

# *Coordination and Prioritization of Laser Ranging on Retroreflector Equipped GNSS (Revisited)*

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# ILRS network tracking GNSS


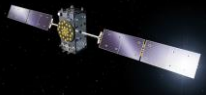

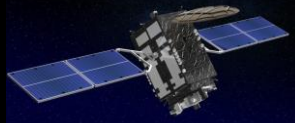




**Map reflects ILRS network stations tracking GNSS satellites since November 2016 as well as plans for future stations capable of tracking GNSS**

# Current ILRS tracking support of GNSS

(Presented previously by Gerald Bawden)



Constellation	Satellites Tracked by ILRS	
GLONASS	26 (8 on priority list)	 <i>ISS Reshetnev</i>
Galileo	24 (20 FOC, 4 IOV)	 <i>ESA</i>
BeiDou	9 (5 MEO, 4 GEO)	 <i>China Academy of Space Technology</i>
QZSS	4 (1 GEO)	 <i>Cabinet Office, Gov. Of Japan</i>
NavIC/IRNSS	7 (3 GEO, 4 IGSO)	 <i>ISRO</i>
Future: GPS-III F	22	 <i>Lockheed Martin</i>



# The problem...

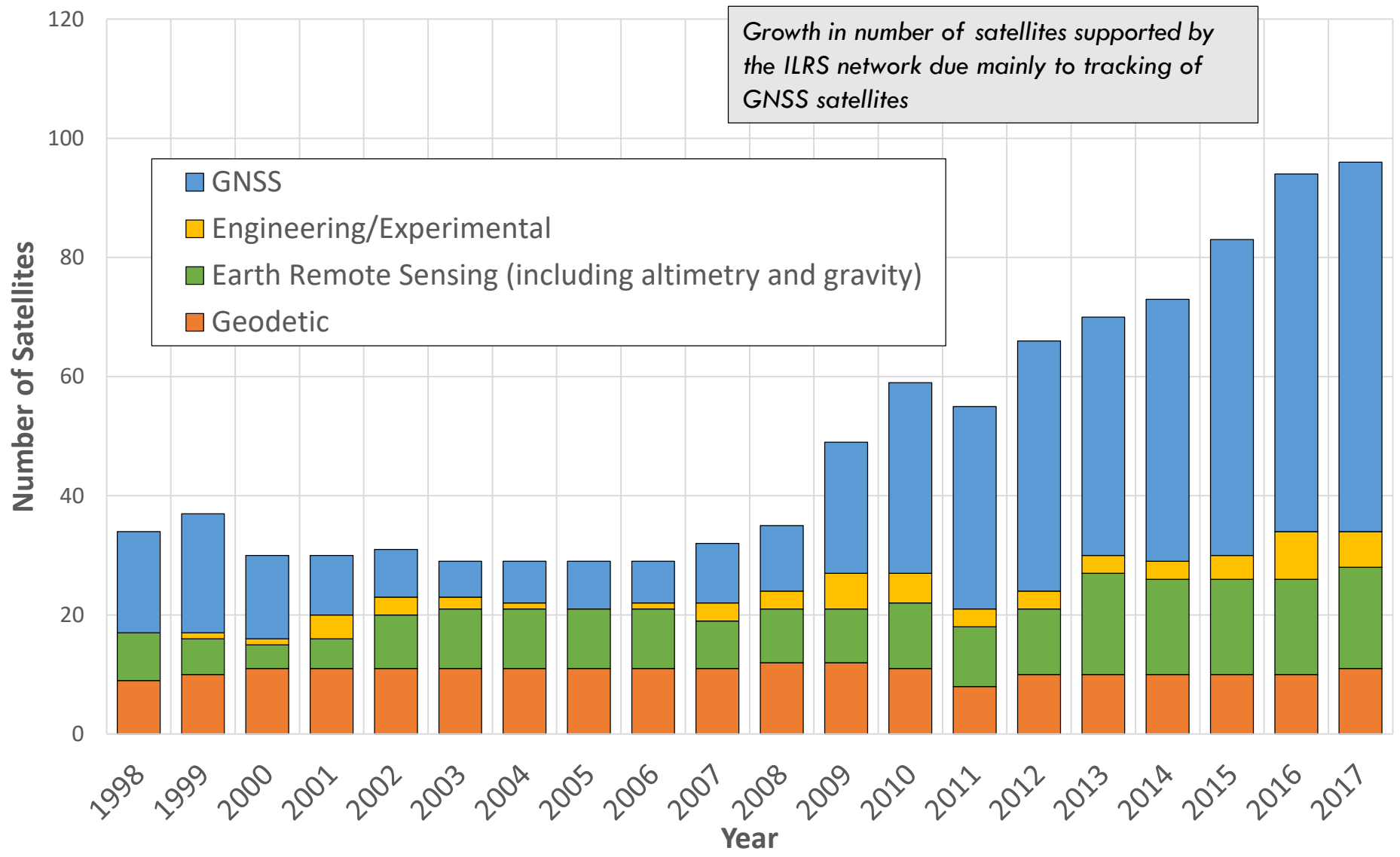
- **The ILRS supports users on a wide variety of missions**, with the highest priorities being the ITRF and some of the Earth remote sensing satellites (e.g., altimetry, gravity field missions), trying to set priorities to maximize the utility of the network
- **The global ILRS network is tracking 42** (and more!) GNSS satellites selected by the Galileo, GLONASS, BeiDou (and QZSS and IRNSS) missions, but tracking on individual satellites is sparse
- The addition of the future GPS-III satellite constellation and their data requirements must also be considered and addressed
- **The ILRS network is getting saturated with requests for tracking support (LEO, MEO, LAGEOS, GNSS, and GEO)**
- **The ILRS is getting conflicting requirements from the GNSS constellations and the data users**
- At the moment, there is **no coordination** among the constellations except what the ILRS provides (*ILRS specifies the priorities for station tracking*);

