

IVS Newsletter

Issue 23, April 2009



The IVS Gathers on the Island of Inspiration

– Dirk Behrend, NVI Inc./GSFC and John Dickey, University of Tasmania

The 6th IVS General Meeting (GM2010) will be hosted by the University of Tasmania, School of Mathematics and Physics in Hobart, Tasmania, Australia. Including splinter meetings, the GM2010 is anticipated to last the full second week of February 2010 (February 7–14, 2010). The additional meetings encompass an Analysis Workshop, a Directing Board meeting, and meetings of the VLBI2010 Committee and the Working Group 4 on VLBI Data Structures.

and related fields are encouraged to attend the meeting and to make an oral or poster presentation. Non-IVS members are cordially invited to attend the meeting and to make a presentation.

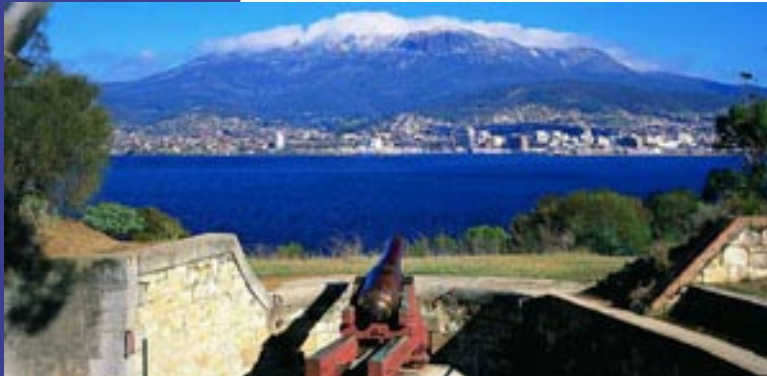
The meeting will include a visit to the Mount Pleasant Observatory, which is located 20 km east of Hobart. The Hobart 26m telescope has been participating in geodetic VLBI observations since the early 1990s; it is currently Australia's only antenna regularly contributing to the IVS program. We anticipate that by the time of the meeting we can study one of the southern hemisphere's first VLBI2010-type antennas in operation (in S/X mode).

We hope that the beautiful setting on the southeastern shore of Tasmania at the foothills of Mount Wellington will be an inspiration for many fruitful discussions. Not without reason is Tasmania nicknamed the Island of Inspiration. And, while down under in the deep south, schedule a week or two to take advantage of the 18 National Parks, which protect the largest area of temperate rainforest remaining on earth, a World Heritage Area. A popular eight-day hike is the Overland Track, through the rugged western mountains, but there are plenty of shorter walks with spectacular views of the Southern Ocean. Tasmania is home to the world's largest carnivorous marsupial, the Tasmanian Devil, and many other unique species of animals and plants, including some of the largest trees in the world, the Eucalyptus Regnans. A couple of photos from the tourist bureau are included here, and for more artistic images see professional photographers' galleries like :

<http://www.robbklakers.com/> and

<http://www.ianwallace.com.au/>

Come and enjoy "Your Natural State".



(above) Hobart seen from a historic fort at the mouth of the River Derwent; (below) Russell Falls, Mount Field National Park.



Hobart is the capital city of Tasmania, an island state in the far south of Australia. Tassie, as the island is known to the Aussies, is roughly 240 km south from the state of Victoria across the Bass Strait. With a population of about a quarter million and thus half of Tasmania's inhabitants, Hobart is Australia's most southern city. At a latitude of 43°S, Hobart has a cool temperate, maritime climate with four distinct seasons. The GM2010 will take place during the last month of summer when temperatures average at around 21°C. Surprisingly, Hobart is Australia's second-driest capital. But bear in mind that Tasmania is located in the 'Roaring Forties'. Coincident with the meeting will be the three-day event of the Royal Hobart Regatta, which will take place on the Derwent River from February 6–8, 2010.

The content of the general meeting will be of interest to the broad spectrum of IVS members as well as to the wider VLBI and Earth science communities. All IVS Members and individuals who have interests in the various applications and research fields of VLBI such as geodesy, astrometry, Earth sciences,



The Mt. Pleasant 26-m antenna.

Permanent Component

MIT Haystack Observatory, Westford, MA , USA

MIT Haystack Observatory has been a hub in developing VLBI technology for about 40 years and operates the Westford antenna and a Mark IV correlator. An analysis center rounds out the VLBI activities. Haystack is located in Massachusetts about 35 miles north-west of Boston close to the border with New Hampshire. Newsletter Editor Hayo Hase e-interviewed IVS Technology Coordinator Alan Whitney in order to get an insight into the current activities at Haystack, to learn about the rich VLBI history, and what is planned for the future.



