

32nd Directing Board Meeting – Summary Notes

Location: Tsukuba, Japan
Date: 27 October 2014
Note taker: Dirk Behrend
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Attending Board members: Axel Nothnagel (Chair), Dirk Behrend, Alessandra Bertarini, Patrick Charlot, John Gipson, Ed Himwich, Alexander Ipatov, Shinobu Kurihara, Jim Lovell, Chopo Ma, Arthur Niell, Bill Petrachenko, Harald Schuh.

Absent: Rüdiger Haas, Hayo Hase, Fengchun Shu.

1. Welcome (Axel Nothnagel)

Axel Nothnagel welcomed the attending Board members. The three absent Board members would call in via Skype for part of the meeting.

2. Approval of Agenda

The Board approved the agenda for the 32nd DB meeting.

3. Approval of Minutes of the 31st DB Meeting (Axel Nothnagel)

The Board approved the notes of the 31st DB meeting.

4. IVS DB Chair's Report (Axel Nothnagel)

On April 25, 2014, Axel attended the IAG Services Assessment review meeting in Vienna and gave a presentation about the IVS. He organized the allotment of station names as well as DOMES and CDP numbers for the RAEGE antennas, Ishioka, and Zelenchukskaya. Axel wrote a letter of recommendation for Lucia Plank for the Erwin Schrödinger Fellowship.

For the VPEG, Axel drafted and revised several documents and he sent a letter of support for the Italian wide-band development (G. Tuccari). He communicated with Claudio Brunini in La Plata, Argentina regarding the South American representative in the Committee on Training and Education. Claudio proposed Professor Mauricio Gende from the Department of Astronomy and Geophysics of the University of La Plata.

Axel sent a letter of acceptance to the Yebes group for their IVS Technical Development Center. He corresponded with Alexander Neidhardt about the Task Force on Seamless Auxiliary Data. Axel corresponded with David H. Hughes, the Director of the Large Millimeter Telescope Project in Mexico. The frequencies used in geodetic VLBI are too low for them to contribute.

5. IVS CC Director's Report (Dirk Behrend)

The main activities of the Coordinating Center during the report period pertained to publications, preparing the TOW meeting, organizing the upcoming Board elections, and looking into organizing the VGOS trials (likely to be postponed by one year).

The IVS 2013 Annual Report was edited by Bayer, Behrend, and Armstrong. The volume was posted online and printed in August 2014. The Proceedings volume of the 2014 General Meeting was edited by Behrend, Bayer, and Armstrong. The editing process was completed on 19 August 2014 and then passed on to Science Press (China) for further processing and printing.

The April and August issues of the IVS Newsletter were prepared, printed, and distributed. The Design Team for the next IVS tri-fold worked on the text for the public outreach version of the tri-fold. The peer tri-fold still needed to be worked on.

Other activities of the Coordinating Center included the preparation of the Directing Board meeting, preparing the DB meeting notes, writing the IVS contribution to the IERS 2013 Annual Report, filling in the IAG Services' Assessment questionnaire, and working on the WDS member activity report.

6. Elections 2015: Forming of Election Committee (Dirk Behrend)

There were three representative positions whose terms were to end in February 2015: Alessandra (Correlator Representative), Hayo (Network Station Representative), and Arthur (Analysis and Data Centers Representative). Hayo was not re-electable after having served two full terms. All three At Large positions were up for election (Alexander, Shinobu, and Fengchun). Both Shinobu and Fengchun were not eligible for re-election.

The Board determined Shinobu (chair), Hayo, and Dirk as the Election Committee members.

7. Reports of the Coordinators and Committee Chairs

7.1 Observing Program Committee Chair's report (Dirk Behrend)

Issues discussed in the period since the last board meeting were:

- CONT14: The CONT14 campaign was observed May 6–20, 2014 with 17 stations at 16 sites. The observing was done in UT days and at a rate of 512 Mbps. Eight stations e-transferred their data. A station sanity check (rapid fringe test) was performed right before the start of CONT14 using one or two 20-second scans. All correlation was done at the Bonn Correlator.
- Source structure simulations and CONT campaigns: Future CONT campaigns may make use of the source structure index for the source selection.
- 2015 Planning: The OPC approved the 2015 plan as proposed by the Coordinating Center.
- T2 at 1 Gbps: One demonstration T2 session could be organized at 1 Gbps to show the maximum correlator load with the legacy system (T2 as largest network with 1 Gbps as highest possible rate).
- R&D proposal for Chang'E-3 lander observations (OCEL): The OPC approved a proposal by Geshi Tang (Beijing Aerospace Control Center) to observe X-band transponder signal of the Chang'E-3 lander with VLBI. There will be four such sessions in 2014.
- R&D sessions in 2014: Two R&D sessions in 2014 were used for checking out the CONT14 stations in the planned observing mode (RD1401 and RD1402). Six sessions were used to observe link sources between the *Gaia* mission and the ICRF2 (RD1403, RD1404, RD1406, RD1408, RD1410, and RD1412). Four OCEL sessions were observed (RD1405, RD1407, RD1409, and RD1411).
- R&D sessions in 2015: *Gaia* and possibly OCEL.