**ILRS is looking to reduce the number of GNSS satellites on its tracking roster... the final resolution would benefit from better coordination**



# ILRS satellite tracking

(Presented previously by Gerald Bawden)







# How are GNSS targets selected by the ILRS?

- Each GNSS constellation provides the list of its satellites it wants tracked, specifying the relative priority
- ILRS orders the overall priority list which includes geodetic, Earth observation, experimental/engineering satellites, and GNSS targets
- At the moment, all satellites requested by GNSS constellations are accommodated, none are left off, but tracking is very sparse on many of the satellites
- ILRS has organized campaigns to try some different tracking strategies to accommodate the requests; a central theme is to reduce the number of targets
- These campaigns point out the possible benefit of a higher level of coordination (network and constellations)

**Campaigns organized by the ILRS collected more data on a subset in each GNSS constellation: results showed some improvement for targeted satellites.**

# Approaches now being tried

- **Allow constellations to select 4 - 8 satellites for high GNSS tracking with 3 segments of tracking requested per pass (with the possibility to switch to a different selection over agreed upon intervals)**
- **Ask the stations to take more robust sampling of the selected satellites**
- **Some number of additional GNSS satellites in each constellation left on the tracking list at low priority (non-interference basis with other requirements)**
- **It looks like this campaign will provide more data than other campaigns tried, but differences in weather and station operating conditions over a period of only 3 months could be deceiving**
- **The IGS has just offered some suggestions along the lines of that mentioned above; discussions are planned at the 21<sup>st</sup> International Workshop on Laser Ranging during 5-9 November**

