IVS Newsletter

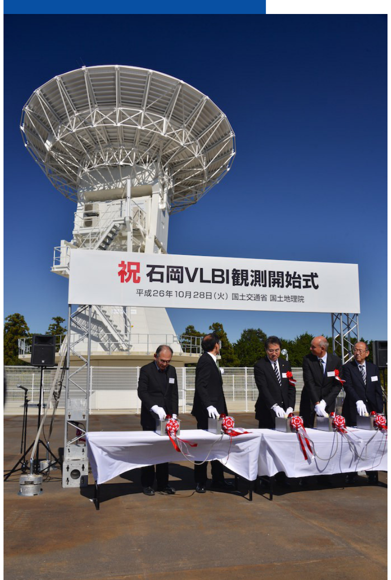
Issue 40, December 2014

Ishioka: GSI Inaugurates First VGOS Telescope in Asia-Oceania

– Shinobu Kurihara, Geospatial Information Authority of Japan

Attendants of the Ishioka inauguration ceremony in front of the new VGOS antenna.

On 28 October 2014, the Ishioka VGOS Station was splendidly inaugurated under clear and sunny skies. The Ishioka VGOS Station is located at the top of a small hill on the ground of the Ibaraki Prefectural Livestock Research Center in Ishioka City, 17 km northeast of the Tsukuba 32-meter antenna. Ishioka City was the provincial capital of the Hitachi Province (Hitachi no Kuni) 1,300 years ago; in the time since, the city was developed as the center of politics, economy, and culture in the region. Also, Ishioka is a place filled with nature such as Lake Kasumigaura to the south and Mt. Tsukuba to the west. The Ishioka telescope was built on very stable bedrock, which continues into Mt. Tsukuba, by the Geospatial Information Authority of Japan (GSI).



Pushing the start button...

The Ishioka telescope was manufactured by MT Mechatronics and has a similar design as the Spanish RAEGE telescopes. It has fast moving Az-El drives with a rate of 12°/s and 6°/s, respectively, and its optics are designed based on a 13.2-meter ring focus reflector. Lightning arresters were also installed to avoid lightning strikes during Japanese summers. The telescope is the first that is fully VGOS-compliant in the Asia-Oceania region. On the south side of the telescope, there are two GNSS stations which are planned to tie with the invariant point of the telescope by co-location surveying.

The ceremony was held with the Mayor of Ishioka City, members of the Ibaraki Prefectural Assembly, the Chair of the Ishioka City Assembly, the IVS Directing Board Members, and many other important constituents from related research institutes in Japan. After the welcome speech by the Director-General of GSI (Mr. Tsuyoshi Koike), the IVS Directing Board Chair (Dr. Axel Nothnagel) and the Ishioka City Mayor (Mr. Fumihiko Imaizumi) gave congratulatory addresses. Then, in order to celebrate the opening of the station and to pray for its future safe operation, a group performed the local traditional music and dance called "Katano Haika Bayashi," which is dedicated to the local Hachiman shrine and has a meaning of expelling various troubles and praying for prosperity.

At the end of the ceremony, the Director-General of GSI, the Ishioka City Mayor, the IVS Directing Board Chair, the Vice-President of the National Astronomical Observatory of Japan (Prof. Hideyuki Kobayashi), and a representative from the University of Tsukuba (Prof. Naomasa Nakai) symbolically started the operation of the telescope by pushing the start buttons. The new telescope immediately slew around with very high speed and a cheer arose from the guests. After the ceremony some guests stood on the pedestal of the telescope and touched the main dish, others went up to the azimuth and elevation cabins and listened to the presentations by GSI staff.

All in all, the inauguration ceremony was very successful. Several newspapers and TV stations reported on the Ishioka telescope and the ceremony, so it became well-known to many people.

After a few more tests and experimental operations, the Ishioka VGOS Station will implement the legacy S/X observation with a tri-band feed horn for two years in order to determine the relative position to the Tsukuba 32-meter telescope. The observing building will be completed by the end of 2015 on the west side of the telescope, and we will make the transition from the legacy observation to the broadband observation.

A traditional 'Katano Haika Bayashi' performance (fox dance) as part of the inauguration ceremony.