Alan, when did Haystack Observatory start to get involved in VLBI? When did you come into contact with VLBI?



Haystack collaborated with NRAO for the first VLBI experiment in July 1967 using the 37-m (120-ft) Haystack telescope and the 43-m (140-ft) antenna in Green Bank, WV. I was looking for a thesis topic in the fall of 1967 when I made contact with Prof.

Haystack Observatory.

Irwin Shapiro at MIT, who had already recognized the potential of VLBI for doing high-precision geodesy. He invited me to join the VLBI effort, and the first switched-frequency group-delay VLBI experiment (a concept first suggested by Alan Rogers) took place between Haystack and Onsala in April 1968; it was a modest effort by today's standards, observing a 50-MHz band around 1660 MHz on a Mark 1 recording system. The results were several-meter level, which were very impressive at the time.

In your long career devoted to VLBI what were the most challenging situations or moments that you recall?

There were certainly many challenging situations, but one that stands out in my mind was in the early days when the only way to adequately synchronize clocks was to carry a rubidium or cesium atomic clock in the seat next to you on an airplane. 'Atomic clocks' always raised eyebrows at check-in! They were heavy and bulky, and there was always a mad rush to find an outlet to recharge the batteries at the end of every flight! We had several close calls, but usually made it to the destination with clock intact! These days GPS makes the job much easier!

Haystack is synonymous with the development of hardware technology for VLBI. Can you summarize the major VLBI products that Haystack was responsible for?

It is a long list in the period of over 40 years that Haystack has been involved in VLBI. Some of the ones that come to mind: 1) phase-calibration and cable-calibration technology, the basic principles of which are still in use today, 2) several generations of tape-based VLBI data-acquisition systems, including Mark 3, Mark 3A, VLBA, Mark 4, and then the transition to disk systems, including the Mark 5A, Mark 5B and Mark 5B+, 3) at least four generations of correlators including the very first hardware correlator, the Mark 3 and Mark 3A correlators, and finally the Mark 4 correlator, for which we designed our one and only full-custom ASIC chip! The data rate of the Mark 1 system was 720 kbps, almost laughably small compared to today's multi-Gbps systems (the Mark 5C will be 4 Gbps). It is important to note the critical role that NASA has played in the support and development of geodetic VLBI since 1969; Haystack's role as a technology center for VLBI development would not have been possible without NASA's generous and continuous support over these 40 years!

In your experience, what are the conditions under which the development of new technological equipment will be successful?

First, it must fill a need that leads to improved results or improved operations. And, secondly, it must be available to the community, either as a direct purchase or with sufficient information that people can build their own.

In March, the IVS celebrated ten years of its existence. From the beginning you have served as the IVS Technology Coordinator. What importance does the IVS play for Haystack Observatory?

The existence of IVS is, in my opinion, crucial to the existence of a global geodetic network, of which Haystack Observatory is a part. Without IVS, Haystack would be rather like an arm without a body attached!

Over the years you have been instrumental in helping to set global VLBI standards. In your opinion, where does this activity fit into the priority list of things to do?

Given the nature of VLBI and the need for successful observations using heterogeneous equipment, standardization critical to global VLBI success and smooth operation. I first became active in this area in the 1980s when I proposed the SNAP (Simple Notation for Antenna Procedures) control/query protocol, which has been used for many years by the Field System. In 1992, I proposed the VEX (VLBI EXperiment) description as a standardized method of specifying VLBI experiment configurations and observing schedules, which is now also widely used in both the geodetic and astronomy VLBI communities. In 1999, IVS supported the formation of a committee, which I chaired, to specify standardized hardware and software interfaces to VLBI data systems, resulting in the VSI-H and VSI-S standards in 2001, the VSI-H standard received the "Radio Day" award from the Japanese Ministry of Public Management, Home Af-

fairs, Posts and Telecommunications. There has been recent agreement on a standardized VLBI data format called 'VDIF' (VLBI Data Interchange Format) that should help smooth the international exchange of VLBI data.

How do you value developments done at other IVS Technology Development Centers?

Developments from other technical development centers are always welcome and encouraged. There is much talent in the global VLBI community, and it should always be exploited for the maximum possible value.

