VLBA Sensitivity Upgrade Memo No. 27

Monitor Data for the VLBA Sensitivity Upgrade

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1 Introduction

This is a partial revision and update of Brisken & Butler [1] describing the project to modernize the VLBA station control software. This project will heavily leverage the EVLA monitor and control software. The specific, immediate goal is to properly control and monitor the new Digital Back End (DBE) and Mark5C recorder, two major components of the ongoing VLBA Sensitivity Upgrade Project. In the short term, it must provide a platform to support the Ka- and C-band receiver enhancements with the concomitant modern control and monitor interfaces. The final goal of the project is to develop to a point where the present station computers and their software can be removed from service. For the future, this plan must make the ongoing operation, support, upgrade, and maintenance as simple and cost-effective as possible.

At some point in the future, the fiber link between the VLBA Pie Town antenna and the EVLA for real-time operations may be re-established. Having a common software platform will simplify the joint operation.

Although this note is primarily to focus on the monitor and alarm data streams, there are several introductory remarks on the other aspects of the VLBA antenna monitor and control system for context.

2 Choice of EVLA software

The old VLA control computer infrastructure has been completely replaced for the EVLA with a more capable one based on modern commodity computer and communication technology. For this architecture, a powerful and flexible monitor and control system has been developed. Fortunately, it will be possible to leverage much of this development for the VLBA with the addition of only an FTE-yr or two of additional effort. This should allow parallel development and maintenance with the EVLA and eventually require very little additional support over and above that needed just for the EVLA. It also has the great advantage that the two systems will be very similar to operate allowing cross-training and possibly an eventual reduction in operational staff.

3 Networking

3.1 Wide Area Network (WAN)

The original VLBA antenna station computers were designed in an era when network connections were slow and unreliable. Although network outages still exist with modern network connection, it may be possible to operate without the necessity for a backup connection.

The testing of the backup system is a weekly task. The present frequency of use is only roughly for one antenna per month. A more modern (and hopefully more reliable) WAN infrastructure will be deployed in the first half of 2010. Nevertheless, the operations group feels that the existence of backup (dial-up) connections to the antennas is a very important element in the security and reliability of the VLBA. The backup network does not drive the design of the new system. In any case, the system as designed should provide minimum outages.

3.2 Local Area Network (LAN)

The LAN for the station building is shown in Figure 1. The LAN will function as does the EVLA LAN. The network is configured with sufficient capacity to allow reliable UDP and multicast protocols to be used. For off-site communication, TCP-based protocols will be used primarily. Monitor and alert data being provided for real-time operator displays may be transmitted via UDP.

It would be desirable for the antenna vertex room have a single Ethernet switch with sufficient capacity to communicate with all expected MIBs. For cost reasons, however, there will probably be no router in the vertex room. A fiber bundle will allow the connection of multiple devices in the vertex room to the central router in the building.

Any direct high-speed connection required for the Ka-band NASA project will be in addition to the diagrammed LAN. It is expected that this will not impact the station LAN.

4 Transition

Until the new system is fully deployed, there will have to be parallel operation with the present system and the new one. As different devices are deployed, more and more devices will be controlled and monitored by the new system. A detailed phased plan for this transition is still to be fully developed. Since nothing beyond the initial deployment is currently funded, this will probably await further funding.

5 Control

It is proposed that each station will run the EVLA executor. New devices (initially just the DBE and the Mark 5C) will be controlled through EVLA MIB interfaces. [Note that the executor calls CALC for each new source. It uses CALC to calculate refraction. The VLBA antenna does not need the precise delay and rate calculations, but it does