The *Gaia* mission had completed its commissioning phase and was at the start of the observation phase. The first *Gaia* catalog (intermediary) was expected for summer 2016. The target of reaching an accuracy of 0.1 mas and a repetition of 12 sessions per year for the *Gaia* link sources was reached for most sources. Some weaker sources still needed dedicated observing.

7.2 Network Coordinator (Ed Himwich)

The Network Coordinator reported on the station performance for 2014 using 815 station days. The overall correlator yield by station was at about 88%, which is in line with the historical yield of 85–88%. The overall data used by the analysts was ~75%; this amounts to about twice as much loss as for the correlator (loss at one station affects more than one baseline). It includes other issues detected by the analysts.

The CONT14 campaign had 250 station days with an average data yield of about 90%. The most significant issues were RFI and wind.

The first VEX2 draft was released on September 16, 2014. At the time of the meeting, the feedback period was running. The testing phase was planned to begin in 2015.

Ed prepared a station e-transfer data release policy for non-Intensive sessions. One goal was to avoid releasing data while it might still be needed. The policy should be released soon.

7.3 Analysis Coordinator (John Gipson)

A comparison of single-tone and multi-tone at the software correlator was in progress. The Bonn Correlator processed all CONT14 days using single-tone and multi-tone. The multi-tone should give better results. Initial results indicated that multi-tone usually had more data and that the fit was slightly better. There was no significant offset in UT1.

Work was done on the analysis of the *Gaia* transfer sources. 13 VLBI sessions were devoted in whole or part to measuring positions of the *Gaia* transfer sources. All 195 *Gaia* sources were introduced into the GSFC source monitoring program in September 2013.

An effort is underway to re-measure all VCS sources (VCS-II). About two thirds were done. The preliminary results were very encouraging. Several sources had their positions changed (they had few observations in the first VCS).

A table of official IVS source names has been prepared. It contains the IVS name and coordinates as well as alternate source names for all sources in the IVS database. The table will be updated whenever a new source is observed. The goal is to provide enough information to unambiguously identify a source (and not much else).

The IVS contribution to ITRF2013 was almost done. A first combined version was expected to be submitted to the IERS ITRS Combination Centers in November 2014.

7.4 Technology Coordinator (Bill Petrachenko)

The Technology Coordinator and the VTC were involved in the following items in the period since the last Board meeting in order to get ready for the VGOS test campaigns:

- Haystack
 - Correlator: Progress with mixed mode processing, now possible to process all four broadband bands simultaneously; discussing more efficient correlation modes and increased automation
 - Cable Cal: New cable cal systems developed and tested at GGAO
 - Synchronous 80-Hz TP detection is tested and working well
 - Upgraded Westford receiver remounted
 - UDC with 3rd stage enhancement will have full 2–14 GHz frequency response
- Noto
 - Lots of work on focus cabin to mount samplers at focus
 - An extra reflector is required to match broadband feed to antenna
 - Single polarization system expected at Noto by mid-2015
- Wettzell
 - North antenna, Wn, (TTY1) has a working S/X system using S/X/Ka band feed
 - South antenna, Ws, (TTY2) is intended for Eleven feed system
- Yebes
 - S/X/Ka system
 - QRFH ordered from Caltech
 - Circular-polarized spiral helical feed development at Yebes
 - Back end with DBBC2s and Mk6 being assembled

- First broadband tests in mid to late 2015
- New 10 Gbps network connection
- Ishioka
 - Eleven feed installed on antenna
 - QRFH feed also available but not tested yet
 - Up-down converters and digital back ends still under development
 - Signal chain for legacy S/X (with S/X/Ka feed) using ADS3000+ and DBEs is now being prepared
 - Field system is being installed
- AuScope
 - Sterling Cycle QRFH front end
 - Broadband back ends: because of funding to Callisto there are extra funds for broadband back ends at Hobart; funding application in place for broadband back ends at all sites, results know in November
 - Record/buffer systems: FlexBuff system purchased, Mk6 system planned
 - Optimistically first broadband tests by mid-2015
- NICT
 - X-band fringes with Kashima-34 and two small (~1.6 m) transportable
 - Note: Kashima-34 feed is 6–14 GHz with new 3–14 GHz version by end of year
 - Would like to test with Haystack but compatibility modes need to be found
 - PCAL system to be better tested

Observing configuration for VGOS test campaigns of 2015: Much recent progress has been made towards fully compliant broadband systems at a number of sites. Nevertheless, no site will be fully compliant by the start of 2015.