IVS Techno Czar Bill

Bill enjoying the outdoors in Garibaldi Provincial Park.

In 2013, William "Bill" Petrachenko took over the reins from the legendary Alan Whitney as the technology czar, also known as the IVS Technology Coordinator. As the lone wolf from Canada, Bill is pushing the envelope of VLBI technology and furthers the development of the VGOS system and network. His tireless efforts and outstanding contributions to the VLBI world are invaluable to the advancement of the IVS. Feature editor Hayo Hase caught up with Bill in his den to get a glimpse of the past, present, and future of VLBI.

Bill, Canada was one of the pioneering countries in VLBI. Can you give us some details?

Yes. Canada, along with the USA, pioneered VLBI. We are particularly proud of the fact that, in April 1967, first fringes ever on a long baseline were achieved between the 46-m Algonquin antenna and the 26-m antenna near Penticton. It was a joint effort of the National Research Council of Canada (NRC), University of Toronto (U of T), Queens University, and the Dominion Radio Astrophysical Observatory (DRAO) in Penticton. I had the privilege to know and work with a number of the original group of Canadian inventors including Norm Broten, Tom Legg, Alan Yen, and John Galt. Of course, each of the groups competing to get first fringes had a slightly different approach. The Americans recorded digitized data on computer tapes, while the Canadians recorded analog data on video tape. The Canadian approach had the advantage of a much wider bandwidth, but it suffered from being difficult to automate. Even when I first started, the data streams were synchronized by counting seconds onto the audio track of the tapes and then, during playback, starting and stopping the tape machines manually until the recovered audios were aligned.

It is a less well known fact that Canada also had a very early first application of VLBI to geodesy. In February 1968, Harold Jones of the Geodetic Survey of Canada recorded VLBI data on the 2,143 km baseline between the Algonquin antenna and a 26-m antenna at Prince Albert, Saskatchewan. His geodetic analysis was presented in the Canadian Surveyor in 1969.

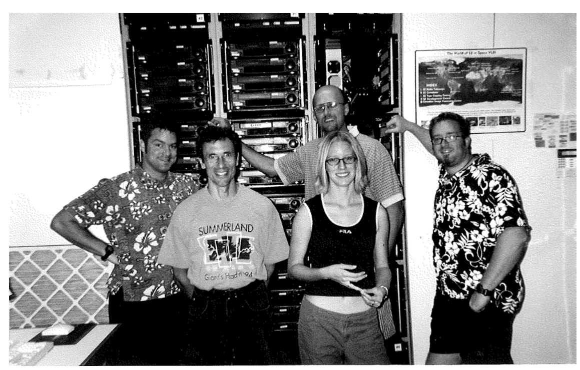
We have known you for many years as one of the "brains" of VLBI. How did you get in touch with VLBI? Who taught you?

My first contact with VLBI came in the spring of 1973. I was walking through the halls of the Physics Department at York University in Toronto looking for a professor to supervise my M.Sc. studies. Eventually I knocked at the office of Wayne Cannon who enthusiastically explained the basics of VLBI, described some of its exciting applications, and didn't forget to mention that I could travel the world hanging tapes at VLBI antennas. It didn't take long for me to decide that VLBI and I would have a future together. I completed my M.Sc. in 1976; worked for a year prospecting for Uranium in the Canadian Arctic; returned to York University from 1977–1982 for a Ph.D.; took up a post-doctoral fellowship under Joe Popelar at Energy, Mines and Resources (EMR); and then spent three happy years at Haystack Observatory working on the design of the VLBA data recorder. Finally, in 1987, I was hired by NRCan to help get the Algonquin antenna operational for regular geodetic observing and to develop an independent VLBI capability in Canada. I have been at NRCan ever since.

What were the important technical questions at the time? What solutions were found?

When I first got involved in VLBI, most geodetic VLBI was done using the U.S. Mark-I system. What was needed most at the time to improve results was a system with wider bandwidth and better delay accountability. The solution was the Mark-III system, which increased the bandwidth from 370 kHz to 56 MHz and introduced the use of parallel tracks and a phase calibration system.