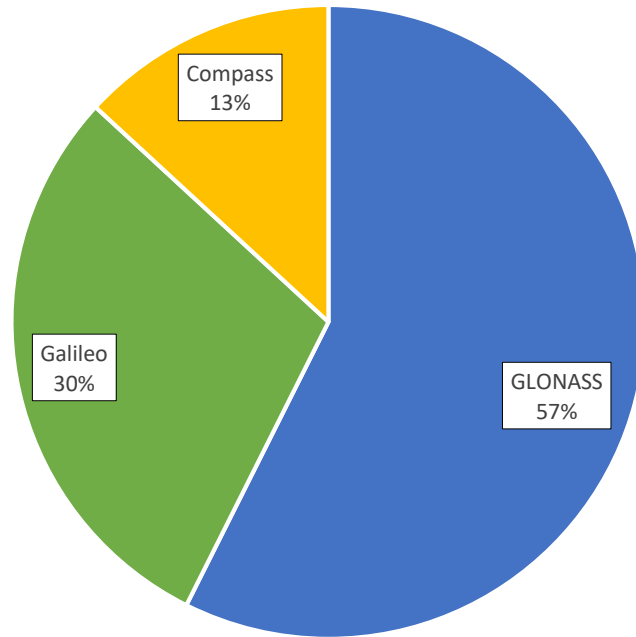


*Beidou laser retroreflector array  
(31.6 x 28 cm, planar, hexagonal array; 2.5 kg)  
(Chinese Academy of Sciences)*

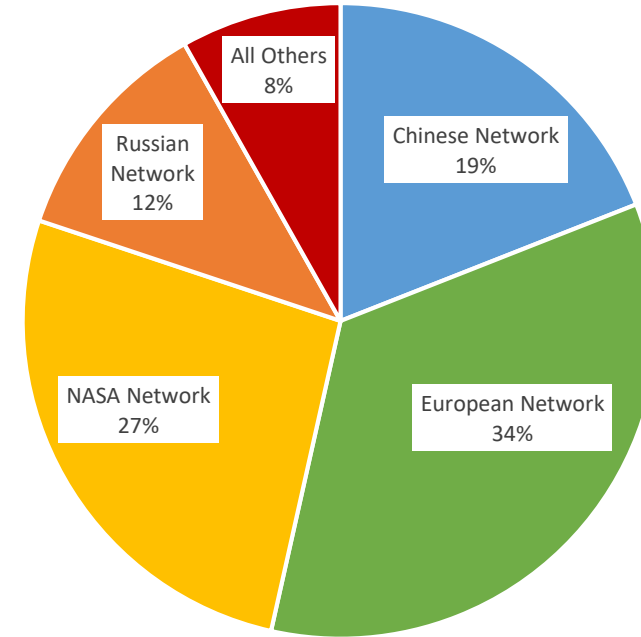
# First 2018 LARGE Campaign

(February – April 2018)

Station tracking totals by constellation  
(passes)



Station tracking totals by network  
(passes)



Second 2018 LARGE Campaign (August – October 2018) just coming to completion





# Role of ICG WG-D

- Investigate the possibility that some coordination of SLR tracking among the GNSS constellations might lead to better utility of the network, resulting in benefits for the users
- This coordination may be difficult since each GNSS constellation has its own vested interests
- Hold off action until the ILRS has its discussions with the IGS (see IGS recommendation to ILRS)
- **Furthermore, encourage national and space agency support for stations in the ILRS network (a resource issue: operations and technological upgrades required to deliver more data to GNSS and other users)**
- **New SLR stations or upgrades to current would expand capacity**

# ILRS recommendation

## *Recognizing*

the increasing load on ILRS stations caused by the increasing number of GNSS satellites equipped with laser retroreflectors

and

the priority of geodetic laser satellites and as well as the needs from other missions;

*considering, furthermore,*

the importance of SLR tracking for orbit validation and analysis of GNSS satellites

as well as

the need to achieve a homogeneous coverage of all GNSS constellations, satellite types, orbital planes and individual spacecraft;

*the ILRS recommends that its infrastructure*

retains the general prioritization of geodetic laser satellites before GNSS satellites and satellites from other missions

and

on request by the **GNSS providers** or the **GNSS user community** gives priority to dedicated campaigns for tracking of selected GNSS satellites at the expense of a reduced background tracking activity

and

uses remaining tracking resources to select and track the remaining GNSS satellites in a randomized manner, where each station can freely select a set of GNSS satellites for tracking on a weekly basis.