

IAG Service Assessment 2014

International GNSS Service (IGS)

- History and mission
- Network, products and users
- Organizational structure
- Planning and reporting
- Links with other communities
- Funding
- Risk assessment
- Future requirements
- Summary

TU Vienna, 25-April-2014

History and Mission of the IGS

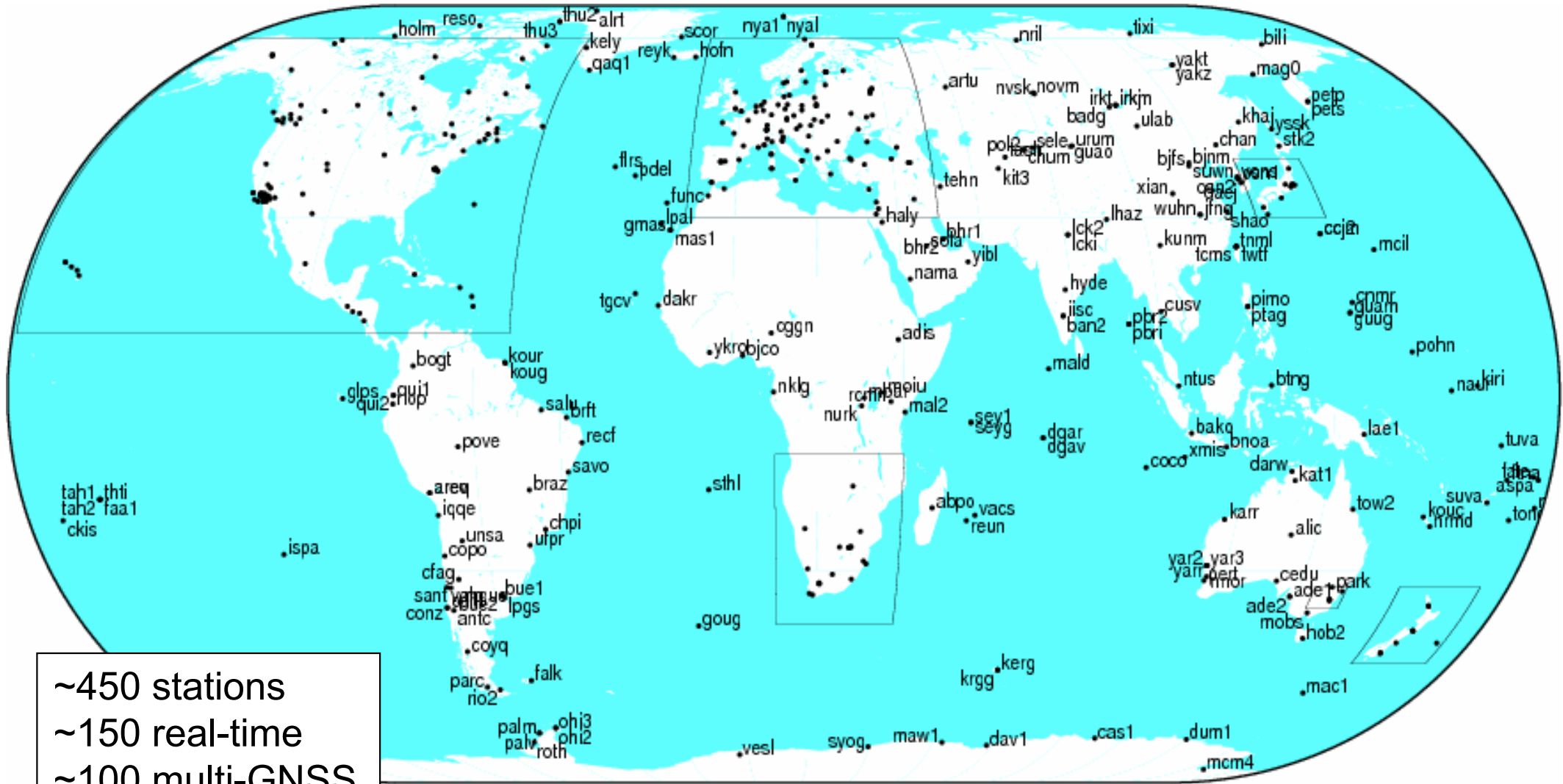
- IGS is an IAG Service since January 1, 1994, i.e., since 20 years
 - Products are available since June 1992 without interrupted
 - Originally called “*International GPS Service for Geodynamics*”
 - 1999 renamed into “*International GPS Service*”
 - 2005 renamed into “*International GNSS Service*”
- Today IGS is a *voluntary federation of more than 240* contributing organizations and institutions

Mission:

The International GNSS Service provides the highest-quality GNSS data, products, and services in support of Earth observations and research, positioning, navigation and timing, the terrestrial reference frame, Earth rotation, and other applications that benefit society.

