US Participation in ICG-IGS Monitoring

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Advancing transportation innovation for the public good

CGSIC, International Sub-committee
25-26 Sep 2017, Portland, OR
ICG GNSS Monitoring Effort

- Project Initiated at International Committee on GNSS (ICG)
  - ICG Monitoring and Assessment Task Force (IGMA)
  - Trial project coordinated with International GNSS Service (IGS)
  - Beneficiary of IGS Multi-GNSS Experiment (MGEX)

- Six Entities Coordinating Under IGMA
  - Five GNSS Service Providers—Beidou, Galileo, GLONASS, GPS, and QZSS
  - IGS Governing Board
IGMA GNSS Monitoring Trial Project

- IGMA—Ambitious Schedule
  - Terms of Reference in place and Call for Participation completed Feb 2016
  - IGS team has 17 organizations from around the globe
  - ICG nominations expect all GNSS service providers

- Anticipated Products for Public Dissemination
  - Periodic SIS performance against published standards
  - Six product “feeds” (IGS, US, China, Russia, EU, Japan)
  - Six individual repositories
  - Reference URLs to be linked on ICG web portal
ICG-IGS IGMA Terms of Reference

- Consensus Document from ICG WG-S & IGS
- Phased List of Monitored Parameters
  - Trial Project: PDOP, orbit error, UTC offset, URE
  - Long-term objective is all Performance Standard (PS) entries published for each GNSS
- Parallel WG-S Effort to Form GNSS-PS Template
  - Introductory edition will be consolidated GNSSs
  - Future objective is a multi-GNSS service performance standard
IGS Call for Participation (CfP)

- Four Support Center Types
  - Monitoring Stations: receivers, pre-processing
  - Data Centers: networking, storage, & retrieval
  - Analysis Center: measurement processing and parameter estimation
  - Coordination Center: administrative control

- Cooperative Effort
  - Expressly opened to new IGS participants
  - Individually contributed resources
  - Sharing of knowledge
## IGS Collaborators Responding to CfP

### IGS IGMA Proposals

1. Richard Langley, University of New Brunswick, Canada
2. Rafał Sieradzki, Paweł Wielgosz, University of Warmia and Mazury in Olsztyn, Poland
3. Sungpil Yoon, Kevin Choi, National Geodetic Survey, Silver Spring, USA
4. Anna Maria Baron Isanta, Joel Grau Bellet, Ernest Bosch Llopart, Institut Cartografic i Geològic de Catalunya, Barcelona, Spain
5. Carey Noll, CDDIS, GSFC, NASA, Greenbelt, USA
6. João Monico, Universidade Estadual Paulista, Presidente Prudente, Brasil
7. Jan Douša, Pavel Václavovic, Pavel Novák, Research Institute of Geodesy, Topography and Cartography, Onrejov, Czech Republic
8. Peter Steigenberger, Oliver Montenbruck, Deutsches Zentrum für Luft- und Raumfahrt, Oberpfaffenhofen, Germany
9. Furqan Ahmed, Srinivas Bettadpur, The University of Texas at Austin, USA
10. Yanming Feng, Charles Wang, Queensland University of Technology, School of electrical Engineering and computer science, Brisbane, Australia
11. Zhiguo Deng, GFZ German Research Centre for Geosciences, Potsdam, Germany
12. Yuki Hatanaka, Geospatial Information Authority of Japan (GSI), Tsukuba, Japan
13. Werner Enderle, ESA/ESOC, Darmstadt, Germany
14. Qile Zhao, Min Li, Chuang Shi, Wuhan University, GNSS Research Center, China
15. Junping Chen, Shanghai Astronomical Observatory, Tonji University, China
16. Irma Rodriguez Perez, Guillermo Tobias Gonzalez, GMV, Madrid, Spain
17. Ahmed Mohamed Ali, Dubai Municipality, United Arab Emirates

http://igs.org

IGMA WS, Shanghai, 22 May 2017
### IGS IGMA Proposals

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IGMA WS, Shanghai, 22 May 2017
USG Work on ICG-IGS Trial Project

- Basis of Monitoring Requirements: Terms of Reference (ToR)
  - US submitted proposal to ICG-IGS Trial Project at ICG-11 (Sochi)
  - Four monitored elements—UTC offset, PDOP, URE, Orbits (Clock & Ephemeris)
    - Initially monitor only US open signal (GPS L1 C/A)

- Proposed US Monitoring Analysis Center (MAC)
  - Leverage USG available data
  - Intermediate processing of raw observables for four data products
  - Data repository at USCG Navcen site
  - Publishing of data links to GPS.GOV and ICG web portal

- Potential Expansion of Data Products in Later Phases
  - Modernized GPS signals (L5, L2C, L1C)
  - GNSS open signals from other Service Providers BDS, GAL, GLN
  - Additional monitored elements if/when ToR is expanded
  - Internationally located tracking sites
Data Sources (1 of 3): Tracking Sites

- FAA Technical Center SBAS Reference Network
- Six Monitoring Stations
  - Boston, Honolulu, Los Angeles, Miami, Juneau, Merida
  - WAAS GIII reference receiver, Cs frequency standard
  - Raw data collected near-real-time, processed daily
- Signals of Interest
  - GPS L1 C/A fully processed
  - Modernized GPS and other GNSS signals under consideration
- Provide Observations for PDOP and URE monitoring
Data Sources (2 of 3): UTC Time Scale

- US Naval Observatory UTC Reference
  - Time Scale provided daily
  - UTC-GPS Offset evaluated on each Time Scale update
**Data Sources (3 of 3): Orbit Parameters**

- Provided Through National Geodetic Survey
  - Reference GPS orbit data available daily
  - Produced in accordance with IGS “final” products

- Orbit Accuracy Processing
  - Processed daily with each reference orbit update
  - Broadcast orbits to be evaluated on IODEs

- Future Consideration of Other GNSS Orbits
  - IGS independent ephemerides are of interest
  - Not likely in trial timeframe
  - Other clock observations possible
IGMA Forward-look

- ICG Meeting & Coordination Rhythm
  - Two to three meetings per year
  - Both technical and administrative exchanges
  - IGMA reporting to WG-S at annual ICG meetings

- US Effort Anticipated Milestones
  - Dec ‘17: USDOT co-leading data model definitions
  - Mar ‘18: US prototype running end-to-end
  - Dec ‘18: US product feed connected to ICG
  - Jun ‘19: Phase two scope determination
Questions?
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Rick Hamilton, USCG NavCen
Jeff Auerbach, US State Department