7.5 VGOS

7.5.1 VGOS Technical Committee (Bill Petrachenko, Arthur Niell)

see TOP 7.4

7.5.2 VGOS Project Executive Group (Hayo Hase)

Incremental update: The group had seven telecons during the report period but no face-to-face meeting. A letter in support of 1000 cores was prepared for the SHAO correlator. Another letter of support was written for the Italian broadband developments. Harald gave a presentation about VGOS at the AOGS meeting in Sapporo. The group worked on the VGOS Data Transmission and Correlation Plan.

The creation of the VGOS operational plans was a major focus. The VGOS Observation Plan was approved by the Board in March 2014 and subsequently published. The VGOS Data Transfer and Correlation Plan was to be approved at the current Board meeting. The VGOS Analysis Plan was being worked on under the lead of John and Axel.

Work in progress were the technical questions of source structure corrections, connecting phase over the observed bands, and mixed-mode scheduling and observation. These items were never done before and are time consuming.

Bill introduced the concepts of the VGOS Data Transmission and Correlation Plan to the Board. Based on the observation roll-out defined in the VGOS Observing Plan, the data rate will be 16 Gbps, the average integration time 7.5 s, and the observation interval 30 s. The plan covers the years from 2015 to 2020, at which point full VGOS operations begin. A number of requirements were considered; e.g., e-transfer, physical shipment of media, media requirements per station, number of playback units at the correlator, correlator cores, internal correlator network, or online correlator memory. All calculations were done assuming a single monolithic correlator. A highly distributed correlator and multiple antennas at a site were not considered.

There should be at least four Mark 6 playback units (or equivalent) in the short term and at least eight in the longer term. The recommended external network connection should have at least 10 Gbps in the short term; in the longer term, the connectivity should be significantly higher (>40 Gbps). At the stations the network connections should at least have 2 Gbps in the short term and over 6 Gbps in the longer run. The capability for removable media should be maintained at the stations. There is a need to decide on a compatibility standard for media to relieve the correlators of the need to support multiple types of media. The correlators should consider to upgrade their internal network technology from 10 Gbps to 40 Gbps.

The Board unanimously approved the VGOS Data Transmission and Correlation Plan.

7.5.3 RFI at IVS Stations (Bill Petrachenko)

A few new RFI surveys were undertaken. A 30-day RFI survey was done at Kokee. No RFI was detected that was serious enough to threaten the VGOS broadband operations (even at S-band). Westford and GGAO are observing regularly in VGOS broadband. Broadband receiver saturation has not been a problem. No observations have been taken yet at S-band. The Eleven feed front end is mounted at Ishioka. The receiver front end was not saturated by RFI. There was significant RFI below 6 GHz.

To investigate the impact of DORIS, a moveable DORIS test beacon was loaned to GSFC. Larry Hilliard (GSFC) has been testing barriers to protect the VGOS antenna. No results have been reported yet. For the SLR aircraft avoidance radar, Larry Hilliard is also investigating another radar at higher frequency and lower power. Proposed Earth observation satellites could potentially damage the VLBI front ends if the antennas point too close when they transmit.

7.6 VLBI Education and Training (Rüdiger Haas)

The Terms of Reference for the IVS Committee on Training and Education (CTE) state that the purpose of the CTE is

- to organize IVS Training Schools on VLBI for Geodesy and Astrometry on a tri-annual basis in connection to, for instance, IVS General Meetings, regional VLBI meetings, or the IVS Technical Operations Workshops.
- to establish and maintain contacts to higher education institutions worldwide that provide education in geodesy, geosciences and astrometry, with the aim to raise the interest for geodetic and astrometric VLBI among students.
- to develop education and outreach material that can be distributed to education institutions in a broader sense, including schools.

The proposed members of the IVS CTE are: Rüdiger Haas (Chair), Alessandra Bertarini, Johannes Böhm, Chris Jacobs, Chris Beaudoin, Fengchun Shu, Thomas Hobiger, Jim Lovell, Yuri Bondarenko, Mauricio Gende, and Alet de Witt. There also should be a member from Japan.

VLBI Training Schools: The first School was held in 2013 in Espoo, Finland. The second School will be held in South Africa in March 2016 in connection with the IVS General Meeting.