On the other hand, in Canada, all we had when I started was a collaborative effort with the astronomers at NRC in which we simply received their data and did a geodetic analysis. Because the data was intended for astronomy, neither the observing system nor the schedules were optimized for geodesy. So our highest priority tasks were to run our own schedules, which of course included a lot more source switching, and to also introduce a rudimentary form of bandwidth synthesis. The Canadian geodetic program didn't however fully get off the ground in a competitive way until we began the development of the S2 system.



The Canadian correlator group in front of the S2 playback units.

Later on several institutions developed the Canadian S2 system. Can you summarize some of its technical characteristics and features? Did you participate in its development?

The development of the Canadian S2 system was a large collaborative effort including NRC, NRCan, DRAO, U of T, the Space Geodynamics Lab (SGL) at York University, and the Canadian Space Agency (CSA). The final catalyst for its development was a significant infusion of funding from the CSA to support the Russian and Japanese orbiting VLBI projects RadioAstron and VSOP.

Given that Canada is a large country but with a modest population base, the goal of the S2 program was to develop a system that was simultaneously cost effective, high performing, and operationally efficient. Costs were kept low mainly by using a frequency switched local oscillator to achieve state-of-the-art bandwidth synthesis and by using a record system based on inexpensive commercial VHS recorders. In terms of performance, its spanned and recorded bandwidths were competitive with the best systems of the era, while its ability to detect all pcal tones in each band minimized the impact of corrupt tones. In terms of operations, a thorough suite of test signals (both analog and digital) along with real-time pcal detection made it possible in mere minutes to automatically and remotely test and troubleshoot the entire system. Finally, because we had a reasonably small team, processes were put in place to operate our sites remotely and with minimal human intervention.

Personally I had a number of functions in the development of the S2 system. In a general sense, it was my responsibility to ensure that the system was well suited to the requirements of the Canadian geodetic VLBI program. In a more specific and hands-on sense, I was responsible for the correlator model and for developing the fringing, data quality analysis, and visualization software. At the same time I was the principle designer of the data acquisition system and did the detailed design of all its subsystems.

The video-tape-based recording was an economic solution for recording at high bandwidth. At which observatories and correlators was this VLBI system used?

Eventually a total of seven S2 systems were deployed. They were at Algonquin, Yellowknife, St John's, Fairbanks, Kokee Park, TIGO, and Svetloe. The only S2 correlator used for geodesy was the one at DRAO.

How did the successful geodetic VLBI program in Canada come to an end? What happened to the Canadian VLBI group?

The federal budget of 2006 ordered the cessation of operations of the Canadian geodetic VLBI program. Other than Steve Farley, who has retired, everyone else has remained at NRcan. Mario Bérubé and Toni Searle are still in the Canadian Geodetic Survey; Jacques Lafrance is in the Cadastral Services Division; and Sylvain Brazeau is in the Earth Observation and Geosolutions Division.

Your experience in all aspects of VLBI inspired you to promote the modernization of the global VLBI system. First called "VLBI2010" the new system is now known as the "VLBI Global Observing System" or VGOS for short. You have been the driving force for "broadband" VLBI observations. Can you summarize briefly the advantages of the new VGOS system over the legacy S/X system?

Final check-out of the S2 data acquisition systems just prior to getting first fringes between Algonquin and CTVA.

I first started talking about a new vision for geodetic VLBI in a talk I gave at the 2nd IVS General Meeting in Tsukuba in 2002. A year or so later, the IVS accepted the VLBI2010 challenge and we began to seriously investigate ways to achieve a completely new level of performance. The first step was to use Monte Carlo simulators to look for strategies that might significantly improve our results. After two years of effort it became clear that the most effective tactic would be to greatly increase the number of observations per session at each station. To achieve this we would need antennas that could slew quickly from source to source and at the same time a means of achieving a high level of delay precision. So the need for short integrations was the motivation for the broadband approach. The idea was that instead of synthesizing a 720 MHz bandwidth like at X-band we would connect the phase all the way from 2 to 14 GHz and hence increase the spanned bandwidth by a factor of about 16 to 12 GHz. That way we could significantly reduce our SNR targets.

