - Seminar on GNSS Spectrum Protection and Interference Detection and Mitigation (IDM) and Space Weather
- **United Nations/United States of America Workshop on Space Weather, 31 July – 4 August 2017, Boston** *(In-line with COPUOS' Thematic Priority Area on Space Weather)*
- **United Nations/Argentina Workshop on the applications of GNSS, 8 – 12 May 2017, Cordoba**

**Information Portal:** http://www.unoosa.org/oosa/en/ourwork/icg/activities.html

# Programme on GNSS applications

- **Promoting the use of GNSS technologies as tools for scientific applications**
  - These activities are to provide technical knowledge on the operational and practical aspects and issues relating to reference frames, in particular to facilitate a regional forum for geodetic agencies, improve data sharing (GNSS leveling, tide gauge, gravity)
  - Technical Seminars on Reference Frames in Practice, FIG Working Week 2017, 29 – 30 July 2017, Kobe, Japan
  - AfricaArray Workshop, the University of the Witwatersrand, January 2017, Johannesburg, South Africa,
- **Space Weather and its effects on GNSS**
  - ICTP and Boston College: Workshops on Ionospheric Effects on SBAS and GBAS Applications at Low Latitudes, March 2017 and May 2017, Trieste, Italy
- **United Nations/Italy Long-term Fellowship Programme: Master in Navigation and Related Applications (MNA), Politecnico di Torino, Turin, Italy**
  - The curriculum is structured to meet effectively work market demands for high-level technicians endowed with a broad vision of the navigation/localization sate-of-the-art

# Information Centres for ICG




United Nations-affiliated Regional Centres for Space Science and Technology Education

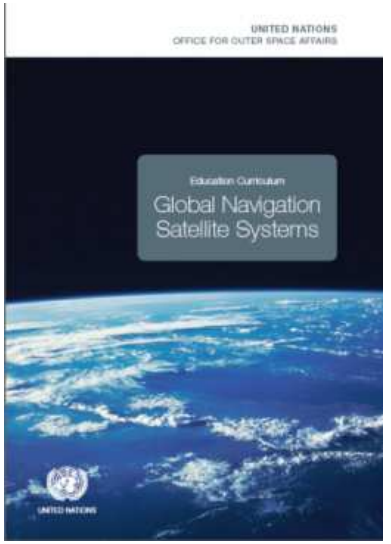
***Africa:*** *Morocco and Nigeria*

***Latin America and the Caribbean:*** *Brazil/Mexico*

***Asia and the Pacific:*** *India and China*

***Western Asia:*** *Jordan*

- The Technical Level: explore the benefits of GNSS technologies for regions and to spread their applications; exchange information and knowledge
- The Cooperative level: facilitate collaboration with the GNSS providers (seminars/trainings and educational material), as well as communication and outreach to the wider community through the ICG information portal



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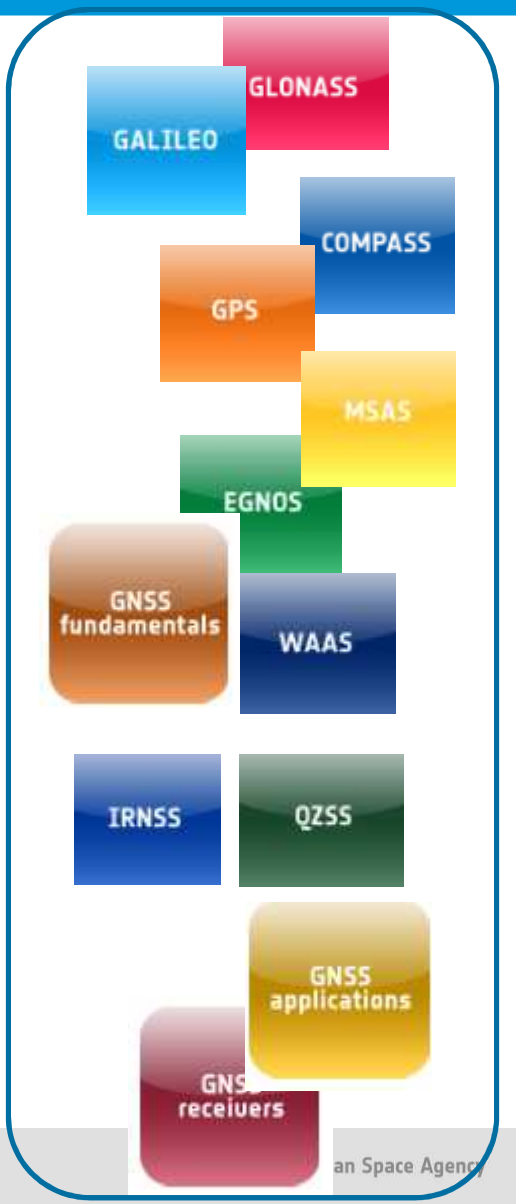
# ICG Information Portal