8. Short Reports of IVS Working Groups and other IVS assignments

8.1 Task Force on IVS Intensives (Rüdiger Haas)

Activities since the last Board meeting:

- Ultra-rapid (UR) UT1-UTC activities:
 - RD1402: four-station UR (On-Ts-Ht-Ho)
 - Two sessions On-Ts during IVS R1 sessions (R1631, R1632)
 - Whole CONT14 in ultra-rapid mode on baseline On-Ts, EOP1 files were produced in near real-time (real-time data transfer, near real-time correlation and analysis, done at GSI Tsukuba)
 - Break due to radome replacement at Onsala

Outlook:

- Observational activities:
 - Continue UR.UT1-UTC sessions and improve analysis strategy (e.g., adapted window length, Kalman filter)
 - Dedicated 4-station UR.UT1-UTC sessions if telescope time allows. Use East-West baselines simultaneously for each hemisphere (e.g., On-Ts for northern and Hh-Hb for southern)
- Analysis work:
 - Develop unified analysis strategy for Intensives
 - Use external atmospheric parameters for Intensive analysis (Niko Kareinen, PhD student)
 - Automated analysis of all INT sessions with C5++ (Niko Kareinen)
 - Develop three different INT products (ultra-rapid, rapid, final)
 - Develop combination approach and new analysis approaches (e.g., Kalman filter)
- Results:

- Continue discussion with IERS Rapid Service on the use of UR
- IVS should make available the UR.EOPI files
- Need to prove that we can achieve the same level of accuracy as the rapid service
- Documentation: a report on the Task Force needs to be written

8.2 Publication about IYA super session (Patrick Charlot)

The paper has not been done yet. The work was still ongoing.

8.3 Task Force on Seamless Auxiliary Data (Axel Nothnagel)

Alexander Neidhardt wrote a short note. In August he established a group consisting of Alexander, Jim, Ed, and Jonathan Quick. The activities center on a server being set up at Wettzell, installing the system as an experimental machine. Axel will tell Alexander that at the Shanghai Board meeting already three members were suggested as initial members of the Task Force (i.e., Arthur, John, and Rüdiger).

8.4 Proposal for Working Group on Satellite Observations with VLBI (Rüdiger Haas)

The purpose of the Working Group shall be the study of possibilities to observe Earth satellites with the VLBI ground network affiliated with the IVS. In particular, the development of corresponding observing schedules, the necessary technology at the observing stations, data correlation, and the data analysis shall be promoted. Experts from the various fields, who are able to perform one or more of the different tasks, shall be brought together to enable observations of Earth satellites by VLBI.

Desired outcomes of the WG are memos and other publications concerning the main requirements, the initiation of corresponding test sessions, the validation and possibly provision of an enhancement to VLBI, an improvement of the accuracy of the VLBI–GNSS combination for ITRF and EOP, and gaining first experience with co-location in space.

The final list of members will be decided at the next Board meeting once the candidates have been contacted. The proposal in general is okay, the ToR needed some fine-tuning. The final approval will be done at the next DB meeting.

9. Reports of Action Items of Last DB Meeting (all)

Most action items were already covered in earlier agenda items and completed. For AI-IVS-DB31-04 Axel will send an initial draft chart to Dirk.

10. Marketing, outreach, public relations (all)

The tri-fold was already covered. The VLBI movie done at NASA has been distributed quite a bit. A UN Resolution ‘Global Geodetic Reference Frame’ was under preparation.

Harald reported that Robert Heinkelmann informed him that the IVS input to the ITRF2013 was awaiting assignment of a DOI. When issued, it would be up to the IVS to use the DOI in the reference list of future publications.

The Board agreed on establishing a Task Force for the Recognition of VLBI Elders under the leadership of Axel and Harald. The initial members consist of Axel, Harald, and Chopo.

11. Strategic plan (all)

A strategic discussion at a higher, more general level would be very useful, e.g., at a retreat.

It was difficult to work on the VGOS Analysis Plan, as the requirements were unknown. Harald was given the mandate to gather a group of people to prepare a draft for a ‘Task Force on Updating WG2’ by the next Board meeting. The final version should be ready by the second Board meeting in 2015.

12. Items related to IAG, IAU, WDS, and related VLBI groups

12.1 IAG

12.1.1 Commission 1 and Sub-Commission 1.4, Commission 3 (Harald Schuh)

At the REFAG2014 meeting the ITRF2013 was the main topic. The work was not as good as it could be, because people continued to do it the same way as in the past (only using more data). The ICRF3 is planned to be published in 2018. The corresponding working group was very active; they follow different approaches. This activity looked good.