The broadband approach was not the only approach being considered however. In addition to our efforts to realize rapid source switching we were also aware that careful attention needed to be given to systematic affects such instrumental biases, antenna deformations, and source structure. Chris Jacobs, who was developing an X/Ka-band CRF to support spacecraft tracking at JPL, made a strong pitch that X/Ka-band would be a better fit for VLBI2010. It had the benefit of reduced source structure and at the same time the wider fractional bandwidths at Ka-band could also be effective for reducing on-source integrations. In 2009, a meeting was held at Wettzell to make a final decision on the frequency structure for VLBI2010. It was recognized that both approaches had benefits and risks. For the broadband approach, RFI (especially at S-band) and source structure were the most significant worries and for X/Ka the concern was primarily related to atmosphere attenuation. In the end the deciding factor for broadband was that its frequency band overlapped the legacy S/X bands so that strong ties could be established between the new VGOS and the legacy S/X networks. Ironically, it was at this meeting that most of us first became aware of the tri-band S/X/Ka-band feeds that would also have solved the network tie issue.

Feature

So, in the end, I am a strong supporter of the broadband approach mainly because it was the decision we made in 2009. We simply don't have the resources to develop and deploy two systems at each site. In my heart, I am convinced that we will make the broadband approach work (although there may be challenges at some stations that have particularly bad RFI). At the same time, I am reassured to know that the S/X/Ka-band approach is being developed as a viable fallback and perhaps in the longer run as an effective means of reducing biases related to variable source structure.

How do you judge the current global activities towards the realization of a global VGOS infrastructure?

On the one hand, I am amazed by the enthusiasm and resources that have been dedicated to building new antennas. This has gone well beyond my most optimistic expectations, though our network is still challenged in the southern hemisphere. The situation has recently improved significantly with the news that funding has been found to upgrade two or three of the AuScope antennas to broadband capability. All the same the addition of one or two antennas in South America and perhaps in Tahiti would be welcome news indeed.

Playing the bass guitar.

At the same time, development of the signal chain is nearly complete with two fully functioning systems at Westford and GGAO. Right now I am doing an assessment of resources and configurations at available stations to see what is required to get networks up and ready for the VGOS test campaigns in 2015 and in the longer term for the VGOS pilot project in 2016.

Do you feel some personal satisfaction with the progress of the many activities for VGOS?

I'm pleased to see the systems nearing completion and I'm gratified to see that many of the early concepts are coming into reality. At the same time I'm wringing my hands with a bit of worry (and excitement) to find out what challenges will be faced when we start collecting data on a more regular basis and with a larger number of stations. For the long term, I'm waiting with eager anticipation for the day when we finally show that VGOS will approach 24/7 operations and millimeter station positions.

Your professional career will someday come to an end. What would you like to see happening before?

Sure, I'd love to be around when a 30-station VGOS network is operating every day at the millimeter level. Unfortunately, I can't see that happening before I retire. On a smaller scale though, I'd like to get my hands dirty (in the design sense) one more time and extend the RDBE FPGA personality to operate at 1-GHz bandwidth and to include a really strong set of data quality analysis features. On a slightly larger scale, I'd like to come up with a compatibility mode which allows legacy S/X-band antennas, S/X/Ka tri-band antennas, and broadband antennas to operate together at a high enough level that a really large network can operate in a unified manner—at least occasionally. Finally, I'd like to be part of the team coordinating VGOS efforts at least until VGOS successfully enters the pilot project phase planned for 2016.

Bill during a Test of Humanity mountain bike race in support of Canadian Humanitarian projects.

You have been very influential in many technical discussions. Did you ever think about writing a book on the method of VLBI and its technical realizations?

It sounds like a great idea and probably someone should do it, but not me. Writing a good and useful book requires a lot of thankless work and for me there are too many other things I'd rather be doing.

We know you as an active mountain climber and ski racer. What do you wish for your future? And what will you do after retirement?

Well, I'm not sure I've ever been a true "mountain" climber or ski "racer", but I'd love to do a lot more rock-climbing (on smaller cliffs), mountain biking, and skiing. If you're not aware, the opportunities for doing these activities are fantastic in the areas near Penticton. I also play the bass guitar in a number of bands—anything from rock to blues to jazz—and I'd like to do more of that. Of course I'd like to spend more time with family and friends; and as for my girlfriend, who lives on the other side of the continent in Ottawa, it'd be great to finally live in the same place with her. All in all, there's a lot to look forward to. And you never know, I might find the time to stay at least a bit involved with VLBI!