(from Strategic Plan 2013-2016)

The IGS Network



IGS Products

- Primary products are
 - global tracking data
 - GPS and GLONASS orbits
 - station coordinates, contribution to global terrestrial reference frame
- Related products
 - clock corrections for satellites and selected stations
 - daily Earth rotation parameters
 - global ionosphere maps
 - station troposphere parameters
 - GNSS systems monitoring (constellation status, DCB, ...)
- Standards and conventions
- Open data, open products, open standards policy



IGS Product Accuracies

2013 IGS Product Availability Metrics								
Availability :percentage of time that accuracy, latency and continuity of service meet target specification								
		Sample Interval	Accuracy	Latency	Continuity	Target Availability	*2013 Actual Availability	Description of significant outages
GPS Satellite Ephemerides / Satellite and Station Clocks								
Broadcast (for comparison)	Orbits Sat. Clocks	1s	~100 cm ~5 ns RMS; ~2.5 ns Sdev	real time	Continuous	99.99%		
Ultra-Rapid (predicted half)	Orbits Sat. Clocks	15 min	~5 cm ~3 ns RMS; ~1.5 ns Sdev	predicted	4x daily, at 03, 09, 15, 21 UTC	95%	99.25%	9 failure events caused cumulative delays in delivering the rapid products of ~2.5 days through year. Power and internet outages were predominant sources. One failure of combination software.
Ultra-Rapid (observed half)	Orbits Sat. Clocks	15 min	~3 cm ~150 ps RMS; ~50 ps Sdev	3-9 hours	4x daily, at 03, 09, 15, 21 UTC	95%	99.25%	
Rapid	Orbits Sat. & Stn. Clocks	15 min 5 min	~2.5 cm ~75 ps RMS; ~25 ps Sdev	17-41 hours	daily, at 17 UTC	95%	99.25%	
Final	Orbits Sat. & Stn. Clocks	15 min Sat: 30 s; Stn.: 5 min	~2 cm 75 ps RMS; 20 ps Sdev	12-18 days	weekly, every Thursday	99%	100%	
Real-time	Orbits Sat. Clocks	5-60 s 5 s	~5 cm 300 ps RMS; 120 ps Sdev	25 seconds	Continuous	95%	99.69%	<24 hour outage at BKG data center due to power failure. Redundant station data availability would have prevented it (since IOC Launch in April).
GLONASS Satellite Ephemerides								
Final		15 min	~3 cm	12-18 days	weekly, every Thursday	99%	100%	
Geocentric Coordinates of IGS Tracking Stations (over 250 Sites)								
Positions of Real-time Stations	Horizontal Vertical	daily	3 mm 6 mm	1-2 hours	daily	99%	100%	
Final Positions	Horizontal Vertical	weekly	3 mm 6 mm	11-17 days	weekly, every Wednesday	99%	100%	
Final Velocities	Horizontal Vertical	weekly	2 mm/yr 3 mm/yr	11-17 days	weekly, every Wednesday	99%	100%	
Earth Rotation Parameters								
Ultra-Rapid (predicted half)	Polar Motion Polar Motion Rate Length-of-day	daily integrations at 00, 06 12, 18 UTC	~200 μas ~300 μas/day ~50 μs	real time	4x daily, at 03, 09, 15, 21 UTC	99%	99.25%	
Ultra-Rapid (observed half)	Polar Motion Polar Motion Rate Length-of-day	daily integrations at 00, 06, 12, 18 UTC	~50 μas ~250 μas/day ~10 μs	3-9 hours	4x daily, at 03, 09, 15, 21 UTC	99%	99.25%	
Rapid	Polar Motion Polar Motion Rate Length-of-day	daily integrations at 12 UTC	~40 μas ~200 μas/day ~10 μs	17-41 hours	daily at 17 UTC	99%	100%	
Final	Polar Motion Polar Motion Rate Length-of-day	daily integrations at 12 UTC	0.03 mas ~150 μas/day 0.01 ms	~11-17 days	weekly, every Wednesday	99%	100%	



