

# **Organizing the Continuous VLBI Campaign 2017 (CONT17)**

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*NVI, Inc., Greenbelt, MD, USA*

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Longyearbyen, Svalbard, Norway  
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# Some History



- In IVS era, (prior to CONT17) five continuous VLBI campaigns have been organized:

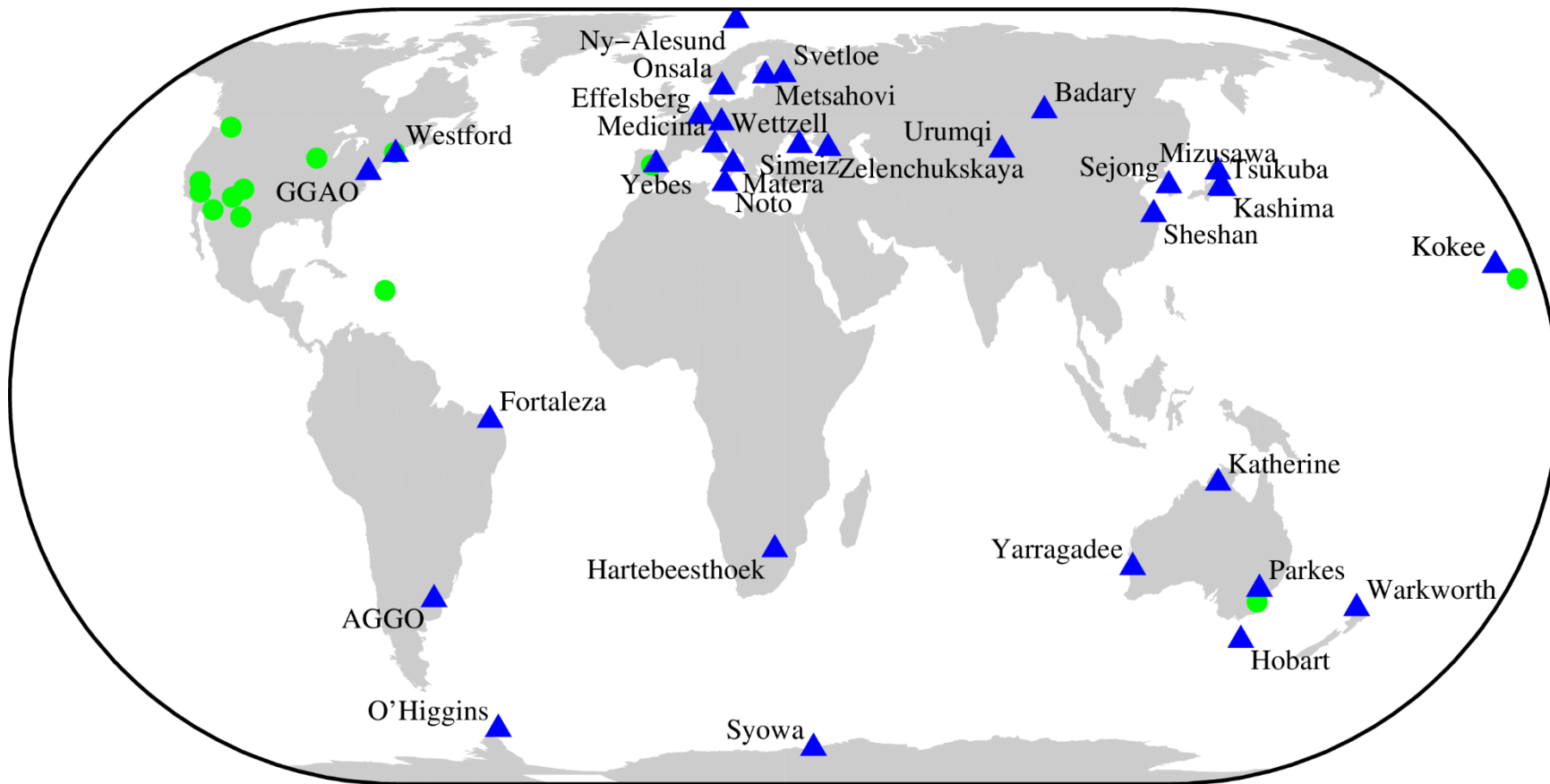
Campaign	Network size	Observation month	Observation length
CONT02	8 stations	Oct. 2002	15 days
CONT05	8 stations	Sept. 2005	15 days
CONT08	11 stations	Aug. 2008	15 days
CONT11	14 stations	Sept. 2011	15 days
CONT14	17 stations	May 2014	15 days

- Main reason for the three-year interval: In 2005, the Observing Program Committee (OPC) decided that CONT campaigns should not be observed more frequently than every three years, because the strain on the resources (mostly stations) was considered too taxing otherwise.
- Next CONT: possibly in 2020 (CONT20).