Thank you very much for this interview. The Newsletter editors hope that your wishes will come true and that you will be able to keep on supporting the IVS work.

Rock climbing at Skaha Bluffs south of Penticton.

A New 12-m Antenna for Kokee Park

– *Brian Luzum, U.S. Naval Observatory*

The 20-m Kokee Park Geophysical Observatory (KPGO) VLBI antenna on the Hawaiian island of Kauai continues to make a significant contribution to the IVS, participating in R1, R4, Celestial Reference Frame (CRF), Research and Development (R&D), Asian-Pacific space geodynamics (APSG), and Intensive sessions. However, the 20-m antenna is over 20 years old and is due for a technology refresh. In order to continue to take advantage of KPGO's beneficial location and its contribution to VLBI, the U.S. Naval Observatory (USNO) has committed to procuring a new antenna.

In 2013, USNO contracted with InterTronic Solutions to construct a new 12-m VLBI2010-compliant antenna. InterTronic Solutions has successfully completed the preliminary design review and the critical design review. Currently, the project is on schedule to complete the factory acceptance and site acceptance tests by the middle of 2015.

Artist's rendition of the new 12-m antenna at Kokee Park (courtesy of InterTronic Solutions).

In addition to the new antenna hardware, USNO has been working with the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) and its contractors to prepare the site for the new antenna. The location for the new antenna has been selected and preparations are underway to design the foundation and provide the electrical and communication support. The site is expected to be ready by summer 2015.

The antenna will also require a new signal chain. GSFC is working with the Massachusetts Institute of Technology (MIT) Haystack Observatory to design and build a broadband receiver that is capable of making VLBI2010-compliant observations. The development of the new receiver is already well underway. A system's requirement review for the KPGO VLBI system is scheduled for early December 2014. The signal chain is expected to be completed by the middle to end of 2015.

Once the individual components of the VLBI system are developed, they will need to be integrated. The verification and validation of the new integrated system is expected to take a few months. The initial operating capability (IOC) is expected by early 2016 and final operating capability (FOC) is expected by the end of 2016.

USNO continues to provide resources to support the next generation of VLBI observations. The new Washington DiFX correlator is approaching FOC and should support operations for years to come. It already is the sole correlator used for the 24-hour R4 and Intensive sessions correlated at USNO and is approaching its final operational configuration. The new 12-m antenna, when complete, should support the VLBI observations that provide the requisite celestial reference frame and Earth orientation parameters needed for USNO's operational users.

The IVS Newsletter is published three times annually, in April, August, and December. Contributed articles, pictures, cartoons, and feedback are welcome at any time.

Please send contributions to
ivs-news@ivscc.gsfc.nasa.gov.
The editors reserve the right to edit contributions. The deadline for contributions is one month before the publication date.

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The newsletter is published in color with live links on the IVS web site at

http://ivscc.gsfc.nasa.gov/.

Upcoming Meetings...

AGU Fall Meeting
San Francisco, CA, USA
December 15-19, 2014

EGU General Assembly 2015
Vienna, Austria
April 12-17, 2015

Eighth IVS TOW
Westford, MA, USA
May 4-7, 2015

22nd EVGA Working Meeting
Ponta Delgada, Azores, Portugal
May 17-21, 2015

IUGG XXVI General Assembly
Prague, Czech Republic
June 22 - July 2, 2015

XXIXth IAU General Assembly
Honolulu, HI, USA
August 3-14, 2015

http://ivscc.gsfc.nasa.gov/meetings

REFAG 2014: Reference Frames for Applications in Geosciences

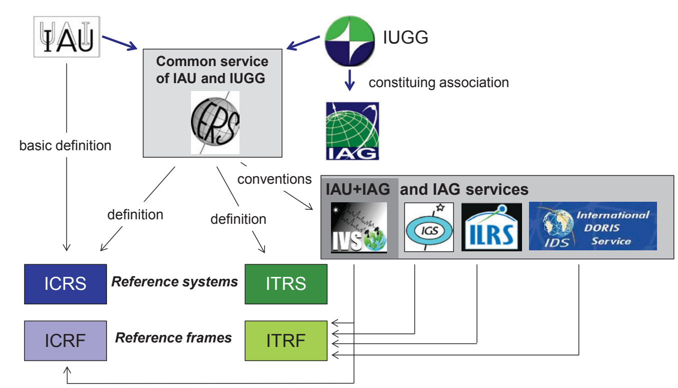
– Johannes Böhm, TU Vienna

View of the Grund in the old town of Luxembourg.