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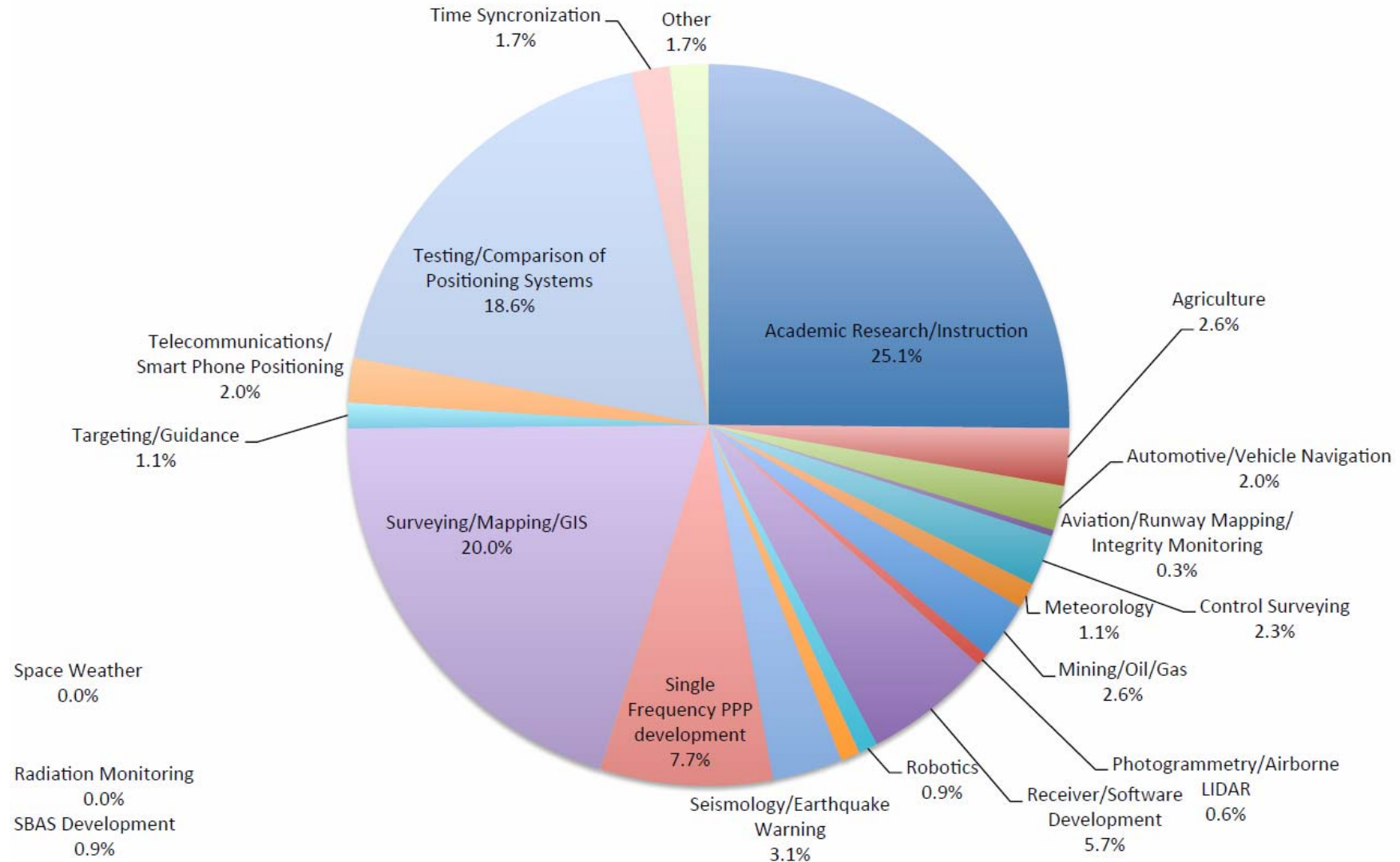
- different product lines
- different latencies, from 2 weeks to real-time
- very high availability
- controlled high quality