- First actual mention of a CONT17 campaign was made at the GM2014 in Shanghai, China with two possible scenarios:
  - observe a campaign with legacy S/X system in parallel to VGOS
  - observe mixed campaign of legacy S/X and VGOS stations
- Serious discussion about CONT17 commenced in early 2016:
  - Coordinating Center discussed possible time frame, decided on late 2017 (or early 2018)
  - April 2016: CONT17 for the first time on agenda of an OPC meeting; possibility of two-network campaign (one legacy S/X and one VGOS) presented at GGOS BNO meeting
- Coordinating Center (Cynthia Thomas) contacted various VLBI groups (e.g., EVN, GMVA, JIVE) to determine time period with least conflict potential → fixed period to **November 28 – December 12, 2017.**
- Time frame discussions triggered interest of the VLBA to be part of the CONT17 effort; the VLBA was reorganized at the time to be managed by the Long Baseline Observatory (LBO) starting 1 October 2016

## December 2017

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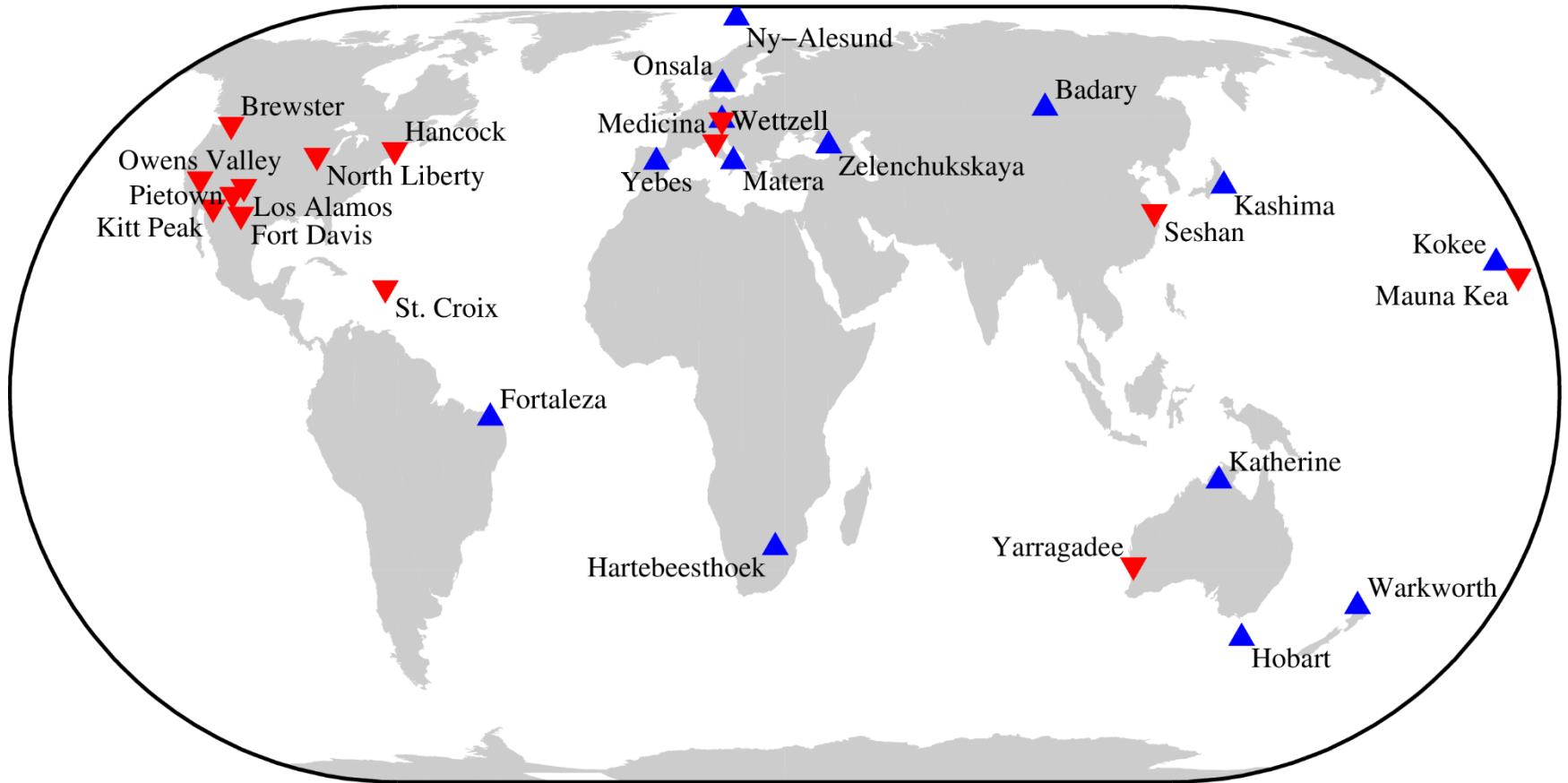
- ▲ IVS Network Station
- Cooperating VLBI Site