Approximately 100 geodesists from 24 countries took part in the Commission 1 Symposium of the International Association of Geodesy (IAG) "Reference Frames for Applications in Geosciences (REFAG)" in Luxembourg from 13 to 17 October 2014. Tonie van Dam, professor at the University of Luxembourg and President of IAG Commission 1, together with her team perfectly organized the meeting, which took place in the Melia Hotel in Kirchberg, Luxembourg. Developers of reference frames gathered with users to discuss the realization and application of reference frames. The program was divided into six sessions, which focused on theory and concepts, geodetic measurement techniques, regional reference frames, celestial-to-terrestrial frame transformations, usage and applications of reference frames in geosciences, and geo-referencing in practice. It was a very interesting and successful meeting, and the following summary will have its focus on VLBI-related topics at the symposium.

In the first session, Zuheir Altamimi (IGN) summarized the status of the International Terrestrial Reference Frame 2013 (ITRF2013) and informed the audience that he is still waiting for the majority of the solutions from the combination centers of the individual techniques. In the second session, Sabine Bachmann (BKG) provided more information about the IVS combination and the corresponding contribution to the ITRF2013. Sabine reported that ten analysis centers provided solutions with five different software packages for the combination that will be made available for the combination with the other techniques within the next weeks. Other oral and poster presentations in that session were devoted to the combination of VLBI and GNSS observations with c5++ by Thomas Hobiger (Chalmers University of Technology), an update on the GRASP mission by Yoaz Bar-Sever (JPL), and refined tropospheric delay models.

The next session dealt with the transformation between the terrestrial and the celestial reference frames, i.e., with Earth orientation parameters and the consistency between these frames. For example, Robert Heinkelmann (GFZ) gave a presentation about issues related to the consistency and Manuela Seitz (DGFI) together with Axel Nothnagel (Bonn University) presented new results on the combination of VLBI with GNSS observations for the determination of celestial reference frames. They revealed a significant impact of the combination on the positions of sources observed in single VLBA Calibrator Survey (VCS) sessions. Hana Krásná (TU Vienna) confirmed the findings in VLBI-only solutions and discussed mitigation strategies for the VCS source positions. A significant part of the session was devoted to the next realization of the celestial reference frame, the ICRF-3. Chris Jacobs (JPL) presented the progress and plans of the Working Group (WG) of the International Astronomical Union (IAU) which is in charge of setting up the ICRF-3. New features of the ICRF-3 also comprise sources observed at new frequencies in addition to the standard X- and S-band observations. Axel Nothnagel drew the attention to proper combination strategies when combining the different frames. Stas Shabala (University of Tasmania) presented new results on the impact of source structure on the terrestrial reference frame and he came up with new ideas about improved scheduling strategies. It should also be mentioned that an ICRF-3 WG meeting took place on Tuesday evening at the University of Luxembourg.



Infrastructure for the realization of the ICRS and ITRS (from Seitz and Nothnagel).

A poster presentation by Lucia Plank (University of Tasmania) in the session on regional reference frames reported about the status of the Australian VLBI network and observations. Of course, there were also many other interesting presentations on theory and application of reference frames. The complete program with abstracts and presentation files for download can be accessed at the meeting Web site http://iag.uni.lu/?id=189. Finally, I would also like to mention here that we had a great conference dinner in the old town of Luxembourg on Wednesday evening.

The Station Performance Feedback Loop

– *Rich Strand, NVI, Inc.*

Staff at the IVS stations have a number of tools at their disposal to assist them in providing the geodetic community with high-quality, high-yield interferometer data. One of these tools is a comprehensive and complete feedback program accessible through the IVS Web site. The process always begins with the observers at the stations and completes when the stations' performance is reported back to them ("feedback loop"). This article discusses "How To" access the feedback information to maintain, or to improve, the high level of data quality.

