Robledo Station Report

EVN TOG Meeting, September 2016
Institute of Applied Astronomy - RAS
St. Petersburg, Russia

1. Hardware and software status.

1.1. DSN digital backend.

The DSN VLBI digital backend -DSN VLBI Processor (DVP)- was declared operational on April 2014. Since then the DVP is successfully supporting JPL VLBI projects and non-DSN VLBI users. The DVP does not use the NASA Field System application to configure the terminal and carry out the observations. A schedule processor has been developed to generate DVP scripts from VEX schedules. Currently it records VDIF format (multi-channels data threads, 16 bytes legacy headers) on a Mark5C recorder with SDK 9.2. The DVP schedule processor (script builder) does not support yet Mark5 continuous recording. DVP recording script needs to be manually edited for continuous recording.

Robledo has supported the EVN observations performed during last observing sessions and out-of-sessions in 2016 with the DVP as the only backend. The MarkIV DAT has been already decommissioned.

To improve our support to the EVN, IVS and other non-DSN users a new delivery of the DVP software is currently being tested. This upgrade includes:

1. DSN VDIF format modification: 32-bytes headers for all external users. Legacy headers still available.
2. DSN VDIF format modification: possibility to record ONLY 4, 8 or 16 complex channels, decreasing recording data rate for certain configurations (Table 1). Maximum data rate is 2048Mbps.
3. DSN VDIF format modification: possibility to use 64MHz complex channels (or 32MHz usb/lsb channels) for 2Gbps recordings (Fig. 1).
4. DSN VDIF format modification: added 1 bit channel sampling.
5. Mark5C upgraded to SDK 9.4: allows to use >16TB SATA disk modules.
6. Mark5C upgraded from Debian Linux 6.0.7 32-bit to Debian Linux 7.10 64-bit.
7. DVP control computer upgraded from Debian Linux 6.0.7 64-bit to Debian Linux 8.4 64-bit.
8. Includes antenna status and weather data in experiment logs.
9. More reliable calculation of total power in 2-bit sampled channels.
10. Several bug fixes for overall robustness.

This new DVP delivery will be operational for incoming EVN session III, 2016. It was tested during EVN OoS gg080 observation performed on DOY 256, Sep. 2016.

Number of channels Complex	USB/LSB	Sample bits	Complex channel size (MHz)	USB/LSB channel size (MHz)	Data Rate Mb/s
16	32	1	32/16/8/4/2	16/8/4/2/1	1024/512/256/128/64
16	32	2	32/16/8/4/2	16/8/4/2/1	2048/1024/512/256/128
8	16	1	64/32/16/8/4/2	32/16/8/4/2/1	1024/512/256/128/64/32
8	16	2	64/32/16/8/4/2	32/16/8/4/2/1	2048/1024/512/256/128/64
4	8	1	64/32/16/8/4/2	32/16/8/4/2/1	512/256/128/64/32/16
4	8	2	64/32/16/8/4/2	32/16/8/4/2/1	1024/512/256/128/64/32

Table 1. DVP different recording modes, including standard EVN mode for 2Gbps supports (green) and RadioAstron co-observing improved mode (yellow).