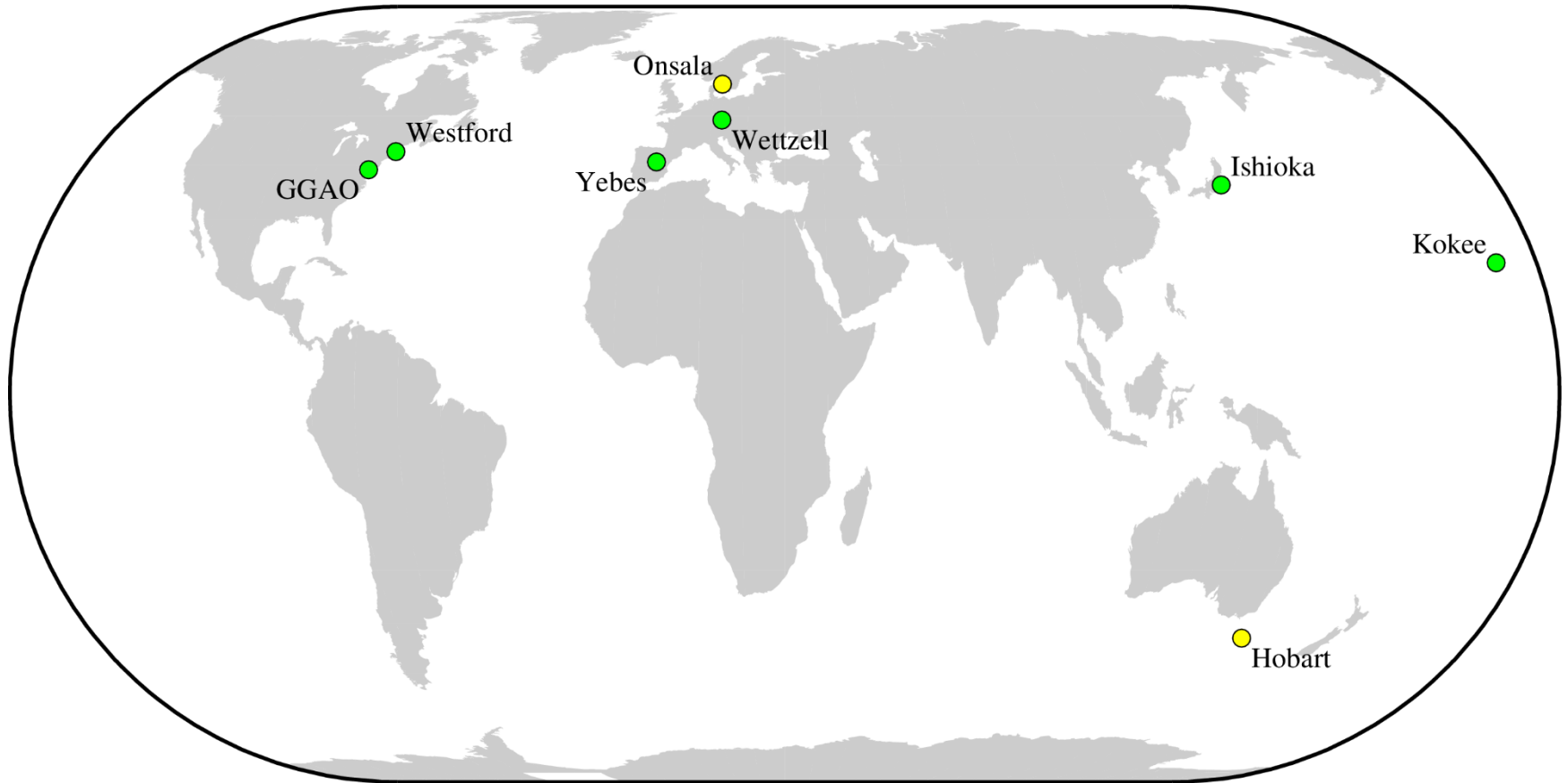
# Station Resources



- Coordinating Center: Call for Participation in CONT17 sent with station time request for the observing year 2017 (in June 2016)
- Some 19 IVS Network Stations (S/X and VGOS) agreed on participating
- Participation of the VLBA possible under LBO control but sponsored by USNO (Megan Johnson talk later this week)
  - ➔ Proposal to USNO VLBA Telescope Allocation Committee (TAC)
- GSFC made a slew of EOP simulations with varying networks, setups, and parameters/options
- Proposal “Using the VLBA in CONT17 as a probe of the accuracy of VLBI estimates of EOP” was submitted in late December 2016 and approved in late January 2017
- Decision for two legacy S/X networks and one VGOS network
- Plans were reported at EVGA 2017 in Gothenburg, Sweden
- Two additional stations (Kashima and Seshan) requested to be added



- ▲ **Legacy-1:** Legacy S/X network of fourteen IVS network stations
- ▼ **Legacy-2:** Legacy S/X network of ten VLBA stations plus four IVS network stations



- **VGOS Demo:** VGOS broadband network of six VGOS stations
- **VGOS Demo:** Hobart no broadband yet; Onsala as tag-along due to test session results not stable enough yet





# EOP Simulation w/o Velocity



Network	X-pole [ $\mu$ as]	Y-pole [ $\mu$ as]	UT1 [ $\mu$ s]	PSI [ $\mu$ as]	EPS [ $\mu$ as]
Legacy-1	13.0	13.7	0.9	36.0	13.1
Legacy-2	15.0	17.5	0.8	37.6	14.3
VGOS-Demo	22.1	22.5	0.8	43.2	18.1