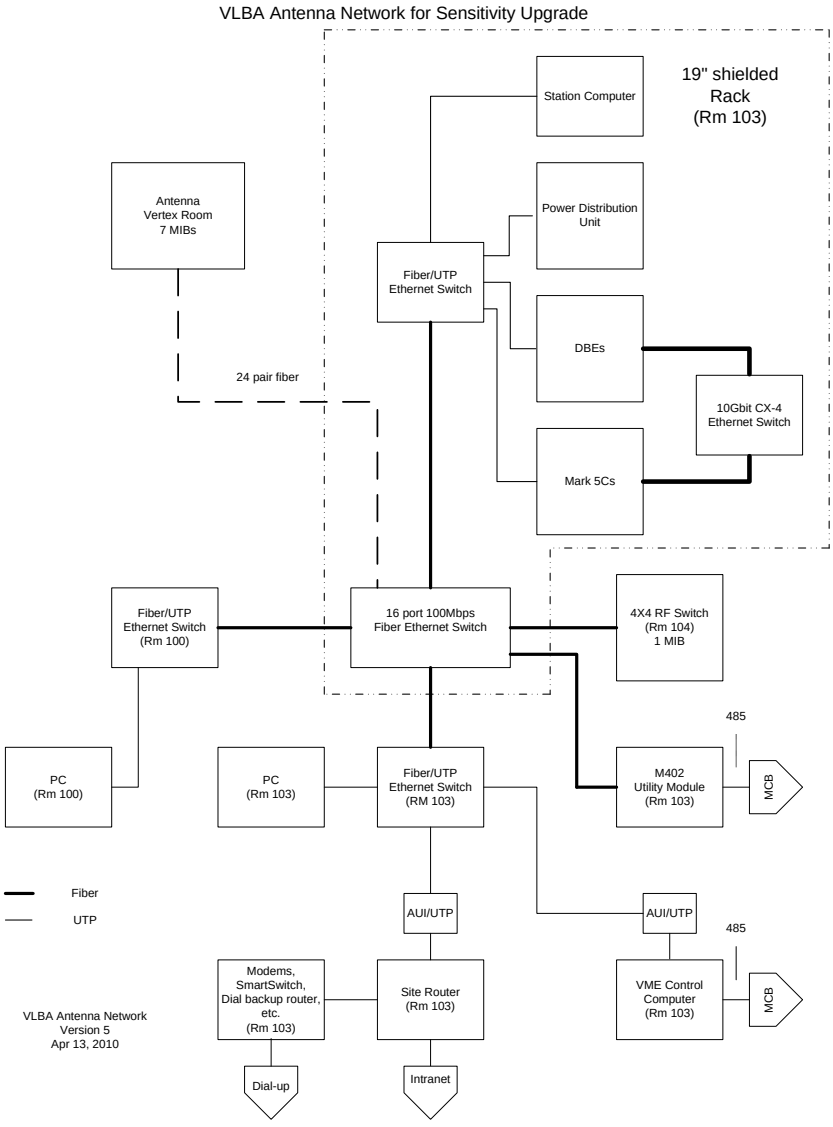

Figure 1: Antenna Station Local Area Network

no harm and there is plenty of spare computer power. There will probably be other modifications to the executor needed for the VLBA, so it will be reasonable to have those excluded with conditional compilations.]

5.1 Operator control

As is done with the present control system, schedule files will be downloaded to the station control computers in advance of observation.

Commands to an individual antenna. Commands executed by logging in remotely and/or as before. Displays run in VLBA station and can be displayed remotely in the Science Operation Center (SOC).

Control and monitor of the whole array. There will be a new unified display in the SOC to display the status of all antennas. This will have the capability of sending commands to all antennas.

6 Device control and monitor

In the final system, we plan that this will be done entirely by MIB, CMIB, or MIB emulators.

The present EVLA device browser should work unmodified (but see section 7).

An equivalent module to the VLA/EVLA Control and Monitor Processor (CMP) will eventually be built to provide MIB control and monitor of un-upgraded equipment, which perforce uses the present Monitor and Control Bus. [Although experience with the EVLA CMP is readily available, both hardware and software MIB development will be needed.]

The CMP will first be essential to control the focus/rotation when the Ka band horn is installed. However, when it is fully deployed, it should be possible to remove the present station computer.

Wherever possible, the monitor points will use the same naming convention as is used on the EVLA.

7 Monitor and alert data

For a graphical overview, please refer to Figure 2.

7.1 At the VLBA station

a Monitor data will be broadcast by multicast locally only. It would be possible to use the VLA multicast groups within the VLBA antennas, thus leaving the EVLA software completely unchanged. However, it is relatively simple to define the multicast group in a config file. A separate multicast group has been defined for the VLBA antennas. The same group will be used in each station.