Haystack Observatory traditionally is the host of the IVS Technical Operations Workshop (TOW). It is a very important event used for training and informing the station operators. The next TOW will take place at the end of April 2009. How important is this event, also in view of your staff getting in touch with the people dealing with technical problems at the stations on a day-to-day basis? What do you learn from the participants?

VLBI is, by its nature, a very complicated technical undertaking. And because much of the VLBI equipment used in the field has been developed at Haystack, we are often called on to help with technical problems in the field. Not only is it important that station operators be trained to properly operate the VLBI equipment, but it is in Haystack's self-interest to minimize the amount of direct technical support that we must provide. We learn from TOW participants that they enjoy learning more about VLBI and the equipment that supports it, plus a certain feeling of empowerment that ultimately results in better data being collected.

The Westford radio telescope, as part of MIT Haystack Observatory, is noted for its long baseline length time series with Wettzell, which is probably the most observed baseline of the IVS. In which IVS observation series do you participate?

Westford participates in the R1 and R&D sessions, as well as test sessions for VLBI2010 development. The R1 sessions provide weekly measurements of Earth Orientation parameters such as UT1-UTC, as well as accurate measurements of station positions for improving the terrestrial reference frame. The R&D sessions are aimed at evaluating new observing techniques and equipment, and for special tests. The VLBI2010 observations help to test new equipment that has been developed for the next-generation geodetic VLBI network.

Speaking of VLBI2010 proof-of-concept tests, what is your opinion about the VLBI2010 efforts? The VLBI2010 effort is, in my opinion, critical to the continued vitality of geodetic VLBI. If the



goal of mm-level global accuracy can be achieved, many new questions and science objectives can be addressed. Even though older systems may not be able to meet all of the specifications of the VLBI2010, such as antenna slew speeds, upgrading to modern broadband systems will significantly improve their performance and contribution to the observing networks.

How do you see the future of IVS and geodetic VLBI in general? What are its strength and weaknesses?

IVS's strength is derived from the strength, talent and co-operation of the people and institutions that form the organization. Without IVS, international geodetic VLBI could not run smoothly. IVS's weakness is that, like most such organizations, it has no budget of its own, and certainly no command or budget authority over its members, who must individually raise their own money. The 10-year success of IVS shows, however, that IVS's strengths are considerably greater than its weaknesses.

I know that your passion is to build and play musical instruments. The day you will have more time for yourself, what do you like to do?

I have been a violinist for more than 50 years (as has my wife Lois, who I met through music), and in recent years have become interested in violin building and maintenance, attending several summer violin workshops at the University of New Hampshire. The violin is a very high-precision instrument, and I take pleasure in the precision handwork and details needed to work with these instruments. It is a fantasy that I might open a small violin business after my retirement. It should be noted, however, that my daughter is a professional violinist who owns a fine violin, and she won't let me anywhere near it!



(above) Haystack Observatory VLBI group; (left) Radome enclosed Westford antenna at night.

FRFF and V2C – The Höllenstein VLBI2010 Workshops

– *Bill Petrachenko, NRCAN*

Höllenstein is a tiny village nestled in the picturesque hills, woods, and farms of the remote southeast region of Germany known as the Bavarian Forest. During the period March 18–21, 2009, the normally tranquil village was transformed into the center of vigorous and fruitful activity revolving around technical recommendations for the IVS VLBI2010 project. Höllenstein was chosen as the location for the meeting due to its nearness to the Geodetic Observatory Wettzell, one of the fundamental stations in the geodetic network operated by Bundesamt für Kartographie und Geodäsie (BKG) and the Forschungseinrichtung Satellitengeodäsie (FESG) of TU Munich. Wettzell is now defining the state-of-the-art for VLBI2010 antennas with its Twin Telescope Wettzell (TTW) project. Because of that, the workshops were quite important for the planning of the construction phase of this project.



In total 65 participants from all over the world could be welcomed at Höllenstein's Landhotel Mietbaner to discuss VLBI2010.

The event was split into two sections, the “VLBI2010 Workshop on Future Radio Frequencies and Feeds (FRFF)” on March 18–20 and the “V2C Workshop on Digital Back Ends (DBEs) and Software Correlators” on March 21. The purpose of the FRFF meeting was to make recommendations to the IVS Directing Board for frequencies and feeds for VLBI2010, and the purpose of the V2C meeting was to explore definitions and organizational synergies for the digital signal processing aspects of VLBI2010. [For more information see <http://www.wettzell.ifag.de/veranstaltungen/vlbi/frff2009/frff2009.html>.]