IGS Products and Users

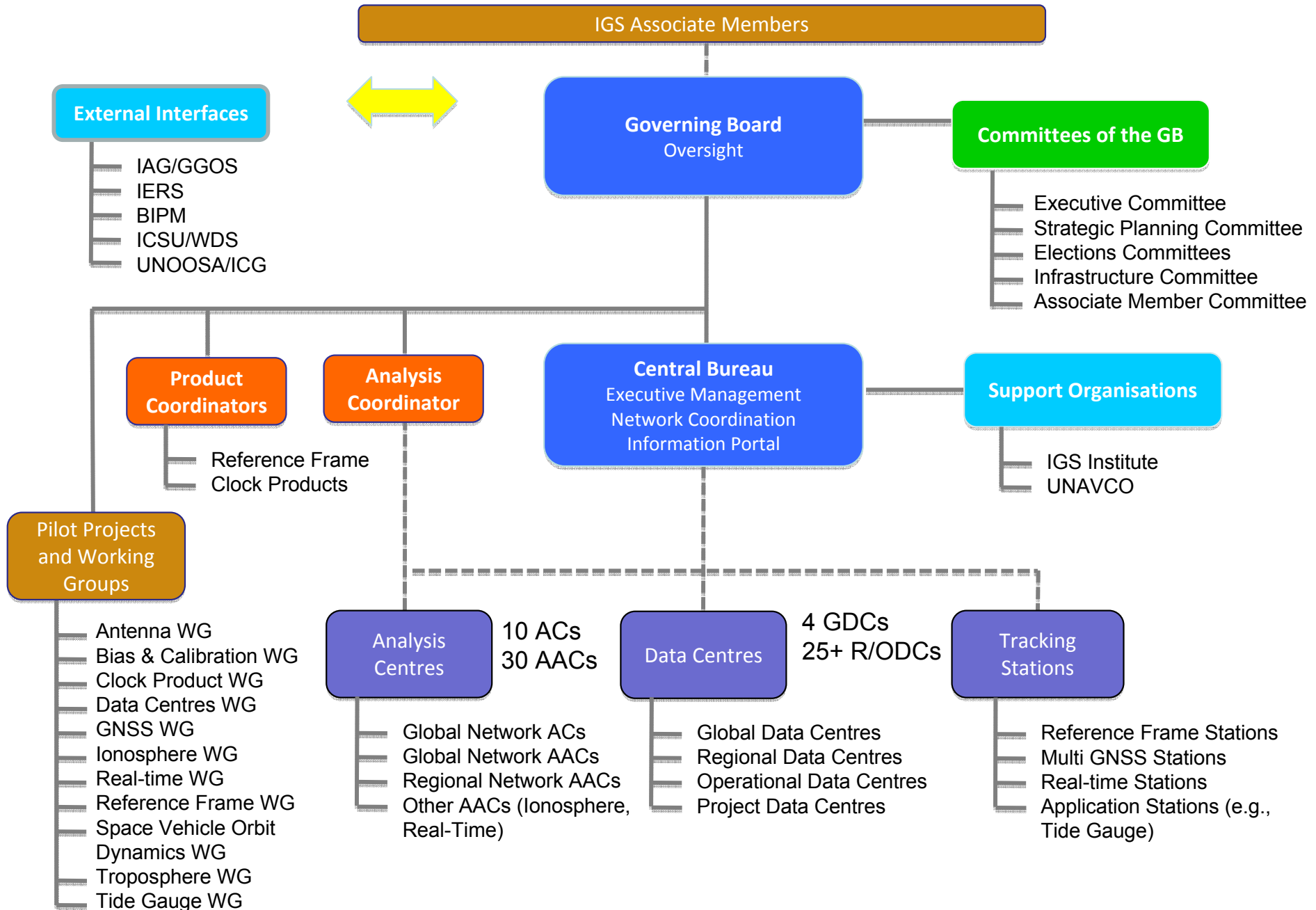
- Regular reanalysis, second reanalysis close to termination, contributing to ITRF2013
- Large and diverse user community (from geophysics and surveying to time keeping and meteorology)
- User access statistics:

www.igs.org :	# visits 2013:	740,000	
	# users/month:	21,800	
	# countries:	146	
ftp.igs.org :	# visits 2013	57,200	
	# users/month	5,700	
	# files	12,700,00	
	# countries	113	
cddis.gsfc.nasa.gov :	# data files <i>per day</i>	1,700,000	(150 GB)
	# product files <i>per day</i>	375,000	(42 GB)