CONT11 Actuals	12.9	13.1	0.7	33.5	13.8
CONT14 Actuals	12.6	12.3	0.7	35.5	13.2

\* Simulations of Legacy S/X networks without Kashima and Seshan

\*\* Simulation of VGOS-Demo included Hobart and Onsala

Network	Scheduler	Change-over time	General technique
Legacy-1	Dirk Behrend, Cynthia Thomas	3 min	full CONT17 period than cut into days
Legacy-2	David Gordon	5 min	individual days
VGOS-Demo	Alex Burns	15 min	individual days

- All schedules were written with NASA's **sked** software
- 0–24 UT (minus changeover time) observing for Legacy networks; VGOS started at 23 UT, last day ran for 25 hours
- Statically scheduled Intensives (Int1, Int2, Ru-I): slots freed of CONT17 observations; no Int3 during CONT17
- Dynamically scheduled VLBA Intensives: no slots freed, accepting loss of observations

Network	#stations	Data rate	Correlator	Comment
Legacy-1	14	512 Mbps	Bonn	—
Legacy-2	14	256 Mbps	Socorro	VLBA
VGOS-Demo	6	8 Gbps	Haystack	—

- Washington Correlator assisted by reducing work load on Bonn prior to and after CONT17, taking over correlation of regular IVS sessions (e.g., R1 sessions at 256 Mbps) from mid-November 2017 through April 2018.
- Legacy-2 recording mode at 256 Mbps is RDV mode; initial plan of using 2-Gbps mode of VCS-II survey was considered too risky for the four geodetic stations.
- After end of observing, correlation took about 138 days (CONT11), 51 days (CONT14), 77 days (CONT17-L1), and 21 days (CONT17-L2) to complete.