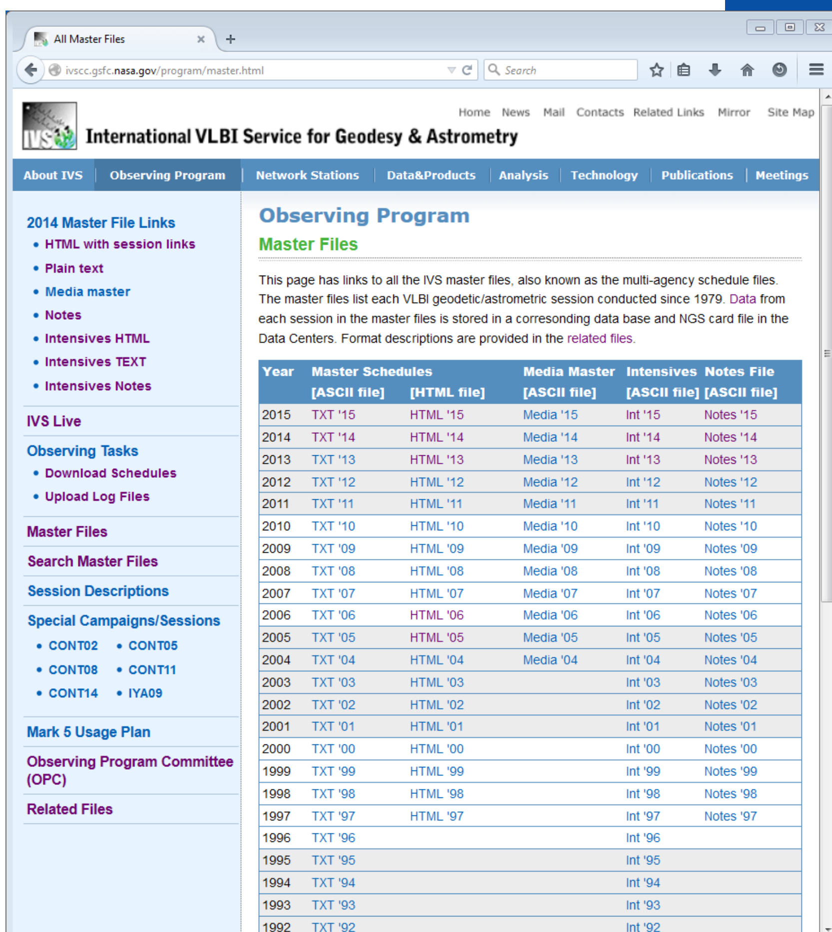
Some years ago there was a request by the station staff for more or better feedback from the correlator and analysis teams. Improved feedback would allow correction and repair of problems that would otherwise not easily be detected by the station pre-checks or that are chronic but are compensated for in the station design and acquisition techniques. The reporting back gradually went from simple feedback reports (to individual stations on request) to the creation of an entire archive system that is in place today. The current archive system provides each station with a complete history of its parameters, data loss, and overall performance. As the VLBI technique veers toward near real-time observing, it becomes ever more important that stations track their performance within the IVS observing program.

The following discussion is based on the Master File for 2014. The IVS Web site provides a list of all Master Files at the URL http://ivscc.gsfc.nasa.gov/program/master.html; clicking on «HMTL '14» will lead you to the Master File for 2014. Alternatively, you can click your way to the Master File of the current year (here: 2014) from the IVS homepage by following the links to «Observing Program» and then «HTML with session links». The Master Schedule shows each IVS observing session of the calendar year. For example, clicking on R4618 brings up the R4 session #618 with data acquisition summaries for each station: log files, comments, Tsys information, and so on. For verifying station sanity the Recorder Checks are of high importance, as they allow to quick check if the recorder worked properly.

The «Correlator summary» in the Correlation box displays the percentage of scans that were processed and, more importantly, the percentage that were not used. It becomes very obvious that one station with a problem will impact this total for other stations as well. This report's real value is that it provides each station with the reason the correlator may have had a problem with the data such as lost channels or operator errors. If you scroll down to +QCODES, you will find a chart of baselines between the stations of the session with a fringe quality code between 0 and 9. A code of 0 indicates that no fringes were detected and 9 is the best quality.