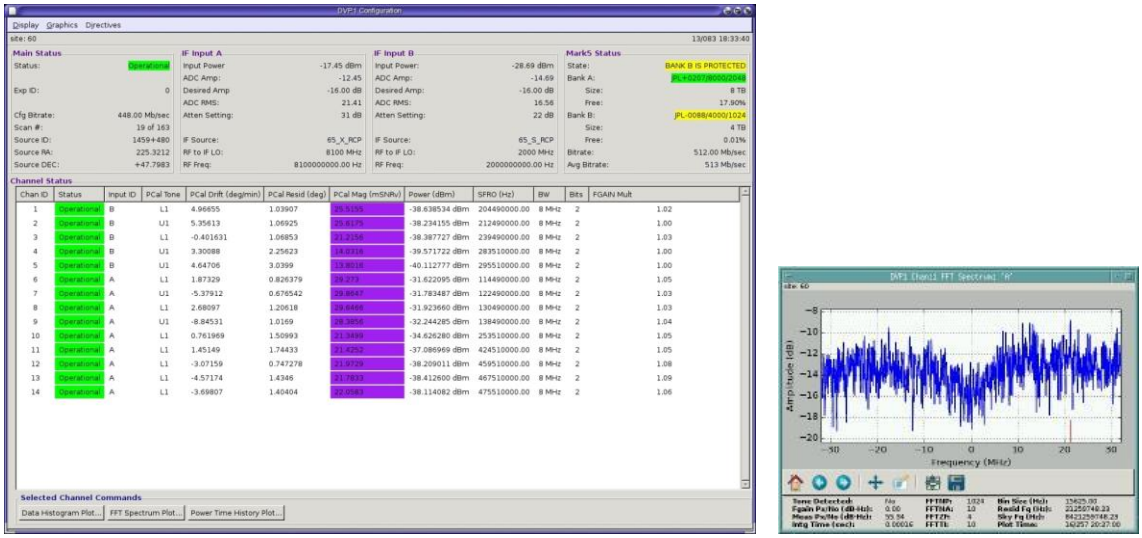

Figure 1. DVP graphical user interface: example of DVP configuration at 2048Mbps (16 U/L channels, 32MHz b/w, 2bits), left, with detail of 64MHz complex channel # 1 bandpass (right).

1.2. DSS-63 (70m) K-band receiver status.

Operational. During this summer RF department performed a cool down of the K-band LNA after helium compressor failure. K-band receiver was repaired during DSS-63 July-August major maintenance downtime by Manuel Franco (JPL) with RA department support. The repair included: the LNAs biases were readjusted, a post amplifier in the calibration assembly was replaced, the aperture load and controllers were installed and the LNAs power supply assembly were modified. Additionally for the high frequency Fiber Optic transmitter/receiver to properly work RF amplifiers were installed and tested obtaining proper signal level at input of Host Country spectrometer. K-band spectral lines detection was confirmed by Host Country group. EVN OoS K-band observation gg080 was supported after the repair. Pending to confirm fringes detection by the correlators.

1.3. DSS-63 (70m) L-band receiver status.

Operational. All DSN 70m antennas L-band receivers have been upgraded from 90 MHz bandwidth (1625-1715MHz sky frequency) to 500 MHz (1400-1900MHz sky frequency). The

upgrade took place at just one of the LNAs, replacing the refrigerated RF filter installed before the LNA. The spare LNA has not been modified yet. We are still using the non-modified LNA to support EVN observations. For 2048Mbps observations and 21cm observations we will start using the modified LNA.

During this summer with the help of Manuel Franco (JPL) L-band configuration was changed to L-RCP instead of the usual L-LCP (Fig. 2). RA department checked proper performance of the receiver before and after the modification.

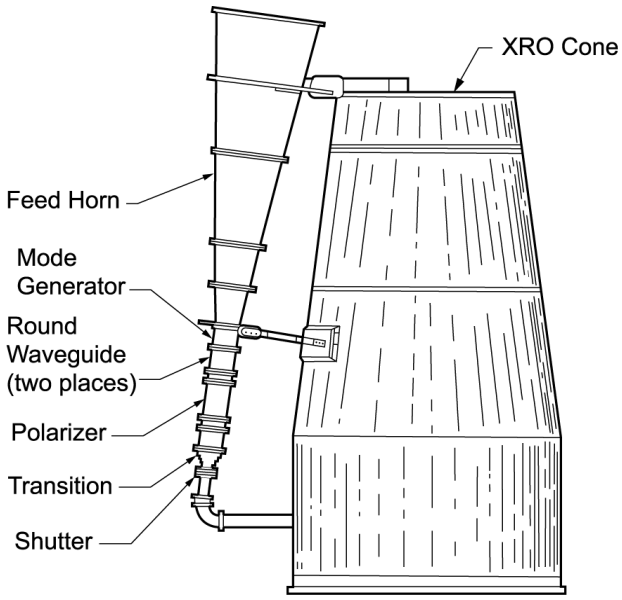

Figure 2. Detail of Robledo 70m antenna L-band feed horn and polarizer.