In total, 65 experts from 12 countries attended the meetings. Because of the wide range of expertise represented, each session was started by a tutorial introducing the fundamentals of the topic to be discussed. The remainder of the time was dedicated to more-focused contributed talks and discussion with questions and comments interspersed throughout.

The FRFF workshop was organized in eight sessions and included a large number of interesting presentations on a wide range of relevant topics. Thanks to the Program Committee (Dirk Behrend, Brian Corey, Hayo Hase, and Bill Petrachenko) and the contributing and invited speakers for making this all happen. At the heart of the meeting were presentations on the innovative feed designs required to address the VLBI2010 frequency requirements. In this regard, several broadband feed designs were presented; the most advanced being the one under development at Chalmers University of Technology in Sweden by Per-Simon Kildal and his group. A working model of the feed was on display at the meeting along with relevant test results. Although significant work remains to broaden the frequency range, test the feed under cryogenic conditions, and interface it to LNAs, the workshop attendees felt confident enough in the progress to date to make the following recommendations:

- The initial implementation of the VLBI2010 system needs to be capable of observing the broadband frequency range of $\sim 2.2\text{--}14$ GHz.
- The VLBI2010 system needs to be capable of S/X operation.
- The antenna should allow for a possible future inclusion of Ka-band (32 GHz) operation.
- The complete end-to-end operation of the VLBI2010 system should be demonstrated in a campaign in early 2012. As many antennas as possible should participate.
- A plan should be established for the transition from the legacy S/X system to the VLBI2010 broadband delay system. Such a transition plan can be beneficial for obtaining future funding and will support a timely changeover.

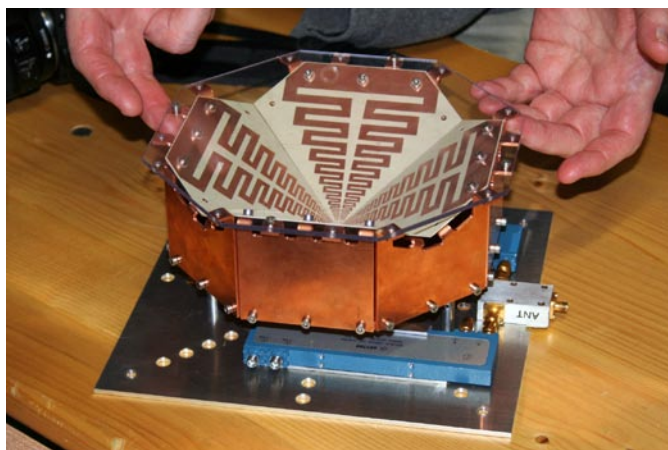
At the final afternoon of the FRFF meeting a tour of the Geodetic Observatory Wettzell was offered, which showed the different co-located space techniques in combination with the additional techniques and of course the area for TTW.

An additional day of the event was set aside to start in motion the development of the digital back end (DBE) and correlator for VLBI2010. In the morning, an in-depth discussion of all potential functions for the VLBI2010 DBE was followed by presentations on advanced DBE projects in China, Japan, the US, and Italy. In the afternoon, presentations on software correlator projects in the US, Germany, China, and Japan were given. It was encouraging to hear that features are currently being added to the Bonn software correlator to make it capable of processing standard IVS geodetic observations. A priority was set to be able to process data from the NASA broadband delay proof-of-concept tests on a software correlator at the earliest possible date.

NEWS...

There is no doubt that this set of meetings was extremely productive not only in terms of conclusions reached but also in terms of information and ideas exchanged and stimulation for future work. To this end, the environment at Höllenstein's Landhotel Miethaner was very conducive to success. With the only possible distraction being the birds singing in the woods or the occasional snow squall, workshop participants could be seen hard at their task for long hours in the day. The idea was to generate something like a "conclave atmosphere" where discussions, talks, and new ideas could be born. In addition, the very friendly and efficient staff at the hotel provided excellent service and wonderful meals and coffee breaks in the local style. Of course, none of this would have been possible without the efforts of the local organizers. Many thanks to Reiner Dassing, Alexander Neidhardt, Thomas Klügel, and all those who assisted them!

All the way from ensuring that everyone successfully arrived at Höllenstein, to setting up the meeting room and arranging for meals, banquet, and tour of the Geodetic Observatory Wettzell everything progressed very smoothly. For many of us, one of the high points was the visit to the Lindner brewery beer garden and traditional restaurant where Schnitzel, Würstl, Kraut, and regional beers could all be sampled. For me, there are many wonderful memories from the meetings, but on a personal level, I cannot help mentioning one experience that is definitely unique to this meeting, that being my face-to-face meeting with a wild pig on one of my early morning walks in the woods.