The analysis report can be found by going to «Analysis comments» in the Analysis box. This report gives you the session fit for all stations in picoseconds as well as the Station Performance chart, which at a glance will indicate a station that had a problem while observing. The «SNR summary file» provides an SEFD chart (scroll down) with scheduled and observed SEFD values for each station for this session. It is valuable to review these values as it may indicate loss of sensitivity over time.

So what does all this mean? Go back to the «Session R4618» page and click on «Station performance for 2014» in the Performance box. For each station there is a «matrix» entry, which is a link to a compilation of the station's performance history for 2014 on a session-by-session basis; columns 5 through 11 are of particular interest. This compilation can be used as a good data quality benchmark for maintaining or improving station performance.



Year	Master Schedules [ASCII file]	[HTML file]	Media Master [ASCII file]	Intensives [ASCII file]	Notes File [ASCII file]
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2014	TXT '14	HTML '14	Media '14	Int '14	Notes '14
2013	TXT '13	HTML '13	Media '13	Int '13	Notes '13
2012	TXT '12	HTML '12	Media '12	Int '12	Notes '12
2011	TXT '11	HTML '11	Media '11	Int '11	Notes '11
2010	TXT '10	HTML '10	Media '10	Int '10	Notes '10
2009	TXT '09	HTML '09	Media '09	Int '09	Notes '09
2008	TXT '08	HTML '08	Media '08	Int '08	Notes '08
2007	TXT '07	HTML '07	Media '07	Int '07	Notes '07
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1996	TXT '96			Int '96	
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1994	TXT '94			Int '94	
1993	TXT '93			Int '93	
1992	TXT '92			Int '92	

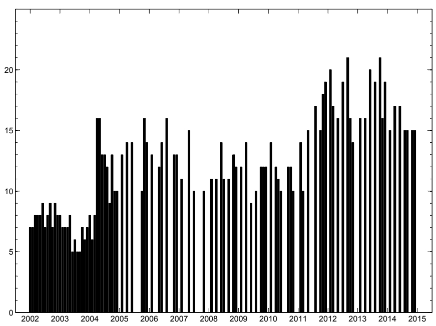
The list of Master Files on the IVS Web site.

NEWS...

T2 Sessions Reach Century Mark

– Arno Müskens and Axel Nothnagel, University of Bonn

On November 11, 2014, the IVS observed the 100th session of the T2 series. This is a noteworthy event and a good moment to look back at the history of this observing series.



Number of stations participating in the T2 sessions since 2002.

The T2 sessions were devised in 2001 when the IVS established its new scheme of observing sessions, most notably the R1 and R4 sessions for rapid turn-around Earth orientation parameter (EOP) determination. Unlike the rapid sessions, the T2 sessions, which are always observed starting on a Tuesday, are not time critical but constitute an essential part of the terrestrial reference frame determination within the IVS observing activities. It was conceived that all telescopes available for high-accuracy geodetic and astrometric measurements should be included at least once per year in these sessions. The first T2 session was observed on January 29, 2002, with seven stations; this was followed by another eleven sessions in 2002 with eight to nine telescopes participating. By adding different stations to a set of kept core stations a total of 27 different telescopes could be included in this single observing year.

From the very first session, the VLBI group of the Institute of Geodesy and Geoinformation, University of Bonn in Germany was in charge of scheduling and correlating the T2 sessions; only for capacity reasons were some of the sessions correlated at the Haystack Correlator. For the first three years, the operational mode of twelve sessions per year with seven to nine telescopes was retained due to limited correlator capacity. In subsequent years, the philosophy of the project gradually changed to fewer sessions but larger networks. With the advent of the more powerful software correlator in 2010, the Master Schedule could include seven T2 sessions per year with network sizes from 15 to 21 stations.

With that many telescopes, the T2 sessions are really global sessions often covering all corners of the world. Scheduling these sessions is tricky, because common visibility issues complicate the optimization process. However, given the large number of participating stations with a truly global distribution, the T2 sessions not only significantly contribute to the improvement of the terrestrial reference frame but also provide some of the best EOP results. Here's to T2!

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