Date: 2021 Apr 23

To: EVN TOG

From: Walter Brisken and Jay Blanchard (representing the VLBA)

Re: VLBA Station Report

While the VLBA is not a member of the EVN, we understand it would be useful for planning purposes for the VLBA to provide an update. Much of the VLBA status can be found in the Observational Status Summary (OSS): https://science.nrao.edu/facilities/vlba/docs/manuals/oss .

Front-end (receivers) and tuning

There have been no recent changes to the front end systems or tuning abilities of the VLBA. There are, however, two efforts underway:

1. A series of tests of the VLBA S-band system is being carried out to examine the impact of removing the front end filters which restrict tuning to 2200-2400 MHz. When removed, the tuning range could be increased to 2000-2700 MHz. Initial tests are encouraging but full characterization of sensitivity, polarization properties, and the RFI environment need to be performed.

2. New frequency synthesizers are being deployed. At the hardware level arbitrary tuning at the 1 Hz level can be commanded within. Two sites have the new synthesizers installed, with the others coming in the next 18 months. Updates to sched will be needed to take full advantage of this new flexibility. Because a fully flexible LO was not envisioned in the design of sched, either a finite list of tuning set-points will need to be specified or some substantial coding changes will be required.

Back-end

The dual RDBE remains the VLBA's sole backend. Two personalities are available: the Polyphase Filter-Bank (PFB) providing exactly 16 channels of exactly 32 MHz bandwidth which must be placed on a 32 MHz grid, and the Digital Down-Converter (DDC) providing 1 to 8 channels of up to 128 MHz bandwidth, with only minor tuning restrictions within the 512 MHz IF band[1]. The VLBA is encouraging its users to migrate from PFB to DDC to the degree possible. The VLBA can now sustain 4 Gbps data rate for all observing.

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[1] See new memo for details on VLBA tuning: https://library.nrao.edu/public/memos/vlba/up/VLBASU_51.pdf .

NRAO engineers are hard at work developing the "VLBA New Digital Architecture" to replace the aging and somewhat problematic RDBEs. This project will result in a system that can fully flexibly tune up to 16 channels with bandwidths up to 256 MHz anywhere within a 1 GHz wide IF. It will also offer 1, 2, 4 or 8 bits per sample. It is anticipated that through this project the VLBA will adopt vex2. The current schedule has deployment of this system to occur in calendar year 2024. More documentation on this project will be made available in the coming year.

Data transmission

VLBA relies on shipped Mark6 media for the vast majority of its baseband data transmission, however, this is slowly changing. All VLBA sites have 200 Mbps (or faster) network connections. The link is now being used on a weekly basis for real-time data quality checks at bandwidths up to 16 MHz per polarization. Further expansion of the e-VLBI and e-transfer capabilities is being discussed.

The VLBA is also supporting, on a very limited basis, e-transfer of data from foreign sites to the VLBA correlator.

Correlation

The VLBA currently uses DiFX version 2.6.2 on a 20-node cluster. In standard continuum modes, 10 stations at 8 Gbps speed can be sustained. Nine Mark6 units, each with expansion units allowing playback of up to four modules at one time, feed the correlator.