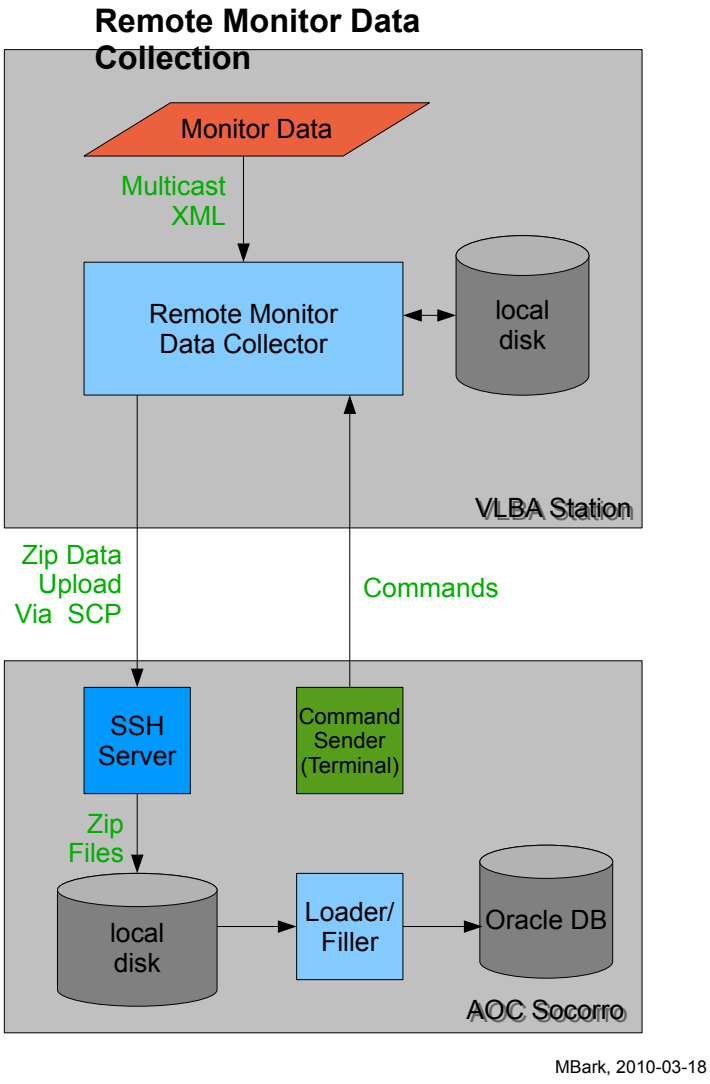

Figure 2: Monitor Data Flow. Figure courtesy Matthias Bark.

[XML broadcast using group 239.193.2.2, port 20010; note that the EVLA uses 239.192.2.2/20010.]

b A monitor data listener will listen to the multicast. We have to provide a continuous record of the monitor data both in the SOC and at the antenna. The continuity has to be maintained during network outages. Although there are several ways to accomplish this, we will write all data to local files. Monitor data is sent as indivual XML documents in a message; these will each be stored in a separate file. The files will be named "<AN>_YYMMDD_HHMMSS.<seq>_monitor.xml" using starting UT dates/times and where "<AN>" is the two letter antenna name and "<seq>" is the sequence number beginning with "1" at each timestamp. The antenna name will be made available in the station computer initialization. Periodically (every 15 minutes), the file(s) will be zipped and rotated. The zipped files will be "<AN>_YYMMDD_HHMMSS_monitor.zip". The zip files will be uploaded to the SOC [using scp over the WAN] and, at the antenna station, moved to subdirectory "/copied" upon successful copy completion. We will probably have sufficient disk storage to retain this data almost forever on spinning media. It should probably be compressed, copied to an archive, and purged annually.

c The device browser will be modified to read historical data from the zip files at the VLBA station.

d Alert data will be broadcast by multicast locally only. [XML broadcast using group 239.193.2.3, port 20011; note that the EVLA uses 239.192.2.3/20011.]

e An alert data listener will listen to the multicast. The data will be processed exactly as monitor data (above). We propose a naming convention "YYMMDD_HHMMSS_alert" for these files.

f An alert server will also run at each station. Using a tomcat server, it will provide data to any client in the SOC [using HTTP over WAN]. As with monitor data, alert data will also be written to a local file. Periodically (15 minutes or on demand), the most recent file(s) will be uploaded to the SOC [scp over WAN].

7.2 At the Array Operation Center

a Monitor data is filled into a monitor database just as is the EVLA data. The data filler will be modified to fill from the files copied from the VLBA stations. With only minor customization, data mining tools presently used by the EVLA will work natively on the VLBA monitor data.

b The data filler procedure will check for recently received files uploaded from the VLBA stations. This may include data several hours old after a network outage. When a file has been processed, it will be moved to a historical directory to be purged or archived as necessary. This simple procedure should ensure that all data is entered into the monitor database with no duplication.

c A parallel scheme will be used for alert data

7.3 VLBA Array operations

Using the configurations specified above, the operators will have all services as before the upgrade.

Summary screen. As for the EVLA, the operators' screens will display monitor and alert data in near real-time directly from the VLBA stations. The screens will be functionally similar to the EVLA displays. They will differ in the display of the information that is essentially different - monitor points are different, weather is antenna-dependent, etc.

Operations has requested that they be able to monitor the following information. These should be implementable using the proposed scheme.

Monitor information and approximate frequency	
Ambient Temperatures	10-20 minutes
Receiver Temperatures	10-20 minutes
Compressor information	10-20 minutes
Weather	few minutes
Tsys	few seconds
Mark5 disk units	few seconds
Antenna Control Unit Status	one second
Flagging information	one second

In addition, the following information will be needed as it occurs.

Alert streams
Scan change information
Messages from site technicians
Reflected commands

Device browser. The device browser will have access to real-time data and to data that has been filled into the database. The device browser may also be executed at the station. This will be able to display all data still on the station computer disks. The array operator may execute this at the station with a display in the array control room.

8 Other issues

MIB development work for the VLBA-specific hardware will also be necessary.

The CPU, I/O, disk storage, and network load of this will be small. The legacy computers to be used for the main station ("control") computers are perfectly adequate for the task.

It is possible that the EVLA will migrate the monitor database to MySQL away from Oracle. The VLBA will simply follow suit. The single table schema used for this purpose will allow for simple transition.

9 Thanks

Many people helped in providing the information in this note. Among these were Matthias Bark, Hichem Ben Frej, Walter Brisken, Steve Durand, Rich Moeser, Peggy Perley, James Robnett. My apologies for omissions.

References

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