- WWW.UNOOSA.ORG
- WWW.UNOOSA.ORG/OOSA/EN/OURWORK/ICG/ICG.HTML

# NAVIPEDIA: Status

- In line with ICG2012 recommendation on NAVIPEDIA, ESA has been maintaining and developing further NAVIPEDIA with up-to-date information.
- NAVIPEDIA is today extensively used by universities and Galileo application developers.
- NAVIPEDIA is also used as reference as part of the European Satellite Navigation Conference (ESNC) for the GNSS application developers
- An APP version of NAVIPEDIA (for both Android and iOS operational systems) is currently under development. This should be ready by the end of 2016.
- By October 2016, **more than 1 million visits** received on NAVIPEDIA website so far s(www.navipedia.org)
- Most visited articles are on GNSS fundamentals and GNSS applications.




**www.navipedia.org**

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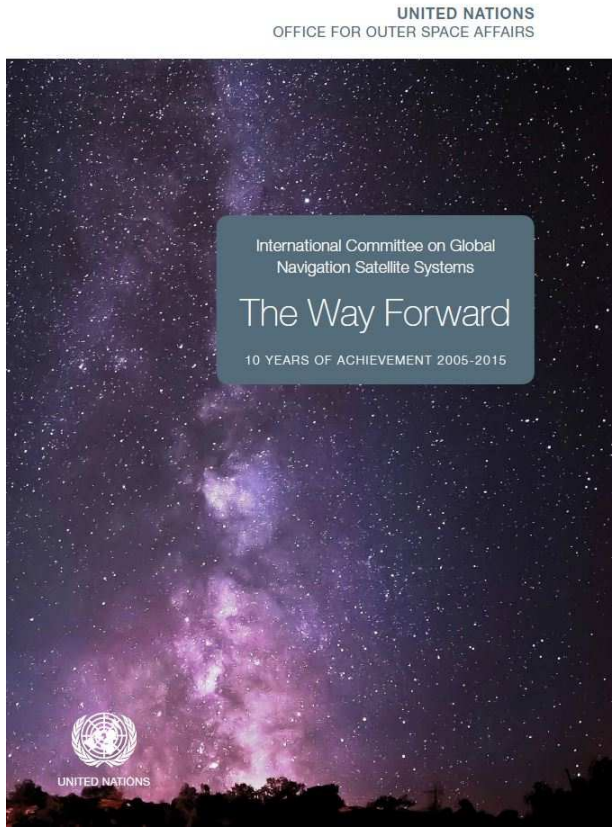
# 2015: The Way Forward




"The establishment of ICG in 2005 ushered in an unprecedented era of cooperation for the United Nations. Over the past decade, ICG has achieved tangible and wide ranging progress", *United Nations Secretary General , Ban Ki-moon*.

"Looking ahead, as co-chairs of the Action Team on GNSS, we believe that ICG will continue to strengthen its role as a major player in the multilateral arena, given that satellite positioning becomes more and more a multinational cooperative venture", *Co-chairs of the Action Team on GNSS (2001 – 2004)*

"ICG has encouraged tangible international cooperation, and leading global satellite operators have coordinated their GNSS services to provide global coverage in satellite-based PNT, for the benefit of all", *Director, Office for Outer Space Affairs*

http://www.unoosa.org/oosa/en/ourwork/icg/documents/publications.html

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# Conclusion

- Significant progress continues to be made through ICG, and the results of this work not only promote the capabilities of GNSS to support sustainable development, but also promote new partnerships among members of ICG and institutions of the broader user community, particularly in developing nations
- The activities and opportunities provided through the ICG result in the development and growth of capacities that will enable each country to enhance its knowledge, understanding and practical experience in those aspects of GNSS technology that have the potential for a greater impact on its economic and social development, including the preservation of its environment
- The ICG is an important vehicle in the multi-lateral arena, as satellite-based positioning, navigation and timing becomes more and more a genuine multinational cooperative venture

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# THANK YOU

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