

Haystack Observatory Technology Development Center

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Abstract

Work at MIT Haystack Observatory is currently focusing on three areas:

1. Development of Mark 5 VLBI data system
2. Interfacing of Mark 5 data system to the Mark 4 correlator system
3. Development of e-VLBI

We will describe each of these areas.

1. Mark 5 VLBI Data System

The Mark 5 disk-based VLBI data system is now in the advanced stages of development. The Mark 5P (prototype) system was used at Westford Observatory in October 2002 for 15 continuous days of observations for the CONT02 campaign. The Mark 5A system, which is more sophisticated than Mark 5P, and is a direct replacement for a VLBI or Mark 4 tape transport, is now being deployed and is expected to be in general usage in mid-2003. The Mark 5B, which will be fully VSI-compliant, should be ready for testing by about the end of 2003. Many more details of the Mark 5 system are given in the special report *The Mark 5 VLBI Data System and e-VLBI Development* included in the Special Reports section of this Annual Report.

2. Interfacing Mark 5 Data System to Mark 4 Correlator

As part of the Mark 5 development program, the new Mark 5A data systems have been interfaced to the Mark 4 correlator and are being used successfully on a routine basis. Two Mark 5A units are currently interfaced to each of the correlators at USNO, MPI, and Haystack.



Figure 1. Mark 5A '8-pack' disk module with typical labeling

The Mark 5 uses the new '8-pack' disk modules, one of which is shown in Figure 1. Each '8-pack' module is labeled and managed in a manner almost identical to tape, which makes the

transition from tape to disk relatively easy. Currently most modules use eight 120GB disks for a total of 960GB of storage in a single module, equal to ~ 1.5 Mark 4 tapes. Using eight 200GB disk gives a total storage of 1.6TB, equal to ~ 2.5 Mark 4 tapes.

When used with the Mark 4 correlator, synchronization of the Mark 5A playback with the correlator is very fast. The Mark 5A incorporates a ‘skip’ function that allows several seconds of data to be skipped, forward or backwards, in an instant. Normally, the Mark 5A unit is roughly synchronized by starting playback at near the correct time; once playback begins, the exact position of actual playback relative to the desired playback position can be determined, and a ‘skip’ command instantly brings the Mark 5A into synchronization. Thus, if all the playback units are disk-based, correlation can start very quickly and much throughput efficiency is gained. However, if even a single tape is being correlated along with the disks, the efficiency drops due to the relatively long time to synchronize tapes.

3. e-VLBI Development

Haystack Observatory continues to develop the e-VLBI technique, using the Mark 5 data system to connect to high-speed data networks. The following major items are noted:

- In October 2002, an e-VLBI experiment was conducted between Westford, MA, and Greenbelt, MD (GGAO antenna at NASA/GSFC), using optical fiber to transmit data to the Mark 4 correlator at Haystack. Data rates up to 788 Mbps were achieved.
- In October 2002, the first intercontinental e-VLBI experiment was successfully conducted between Westford, MA and Kashima, Japan. Data were recorded on the K5 at Haystack and on the K5 and Mark 5 systems at Westford. Data were exchanged via e-VLBI in both directions so that both groups could do correlation. Normal fringes were observed.
- Haystack Observatory received a major grant from the National Science Foundation to develop a new IP protocol especially tailored for e-VLBI and similar applications. In summary, this new protocol will ‘scavenge’ unused bandwidth and use it for e-VLBI purposes, but will quickly back out of the way for higher-priority users. In this way, we expect to maximize the use of the network without impacting ordinary higher-priority users.

Additional e-VLBI experiments are planned to both Japan and Europe during 2003 with the hope of achieving near-real-time performance over intercontinental distances.

More information on e-VLBI development is given in the special report *The Mark 5 VLBI Data System and e-VLBI Development* included in the Special Reports section of this Annual Report.