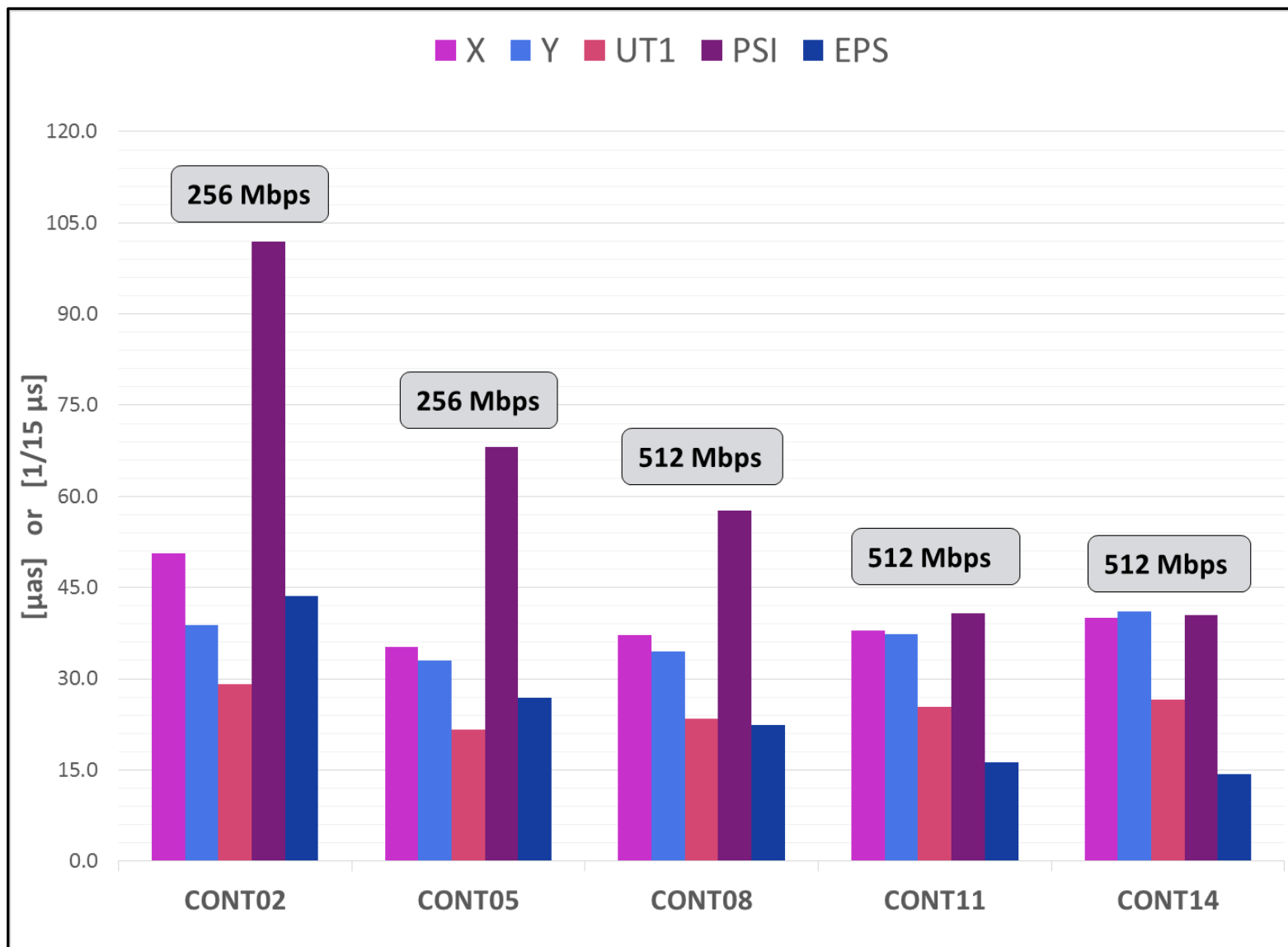


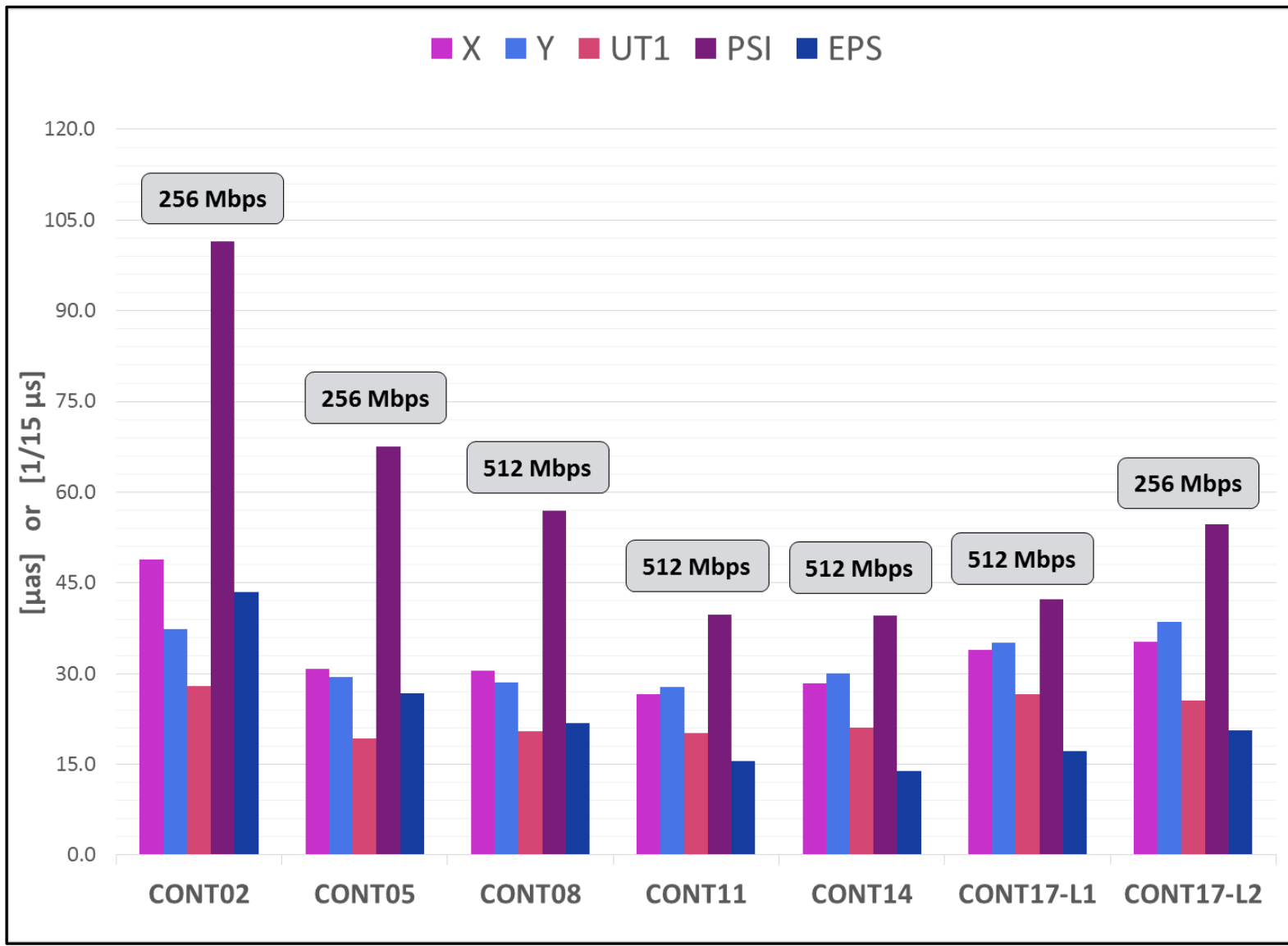
# Data Storage and Transport Resources



Network	e-transfer	Module shipment	Storage type	Capacity per day
Legacy-1	12 stations	Matera, Kokee	Mark 5, FlexBuff	40.6 TB
Legacy-2	—	all stations	Mark 5	23.8 TB
VGOS-Demo	Ishioka	5 stations	Mark 6	132 TB

- Each station was allocated two spare modules as backup.
- Bonn arranged to have 600 TB of data storage available for Legacy-1; a contingency RAID was based on eight 32-TB Mark 6 modules.
- Fortaleza shipped modules for R-type equivalent sessions physically to USNO from where the data were e-transferred to Bonn.
- Rapid-turnaround equivalent sessions were given precedence for module shipment or e-transfer.