(above) One of the most advanced developments for VLBI2010, the so-called "Eleven feed" from Per-Simon Kildal and his group from Chalmers University of Technology; (below) The very conducive atmosphere in the conference room supported the goals of the workshop.



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...

6th Orlov Conference Kiev, Ukraine June 22-24, 2009	IAG Scientific Assembly Buenos Aires, Argentina Aug. 31 - Sep. 4, 2009
8th International e-VLBI Workshop Madrid, Spain June 22-26, 2009	AGU Fall Meeting San Francisco, USA Dec. 14-18, 2009
IAU General Assembly Rio de Janeiro, Brazil August 3-14, 2009	6th IVS General Meeting Hobart, TAS, Australia Feb. 7-14, 2010

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

IVS Directing Board Elections Held

– Alan Whitney, MIT Haystack Observatory and Dirk Behrend, NVI Inc./GSFC

As directed by the IVS Terms of Reference, election of IVS Directing Board members takes place every two years to fill any vacancies due to term expiration or any other reasons. As a result, and as you are no doubt aware, the last few months have been filled with IVS election activity. An Election Committee consisting of Dirk Behrend (NVI, Inc./GSFC, USA), Hayo Hase (BKG, Chile), and Alan Whitney (Haystack Observatory, USA; Committee Chair) was appointed and charged with conducting the elections.

Members whose terms were due to expire by February 2009 were (* indicates ineligible for re-election after completing two consecutive full terms):

- Network Representative: Kazuhiro Takashima (Japan);
- Analysis and Data Centers Representative: Arthur Niell* (USA);
- Technology Development Centers Representative: Bill Petrachenko* (Canada);
- At-Large Members: Andrey Finkelstein (Russia), Oleg Titov (Australia), Xiuzhong Zhang (China).

Nominees for the December representative election were:

- Networks Representative: Jim Lovell (Australia), Kazuhiro Takashima (Japan), Gino Tuccari (Italy);
- Analysis and Data Centers Representative: Zinovy Malkin (Russia), Oleg Titov (Australia);
- Technology Development Centers Representative: Rüdiger Haas (Sweden), Ryuichi Ichikawa (Japan).

In a close election from this strong slate, the successful candidates were Gino Tuccari, Oleg Titov, and Rüdiger Haas.

Candidates for At-Large members were: Andrey Finkelstein (Russia), Ryuichi Ichikawa (Japan), Zinovy Malkin (Russia), Kazuhiro Takashima (Japan), and Xiuzhong Zhang (China). In the interests of the broadest geographical representation, the Directing Board selected Andrey Finkelstein, Kazuhiro Takashima, and Xiuzhong Zhang from this group of extremely well qualified candidates.

We welcome the new Directing Board members to help us build a stronger IVS, while at the same time thanking the departing members for building the secure foundation that already exists.

New Working Groups in the Making

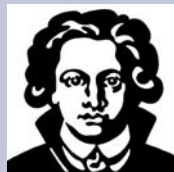
– Dirk Behrend, NVI Inc./GSFC

The IVS is in the process of establishing two new working groups, which will be numbered #5 and #6. WGs are entities of the IVS that have a limited life time (of 2–4 years) and provide a deliverable at their conclusion, typically a final report or recommendation. Committees, in contrast, are standing bodies of the IVS that remain in existence until the Board decides that they are no longer needed and can be closed.

The *WG on Space Science Applications (WG5)* will be chaired by Leonid Gurvits from JIVE and co-chaired by Patrick Charlot from Bordeaux Observatory. WG5 will investigate synergies between IVS and VLBI space science applications, look for mutually beneficial collaborations, and eventually give recommendations for future actions.

The *WG on VLBI Education (WG6)* will be chaired by Rüdiger Haas from Chalmers University of Technology. This working group will explore educational activities, such as summer schools or training seminars, that will help in the formation of a new generation of VLBI experts.

The two new WGs will augment the currently active pair of the WG on VLBI Data Structures (WG4) and the joint IERS/IVS WG on the Second Realization of the ICRF (WG-ICRF2). For a limited time we expect to have four active WGs and two Committees (Observing Program Committee and VLBI2010 Committee). For both new working groups the charter and membership are currently being put together. More information will be posted on the IVS Web site at <http://ivscc.gsfc.nasa.gov/about/wg/> when it becomes available.



