VLBA Processor Operations

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The VLBA processor will be much larger than existing VLBI processors and must keep up with observations that are being made almost continuously. Therefore, the processor must be operated in a manner that is rather different from current practice. This document is an attempt to specify the operating style for the VLBA processor and to identify hardware and software that will be needed to facilitate the operation.

First, some basic philosophical points about the processor operations should be made:

A. The processor will run the telescope schedule after a delay of sufficient length to allow all tapes to be shipped from the telescopes. That delay is likely to be about two to three weeks. The processor will not be scheduled independently of the telescope.

B. Multiple pass processing will be rare and can only be allowed when some other processing goes faster than real time. On the average, the time it takes to process an experiment must be less than, or equal to the observing time because the telescope will be observing full time.

C. The user may be present at the time of the processing but his/her presence should not be required and, in fact, may be discouraged. The user should have no serious interaction with the data until after it has been processed. All information required from the user regarding processing modes should be provided along with the detailed schedule for the experiment prior to the observations. Changes in the processing parameters should, however, be allowed after the observations in order to best compensate for unexpected problems that might have occured during the experiment.

D. The output of the correlator and fringe processor should be an archive data set on tape (or other long term storage medium). The VLBA operations staff will be responsible for the quality of the data up to the time that the archive data (or a copy) is given to the user.

The tasks that need to be performed by the processor operations staff can be described most easily by following an experiment from observation to the start of postprocessing.

A. Prior to the observations, the observer will have set up a detailed schedule and, at the same time, will have specified the mode in which the experiment should be processed.

B. During the observations, log files will be generated at each telescope and at the operations center. The log files will include all the information needed for the on-line calibration and editing that will be done on the processor. They will also include the results of the real time fringe checks which should allow the delays analyzed to be restricted to a small range.

C. The tapes will be shipped to the operations center by some means that will reliably get then there in time for the processing. The shipping does not need to be especially fast, but it must be reliable. Any failure to deliver a shipment of tapes within the allotted time could play havoc with the processing schedule.

D. The operations staff must prepare the necessary files for processing each experiment sometime between observing and processing. For most experiments, this operation should be almost completely automatic. Software will be needed to make it automatic.

E. Prior to processing, any non-VLBA telescopes that were used in an experiment must be integrated into the processing system. This involves generating the equivalent of the telescope logs and determining approximately where in delay and fringe rate to expect the fringes. There will not normally be time for the fringe searches that are done now unless there is a capability of using 'subarrays' in the correlator Therefore, this should be a specification for the correlator. With the 'subarray' capability, any time that less than the whole correlator is being used for normal VLBA processing, the remaining channels can be used for fringe searching. Since the correlator can handle several more antennas than are in the VLBA, this should be much of the time. Enough time should be allowed between the expected arrival of tapes and the processing to do the fringe searches (about one week).

F. The processor should not be required to take time out from processing to rewind tapes. The actual time at which the tapes get rewound will probably depend on the tape recording system used. If the instrumentation tape system (like Mark III) is used, the tapes will be rewound at the telescope (the shuttle modes may leave the tapes at the start of tape anyway). If the cassette system is used, it may be desirable to have one robot system similar to the playback system whose only job is to rewind tapes.

G. At the time of processing, the operator must mount the tapes, invoke the appropriate file of processing parameters, and monitor the operation of the processor. There are several requirements to make this job reasonably relaxed and reliable:

1. The operator must not be required to preposition tapes at specific times as is the case on the current Mark II processors. The processor control system must be capable of either finding a load point on each tape as in the Mark III system or of using the fast foreward and rewind capabilities of the recorders to position tapes.

2. The operator should not be required to change tapes for all telescopes of the array at once while the processor is idle. This invites a rush job and risks mistakes. If the cassette system is used, it might be useful to have the playback racks capable of holding two of the bins of cassettes. That way, one can be changed while the other is being processed. If the instrumentation drives are used, it might be worth providing enough drives so that tape changes can be made on idle drives. If all tapes play equally well on all drives and the tape change times at the telescopes are staggered, this could be done with only a few extra drives and appropriate switching networks.

3. The operator should not be required to align tape drives. If electral or mechanical realignments are required when tapes from a different station are put on a machine, the operations should be done in such a way that the same drives on the processor are always used for the same telescope.

H. During processing, the system should provide some way of monitoring the data in nearly real time. The processor will probably be using the results of calibrator scans to restrict the ranges of delay and fringe rate that are saved on the output tape. Useful displays of these results should be provided for the use of the operators or of the observers. Also, various displays of the status of various processor subsystems will be needed. An especially important status for display and monitoring is that of the playback quality. While the playback quality must be good, there is little opportunity to correct problems by reprocessing.

I. After processing, the data will be archived. The telescope tapes should probably be retained at the processing center for some (short) fixed period of time while the observer and the staff determine if the processing quality was good enough. Eventually, the tapes need to be erased, cleaned, and returned to the telescopes. The total cycle time for a tape determines the number of tapes that must be purchased for the array so there is strong incentive to keep it as short as possible.

J. As a result of the policy of scheduling the array in a flexible manner in order to take advantage of good conditions for high frequency work and in order to minimize the impact

of equipment problems, the data from any given experiment may be scattered on several archive tapes. Once all the data for a given program has been processed, the operations staff should be responsible for producing a data tape(s) for the observer that contains all of his/her data.

The operations staff will need to include five full time processor operators to cover all shifts and two people to oversee the data flow. The processor operators may be the same as, or share tasks with, the array operators. Probably one manager will be needed to oversee the operations as a whole. The processor operators will have the following duties:

A. Mount and dismount tapes.

B. Activate processor control files.

C. Monitor status of processor.

D. Archive processor output.

E. Keep track of tapes.

F. Erase and clean processed tapes.

G. Ship and receive tapes (separate people?).

The two people who oversee the data flow might be experienced operators but may need to have some astronomical training and an understanding of the end product of the array. They should probably be the same people who coordinate the detailed scheduling of the array and who guarantee the quality of the data from the array. Their activities probably should be managed by a member of the scientific staff. Two people probably are needed because the work load will be heavy and because one will need to cover when the other is on vacation, sick etc. In the area of processor operations, these people will have the following duties:

A. Gather telescope log files and generate the observing history file.

B. Determine whether the observations went sufficiently well that they do not need to be repeated.

C. Generate the processor control files based on the telescope logs and on the desires of the observer. Interaction with the observer should be allowed, but not necessarily encouraged, at this stage.

D. Oversee the operation of the processor.

E. Ensure that the processing was done properly before tapes are recycled.

F. Retrieve all data from each program to give to the observer.

The major items that will be needed to facilitate the processor operations that are not obviously needed just to make the processor work (and hence will be provided regardless) are:

A. Software to facilitate preparation of processor control files.

B. Software to manage the tape inventory.

C. Some mechanism for rewinding tapes other than using the processor.

D. A smooth mechanism for interfacing non-array telescopes to the processing scheme even if they do not provide VLBA-type telescope logs.

E. A capability to do fringe searching on non-array telescopes in parallel with normal processing.

F. Display routines for use during processing.

This is a first attempt to specify the operation of the processor. Any ideas for changes, additions, or deletions are encouraged.