# Acknowledgement in Publications



- Acknowledgement text for publications that make use of CONT17 data
- Policy decision from IVS Directing Board
- Acknowledging the contributors to CONT17 in publications essential for securing continued funding of VLBI components
- Acknowledgement text can be downloaded from the CONT17 Web page: <https://ivsc.gsfc.nasa.gov/program/cont17/>
- Version 4 vgosDB databases of full campaign (legacy networks) can be downloaded from password protected area (send an email to Laura la Porta <laporta@mpifr-bonn.mpg.de> with cc to Axel for details; with download request analysts agree to adhere to referencing rule
- vgosDB databases of VGOS-Demo will be available in June 2018; re-correlation in progress to ensure UT1 consistency between VGOS and legacy S/X data
- CONT17 data will become public after a grace period of 6 months; however, proper acknowledgement is to continue



# Acknowledgement in Publications



## Acknowledgements:

We are grateful to all parties that contributed to the success of the CONT17 campaign, in particular to the IVS Coordinating Center at NASA Goddard Space Flight Center (GSFC) for taking the bulk of the organizational load, to the GSFC VLBI group for preparing the legacy S/X observing schedules and MIT Haystack Observatory for the VGOS observing schedules, to the IVS observing stations at Badary and Zelenchukskaya (both Institute for Applied Astronomy, IAA, St. Petersburg, Russia), Fortaleza (Rádio Observatório Espacial do Nordeste, ROEN; Center of Radio Astronomy and Astrophysics, Engineering School, Mackenzie Presbyterian University, Sao Paulo and Brazilian Instituto Nacional de Pesquisas Espaciais, INPE, Brazil), GGAO (MIT Haystack Observatory and NASA GSFC, USA), Hartebeesthoek (Hartebeesthoek Radio Astronomy Observatory, National Research Foundation, South Africa), the AuScope stations of Hobart, Katherine, and Yarragadee (Geoscience Australia, University of Tasmania), Ishioka (Geospatial Information Authority of Japan), Kashima (National Institute of Information and Communications Technology, Japan), Kokee Park (U.S. Naval Observatory and NASA GSFC, USA), Matera (Agenzia Spaziale Italiana, Italy), Medicina (Istituto di Radioastronomia, Italy), Ny Ålesund (Kartverket, Norway), Onsala (Onsala Space Observatory, Chalmers University of Technology, Sweden), Seshan (Shanghai Astronomical Observatory, China), Warkworth (Auckland University of Technology, New Zealand), Westford (MIT Haystack Observatory), Wettzell (Bundesamt für Kartographie und Geodäsie and Technische Universität München, Germany), and Yebes (Instituto Geográfico Nacional, Spain) plus the Very Long Baseline Array (VLBA) stations of the Long Baseline Observatory (LBO) for carrying out the observations under the US Naval Observatory's time allocation, to the staff at the MPIfR/BKG correlator center, the VLBA correlator at Socorro, and the MIT Haystack Observatory correlator for performing the correlations and the fringe fitting of the data, and to the IVS Data Centers at BKG (Leipzig, Germany), Observatoire de Paris (France), and NASA CDDIS (Greenbelt, MD, USA) for the central data holds.





# Conclusions and Outlook



- Preparation of CONT17 started as early as February/March 2016, i.e., more than 1.5 years prior to the actual observing
- CONT17 was first three-network continuous VLBI campaign
- Independent networks allow to probe the accuracy of EOP estimates, in particular for UT1 and nutation
- CONT17 first continuous VLBI campaign that included the VLBA (in the IVS era)
- CONT17 likely to remain the largest legacy S/X CONT effort, as stations start to convert to VGOS (e.g., AuScope)
- Acknowledge the contributors to CONT17 in publications
- Special issue about CONT17 planned in Journal of Geodesy: initial call sent out by John Gipson to ivs-analysis
- Possible CONT20 using a mixed network of S/X and VGOS stations