

Bonn Geodetic VLBI Operation Center

A. MÜSKENS, A. NOTHNAGEL

Abstract The IGGB Operation Center has continued to carry out its tasks of organizing and scheduling various observing sessions of the IVS-T2, IVS-OHIG, IVS-INT3, and EUROPE series.

1 Center Activities

The IGGB VLBI Operation Center is part of the Institute of Geodesy and Geoinformation of the University of Bonn, Nußallee 17, D-53115 Bonn, Germany. It has been organizing and scheduling VLBI observing sessions for more than thirty years. The work of the Operation Center is closely related to the Bonn Correlator. For this reason, distribution of the Mark 5 disk units to the stations after correlation and the extension of the Internet connection from previously 1 Gbps to 2 Gbps in Fall 2016 are the most costly parts of the operations. Below, we describe the activities related to individual observing programs.

- **IVS-T2 series**

This series was observed roughly every second month (seven sessions each in 2015 and 2016) primarily for maintenance and stabilization of the VLBI terrestrial reference frame as well as for Earth rotation monitoring as a by-product. Each station of the global geodetic VLBI network is planned to participate in the T2 sessions at least once per year. In view of the limitations in station days, priority was given to strong and robust

networks with many sites over more observing sessions. Therefore, generally 15 to 24 stations were scheduled in each session. The scheduling of these sessions has to take into account planning a sufficient number of observations for each baseline of these global networks.

The recording frequency setup has always been 16 channels, with 4 MHz channel bandwidth and 360/80 MHz spanned bandwidth at X- and S-band, respectively. Considering that the standard setups of the majority of IVS sessions cover a wider spanned bandwidth and a higher sampling rate, it was decided to test which stations of the global IVS network are capable of this as well. So, in December 2016 we carried out a test experiment to check a higher recording mode. We observed with 256 Mbps, 16 tracks, and a bandwidth of 8 Mhz/channel. Wideband was used with 720 Mhz spanned bandwidth at X-band and 140 Mhz at S-band, i.e., setting the sky frequencies to 8212.99, 8252.99, 8352.99, 8512.99, 8732.99, 8852.99, 8912.99, 8932.99 MHz and 2225.99, 2245.99, 2265.99, 2295.99, 2345.99, 2365.99 MHz.

It turned out that several stations such as KASHIM11, KOGANEL, NOTO, CRIMEA, and the DSN stations can only observe the 360 MHz spanned bandwidth at X-band. Here, it was decided to record only the first four channels, i.e., 8212.99, 8252.99, 8352.99, and 8512.99 MHz still covering 300 MHz spanned bandwidth and producing a reasonable delay resolution function. The full 140 MHz spanned bandwidth at S-band was not covered in all cases, either. This session is being analyzed to figure out how to proceed with the T2 sessions in the future.

Institut für Geodäsie und Geoinformation der Universität Bonn

Bonn Operation Center

IVS 2015+2016 Biennial Report

- **Measurement of Vertical Crustal Motion in Europe by VLBI (EUROPE)**

Since the late 1980s, a series of special sessions has been regularly scheduled in Europe for precise determination of station coordinates and for long term stability monitoring. In 2015 and 2016, six observing sessions were scheduled each year with NYALES20 (11 sessions), METSAHOV (3), DSS65A (7), SVETLOE (7), ZELENCHUKS (7), BADARY (7), EFLSBERG (4), WETTZELL (12), WETTZ13N (5 in tag-along mode), MEDICINA (7), MATERA (5), NOTO (8), ONSALA60 (9), YEBES40M (8), and CRIMEA (1). All sessions employed the narrow band frequency setup of 360/80 MHz with 16 channels and 4 MHz bandwidth, identical to the IVS-T2 sessions' setup. Beginning with the session of September 5, 2016 we started to increase the data rate to 256 Mbps with 16 tracks and a bandwidth of 8 Mhz/channel. We also increased the spanned bandwidth to 720 Mhz at X-band and 140 MHz at S-band. In 2017, we will also test a 512 Mbps setup in sessions called EUR-R&D.

- **Southern Hemisphere and Antarctica Series (OHIG):**

In 2015 and 2016, six sessions of the Southern Hemisphere and Antarctica Series were organized. The purpose of these observations is the maintenance of the VLBI terrestrial reference frame (TRF) and monitoring of Earth rotation as a by-product. The recording frequency setup is 16 channels with 4 MHz channel bandwidth and a data rate of 128 Mbps spanning 360/80 MHz. Due to the fact that SYOWA is not able to deliver the recorded data for nearly one year after the observations, the correlation and the generation of the databases is always delayed considerably.

In the OHIG sessions, the two Antarctic stations OHIGGINS (Germany) and SYOWA (Japan) were mostly scheduled with KATH12M (North Australia), YARRA12M (West Australia), HOBART12 and HOBART26 (Tasmania), WARK12M (New Zealand), HARTRAO and HART15M (South Africa), KOKEE (Hawaii, USA), and FORTLEZA (Brazil). Three sessions were observed in February 2015, three in November 2015, three in February 2016, and three in November 2016. In November 2015 and November 2016 the sessions, unfortunately, could only be observed without OHIGGINS

due to receiver and dewar upgrades as well as to extreme wind velocities and logistical constraints. February 9, 2016, marks the date of the 100th OHIG session, which is quite a noteworthy occasion considering that mostly only six sessions were scheduled each year.

- **UT1 determination with near-real-time processing (INT3):**

The basic INT3 network consists of NYALES20, TSUKUB32, and WETTZELL for rapid UT1 determination on Monday morning at 7:00 UT. SESHAN25 takes part on a monthly basis. In 2016, WETTZ13N started participating in a tag-along mode. 40 INT3 sessions in 2015 and 50 in 2016 were observed with the standard frequency setup of 256 Mbps with 16 tracks, 8 Mhz/channel, and 720/140 Mhz spanned bandwidth as in the R1/R4 sessions. Starting in September 2016, we increased the observing data rate and changed the frequency setup to 512 Mbps with 16 tracks, 8 Mhz/channel, 2-bit sampling, and 720/140 Mhz spanned bandwidth.

The operations part of the INT3 sessions also includes rapid data transmission and correlation. The raw VLBI observation data of the four sites are transferred to the Bonn Correlator by Internet connections directly after the session is completed. The transmission rate is about 400-600 Mbps from Tsukuba and Wettzell, 300 Mbps from Seshan, and 100 Mbps from Ny-Ålesund. For the latter, the data rate is limited due to the use of a radio link for the first part of the distance. All transmissions share the "last mile", which is still limited to 1 Gbps because the second 1 Gbps line is restricted to local night time operations (see the Bonn Correlator Report, this issue).

In the last two years, around 96% of the sessions were correlated and the databases delivered within the first four hours after the end of the observations. A further 2% were completed within the next 48 hours due to difficulties with networking hardware and/or station and processor problems.

2 Staff

Table 1 Personnel at IGGB Operation Center.

Arno Müskens	+49-228-525264	mueskens@mpifr.de
Axel Nothnagel	+49-228-733574	nothnagel@uni-bonn.de