Current RTS User Statistics by Application



Organizational Structure



Organizational Structure

- Organizational structure and governance principles defined in *Terms of Reference*, revised 2010, IAG-approved
- 275 IGS Associate Members
- Governing Board, diversity in expertise and geographical distribution, meeting twice per year
- Executive Committee
- Central Bureau
- Infrastructure Committee
- Data Centers, Analysis Centers
- Product Coordinators
- Working Groups and Pilot Projects
- *Charters for components*: AC and AAC, DC, IC, Assoc. Comm., WGs and PPs, regularly reviewed by GB

Planning and Reporting

- four-annual *Strategic Plan*, current plan for 2013-2016
- annual *Strategic Implementation Plan*
- annual *Components Reports*
- annual *Strategic Plan Progress Report*
- monitoring of activity impact and progress with respect to Strategic Implementation Plan
- annual *Annual Report* and *Technical Report*
- contributing to IAG Travaux and IERS Reports
- *Web-site* <http://igs.org>
- new web site and site log manager under beta testing
- biannual *Workshops*
- next workshop "Celebrating 20 Years of Service" on June 23-27, 2014, in Pasadena, USA



Links with Other Communities

- Member of
 - IAG/GGOS
 - ICSU/WDS
- Representation in GB from
 - IAG
 - IERS
 - BIPM
- Joint Working Group
 - RINEX/RTCM
- GNSS system providers
 - UNOOSA/ICG
 - co-chairing WG-D
 - co-chairing IGMA in WG-A
- FIG

Funding

- CB funded by NASA Earth Sciences - Earth Surface and Interior Focus Area, 2.5 FTE (JPL) and 0.75 FTE (UNAVCO)
- IGS is a voluntary Service
- conservative assessment of annual in-kind contribution of participating institutions: 10 Mio \$
- assessment ongoing to estimate economic value of products

Risk Assessment

- high user expectation of availability of products
- IGS is a voluntary service → no service guarantee
- but high redundancy:
 - 4 global Data Centers
 - 13 Analysis Centers
 - concept of duplicated data and product streams
 - multiple products with overlapping validity
- Real-time product:
 - 2 combination centers, 2 combination strategies, multiple casters
- availability of products is monitored, is above 99%

Future Requirements

- vehicle to formulate future requirements and directions of development is the Strategic Plan
- *Challenges:*
 - (1) Network
 - long-term stability and upgrade to newest technology (discontinuities)
 - IGS site guidelines
 - expansion to Africa, China, Siberia
 - (2) Real-time
 - reducing latency of product availability
 - IGS Real-time Service launched on April 1, 2013
 - supporting GGOS Theme "Natural Hazards"

Future Requirements

- *Challenges (cont.):*
 - (3) Multi-GNSS
 - new satellite constellations, frequencies, signals, clocks and new equipment forming a heterogeneous environment
 - IGS Multi-GNSS Experiment (MGEX) launched to address related issues (formats, conventions, consistency, biases, data analysis, product generation, combination, validation)
 - transition plan for integrating new systems into IGS products
 - IGS will provide consistent multi-GNSS products
 - (4) combination
 - eventually short latency multi-technique combination required (GNSS-VLBI for ERP, GNSS-SLR, GNSS-DORIS)
 - (5) new brains
 - involvement of new groups, young scientists and engineers

Summary

- IGS ...
 - ... is in its 20th year of service
 - ... is at the forefront of high quality GNSS product generation
 - ... has a large user community
 - ... develops new and evolves existing products
 - ... is well connected beyond scientific community
 - ... is engaged with WDS
 - ... has a developed governance structure
 - ... is a robust service