1.4. DSS-54 (34m) Q-band receiver status.

Operational. During this summer Q-band receiver was repaired by Manuel Franco (JPL) with RA department support. The repair included: the LNAs biases were readjusted, the aperture load was realigned, a 12 ft. cable replaced, RF and IF gains adjusted from the downconverter to Host Country spectrometer inputs and to the 321.4 MHz distribution assembly outputs, and modified the distribution assembly. Host Country group confirmed proper detection of spectral lines at the expected amplitudes at both polarizations.

2. Calibration.

a. DVP data calibration. Continuous calibration scheme has been tested with the DVP during EVN sessions I and II, 2016. A noise diode with 3-6% of Tsys noise was modulated at 10 Hz for L and X-band observations. Linear System Temperature was measured using a Power Meter and results have been compared with the DSN continuous calibration at L-band (Fig. 3). For L-band DSN calibrations are too noisy compared with the PM measurements, and seems to be affected by RFI. EVN software correlator has been modified to extract continuous calibration from the Robledo data using a non-standard modulation frequency (Fig. 4). Results agree with Power Meter measurements within 10%.

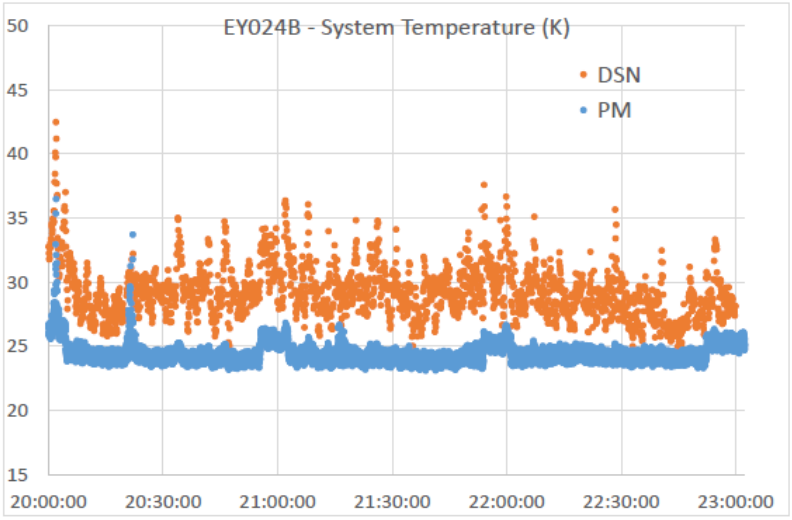

Figure 3. Linear System Temperature measured for the whole L-band bandpass using a Power Meter (PM, blue) and continuous calibration using a DSN receiver (DSN, orange). Measurements with DSN receiver are performed in a frequency affected by RFI.

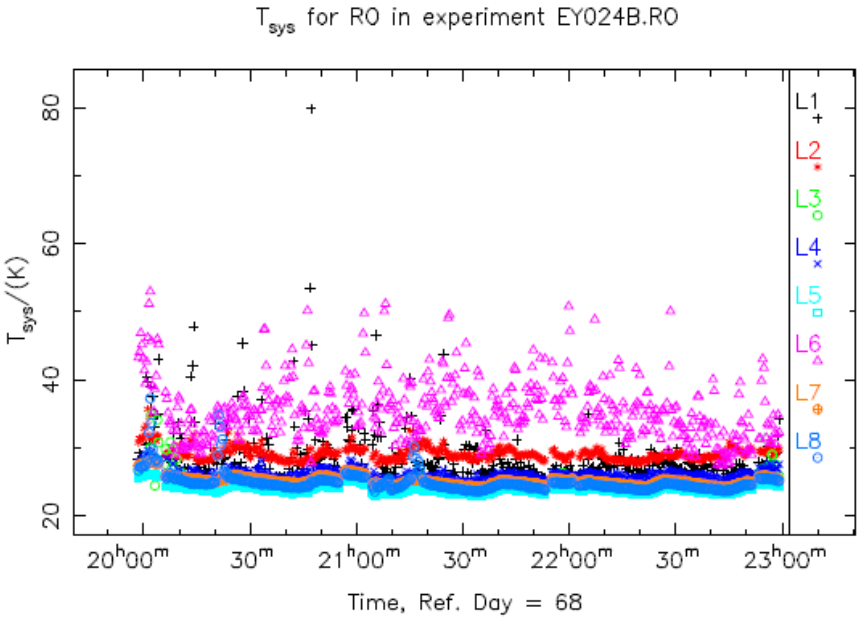

Figure 4. Continuous calibration for each of the recorded channels calculated with EVN software correlator. Results agree with PM linear calibrations to 10% or better. Channel affected by RFI (L6, pink) has similar behavior as the DSN calibration.