The IUGG General Assembly will be held in Prague in 2015.

12.1.2 Service Assessment 2014/2015 of the IAG (Harald Schuh)

There was disappointment that several services did not submit their questionnaires on time. They had to be reminded twice. The intention is to get the services onto a more professional level.

12.1.3 Nominations for election of service representatives in Executive Committee (Axel Nothnagel)

There will be elections in spring 2015 for all members of the IAG Executive Committee. Three positions for service representatives are to be filled. Nominations are due by November 3. The Board unanimously agreed on Axel's nomination.

12.1.4 Newsletter contributions (Harald Schuh, Dirk Behrend)

No contributions were submitted.

12.1.5 GGOS (Harald Schuh)

No news since last Board meeting.

12.2 EVGA (Rüdiger Haas)

The 22nd Meeting of the EVGA will be held in Ponta Delgada, Portugal on May 17–21, 2015. The venue is the Teatro Micaelense. The 33rd IVS DB Meeting will be held in conjunction on May 22, 2015.

12.3 Asia-Oceania VLBI Group for Geodesy and Astrometry (Shinobu Kurihara)

After the Shanghai meeting, the ToR were finalized. For the AOV chair, there were two candidates and Jim Lovell was elected as the first AOV chair. The chair nominated the Secretary of the group. Kawabata-san was the AOV Secretary.

12.4 IAU

12.4.1 IAU Division A (Patrick Charlot, Harald Schuh, Chopo Ma) (PPT)

The IAU XXIX General Assembly will be held in Honolulu, Hawaii in the period August 3–14, 2015. Six symposia and 22 focus meetings are planned. The Division A meetings are scheduled for Friday, August 7 and Monday, August 10.

IAU Commission Reform: On June 15, 2014 there was a call for proposals for commissions. By the deadline for Letters of Intent on October 15, 2014, 53 letters were received. There were nine commissions proposed or co-proposed by Division A:

- Astrometry, Rotation of the Earth, Fundamentals, Standards, Time.

- Solar System Ephemerides, Celestial Mechanics and Dynamical Astronomy.
 - Computational Astrophysics, Gravitational Wave Astronomy, Gravitational Lensing.
- Full proposals are due by January 31, 2015.

12.4.2 IERS (Chopo Ma)

The IERS continued its work. The ITRF2013 was the major activity.

12.4.3 ICRF3 (Chopo Ma)

Part of the preparation was the improvement of the data set. VCS-II is under way under the leadership of D. Gordon. Data from other frequencies, e.g. S/X/Ka, will be included. Also data at K-band start to get used. The improvement of the southern hemisphere network changed the character of the southern hemisphere observing. This may reveal systematic effects. Analysis of the data: for ITRF2013 it is a combination of data from different techniques, but for ICRF3 only VLBI data are used.

12.5 EVN (Patrick Charlot)

JIVE will move to a new legal entity (ERIC). The Netherlands, Sweden, the UK, and France have signed to found the new structure. Italy and Spain are expected to join later. The new entity should come into existence in January 2015 and should guarantee more stability. MPI will sign an agreement with the new entity but will not be part of the new structure.

An EVN Symposium was held from October 7–10, 2015 in Cagliari, Italy.

12.6 ICSU World Data System (Dirk Behrend)

There will be a joint meeting of WDS and CODATA: SciDataCon (International Conference on Data Sharing and Integration for Global Sustainability) 2014, <http://www.scidatacon2014.org/>. This will be the first of a new series of joint biennial WDS–CODATA conferences. The meeting will be hosted by the Indian National Science Academy and held in New Delhi, India in the period November 2–5, 2014. On November 2, 2014, a one-day business meeting (WDS Members' Forum) will be held. There will be scientific and plenary sessions. WDS was planning to provide a personalized template for the Activity Report of the non-attending members.

13. Highlights of recent meetings

Harald reported that the Unified Analysis Workshop was attended by John Gipson and Dan MacMillan, among others. A major topic was the scale difference between SLR and VLBI. The

“blue sky” bias in SLR could be a major contributor. John added the contribution of general relativistic corrections.

The AOGS meeting took place in Sapporo. There were several presentations about VLBI. The meeting was well attended with participants mainly coming from Asian countries. The next AOGS will be held in Singapore.

14. Upcoming Meetings

14.1 Discussion and decision on 2015-2 DB meeting (34th) (all)

The plan was to meet in Penticton, Canada. Axel and Bill will fix the meeting date by the end of November. The Board decided to reserve two days for a Retreat at the same venue.

12.2 Other

None.

15. Summary of Action Items

There were six action items resulting from this Board meeting (separate document).

16. Miscellaneous (all)

None.