Knowing is not enough; we must apply. Willing is not enough; we must do.

– Johann Wolfgang von Goethe

IVS Celebrates 10th Anniversary in and with Bordeaux

– Dirk Behrend, NVI Inc./GSFC



On March 1, 2009 the IVS completed its first decade of being a service for geodetic and astrometric VLBI. Considering the accomplishments of the first ten years, it was no question that the milestone birthday “10” had to be celebrated in “09”. With the 19th European VLBI for Geodesy and Astrometry (EVGA) Working Meeting taking place in Bordeaux, France on March 24–25, 2009, it was an obvious choice to add a special event celebrating the 10th Anniversary at the same time. Hence, the way was paved for a special afternoon and evening on March 25, 2009.



Part of the local organizing committee.

It was up to the local organizers—Patrick Charlot and his team—and the Coordinating Center to make this opportunity a memorable event. This was not an easy task, as in addition to the EVGA and 10th Anniversary there was also a slew of splinter meetings that needed to be organized (IVS Directing Board meeting, IVS Analysis Workshop, WG4 meeting, ICRF2 meeting). But, I dare say, everything worked out almost perfectly.

The 10th Anniversary Celebration consisted of two parts: (1) a commemorative symposium followed by (2) a reception and a common dinner. The symposium was structured into three sessions. Session 1 covered the history of the IVS with presentations given by Tom Clark, James Campbell, and Wolfgang Schlüter. The interrelation of the IVS to other geodetic services was highlighted in the second session in the

talks of John Dow, Graham Appleby, and Frank Lemoine. In Session 3 the IVS was put into context with the other VLBI networks in talks presented by Franco Mantovani, Jim Ulvestad, and Hideyuki Kobayashi. This was complemented by welcome addresses and greetings given by Harald Schuh, Jean-Baptiste Verlhac (Vice President of University of Bordeaux 1), Herman Drewes, and Jan Vondrak. The symposium was held in the Salle Agora of Université Bordeaux 1. This chapel-converted-to-ballroom gave the event the proper ambience. The event was live broadcast over the Internet. A recording of the various presentations is available at <http://canal2.u-strasbg.fr/video.asp?idvideo=8558>. Pictures are available at the URL <http://www.u-bordeaux1.fr/vlbi2009>.

The event was crowned with a dinner held at a restaurant overlooking the Garonne River in the countryside near Bordeaux. The excellent cuisine with local delicacies was accompanied by local vintage wines. The feast reached its point of culmination, when all guests were presented with an IVS-sponsored bottle of Bordeaux wine in a commemorative case. I would like to thank Patrick for making all this possible. I will keep fond memories and a bottle of Bordeaux red (the wine for a year or two only) from the 10th Anniversary.



Herman Drewes during his speech and Rüdiger Haas showing the IVS present at the event dinner.



(above) James Campbell giving his history presentation. (left) Franco Mantovani at the end of his talk about the connection between IVS and EVN.

V2C Submits Progress Report

– Dirk Bebrend, NVI Inc./GSFC

It is 56 pages strong and has 17 figures and illustrations: after more than a year in the making, the VLBI2010 Committee (V2C) submitted a progress report entitled “Design Aspects of the VLBI2010 System” summarizing the current wisdom about the next generation geodetic VLBI system. The report constitutes a major milestone on the way to the new system. A copy of the report can be downloaded from the URL: ftp://ivscc.gsfc.nasa.gov/pub/misc/V2C/PR-V2C_090417.pdf

The report covers a slew of aspects of the VLBI2010 system development. It starts out with Monte Carlo simulations showing the impact of the new operating modes on the final products. A section on system considerations describes the implications for the VLBI2010 system parameters by considering the new modes and system-related issues such as sensitivity, antenna slew rate, delay measurement error, RFI, frequency requirements, antenna deformation, and source structure corrections.

This is followed by a description of all major subsystems—some extensively, some to a lesser degree, depending on the state of development. In this section you will find recommendations for the network, station, and antenna, and it covers aspects of the feed, polarization processing, calibration, digital back end, and correlator subsystems. A section is dedicated to the NASA proof-of-concept demonstration describing the results and current status of the development of the broadband delay system. Sections on operational considerations, on risks and fallback options, and on the next steps round the report out.

A version of the report is included in the 2008 IVS Annual Report. Printed standalone copies can be requested from the Coordinating Center. There will only be a limited number of printed copies available.

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