b. DSS-63 K-band calibration. During this summer K-band ambient load was installed and its control repaired allowing Zenith Calibrations during the observations.

c. DSS-63 K-band pointing. K-band pointing models have been improved during this summer. This task was included in past August Depot Level Maintenance DSS-63 antenna downtime.

3. Immediate and Future Plans.

DSS-63 Robledo 70m antenna has been stopped for major maintenance during weeks 20-21 (second half of May) and 29-33 (July 18 – August 19). It is currently stopped again (Sep. 12- 28). Among other tasks maintenance staff has performed shimming and AZ track epoxy grouting of one of the AZ segments.

Robledo e-VLBI activities: 300 Mbps connection from Robledo to the Spanish Research and Educational Network (RedIRIS) has not yet being upgraded to 1 Gbps.

4. Recent Robledo support to EVN observations.

Robledo has supported the EVN observations performed during 2016 with the DSN digital backend (DVP). Very recent EVN OoS observation gg080 performed on DOY 256 was supported using the new DVP s/w application with enhanced capabilities, awaiting feedback from JIVE and Bonn correlators.

During EVN session#2 2016 Robledo participated with DSS-63 antenna in following observations in L-band, correlated at JIVE (J) correlator:

DOY START BOT EOT END FACILITY USER ACTIVITY

064 1005 1135 0500 0530 DSS-63 EGS EVN EG001 J-M5

065 1730 1900 2350 0020 DSS-63 EGS EVN-EJ016B J-M5

066 1920 2050 2300 2330 DSS-63 EGS EVN-EG078D J-M5

067 1920 2050 2340 0010 DSS-63 EGS EVN-GF019B J-M5

068 1920 2050 2300 2330 DSS-63 EGS EVN-EY024B J-M5

090 2049 2219 0140 0210 DSS-63 EGS EVN GG079A J-M5

During Out of Session EVN observations, April 2016: Robledo participated with DSS-63 antenna in following L-band and K-band observations, correlated at Bonn (B):

DOY START BOT EOT END FACILITY USER ACTIVITY

099 1620 1750 0105 0135 DSS-63 EGS EVN-EB055C/D B-M5 L-band (cancelled due to Kepler s/c emergency)

107 1530 1700 0500 0530 DSS-63 EGS EVN-GG079B B-M5 Lband

116 1430 1600 0030 0100 DSS-63 EGS EVN-GG079C B-M5 Kband

During EVN session#2 2016 Robledo participated with DSS-63 antenna in following observations in L and K bands, correlated at JIVE (J) and Bonn (B) correlators:

DOY	START	BOT	EOT	END	FACILITY	USER	ACTIVITY
125	1530	1700	2325	2355	DSS-63	EGS	EVN GG079D B-M5 Kband
148	1700	1830	2100	2130	DSS-63	EGS	EVN-EG092B J-M5 Lband
164	0555	0725	0950	1020	DSS-63	EGS	EVN-GP054 J-M5 Kband

During Out of Session EVN observations, September 2016: Robledo participated with DSS-63 antenna in following K-band observation, correlated at Bonn (B):

DOY	START	BOT	EOT	END	FACILITY	USER	ACTIVITY
256	0005	0135	0530	0600	DSS-63	EGS	EVN GG080 B-M5 Kband (supported with new DVP application)

Best regards,

Cristina Garcia Miró

Robledo VLBI/Technical friend for the EVN

cgmiro@mdscc.nasa.gov

Madrid Deep Space Communication Complex -MDSCC-
Robledo Tracking Station NASA/INTA
Tel +34-91-867-7130
Fax +34-91-867-7185