VLB ARRAY MEMO No. 141

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HAYSTACK OBSERVATORY

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TO: VLBA Recorder and Processor Groups

FROM: Haystack VLBI Group

SUBJECT: Some suggested changes and improvements to MK III which might be appropriate for the VLBA.

The MK III is a wideband VLBI data acquisition and recording system. While the MK III was developed primarily for geodetic application of VLBI it was also developed for astronomy. It would seem appropriate therefore to consider the MK III or an upgraded evolved MK III for the VLBA. To make the MK III even more suitable for astronomy (while preserving the features useful for astrometry and geodesy) and to meet the goals of the VLBA we suggest a number of changes.

I.F. Distributor:

1) Allow 4 IF channels (Dual polarization for 2 - wavelengths)
2) Eliminate rear patch panel and bandpass preselection filters

Video Converters:

1) Add 2-way I.F. input selector
2) Add low pass filters for $\pm$8 MHz
3) Add preselection filters[+] which switch with L.O. range

Formatter:

1) Add sample rate 16 Mbits/sec
2) Eliminate mode switching
3) Add 4 channels to increase # channels from 28 to 32

Decoder/Data buffer:

1) Increase max clock rate from 4.5 MHz to 18 MHz

Recorder:

1) Add new ("channelizer" or "mode selector") to enable remote and/or dynamic assignment of sampled formatted data packets

   (one frame = one packet) from up to 32 video signals to tape recorder channels
2) Narrow track heads plus positioner - If recorder is Honeywell model 96

[+] Presently in the I.F. distributor

Format:

1) Add video channel number (1 - 32) to aux data field so that a frame can be traced to the channel from which it originated.

With the above changes the acquisition system could support an abundance of modes from 32 8 MHz channels down to a single 125 KHz channel. Most of the changes are a natural evolution or extension of the present GSFC/NRAO/Haystack/JPL/Phoenix Mark III system. The mode switching (presently in the formatter) would be moved to the recording system and would allow far more flexibility than the present modes A, B, C, & D. For ease of use standard modes might be defined, such as:

1) 8 16 MHz bands* - Normal astronomy mode
2) 14 4 MHz bands - Astrometry/Geodesy mode (MK III Mode A compatible)
3) 1 2 MHz channel - MK II compatible
4) 6 2 MHz channels - Typical spectral line mode
5) 16 16 MHz bands - High sensitivity wideband mode
6) 14 2 MHz channels - "POLARIS" (MK III Mode C compatible)

while more complex modes would be used for special experiments.

If the recording system is VCR based the "channelizer" might# distribute data packets among all available recorders. For a longitudinal recorder the "channelizer" would just provide fixed assignments between channels and tracks. Since the cost of electronics continues to decline most of the changes could probably be made without increasing the cost of the terminal. We estimate that changes to the video converter would increase the parts cost for one converter from $1600 to about $2000. Construction labor costs would probably be reduced in a redesigned module by paying more attention to simpler methods of interconnection and eliminating front panel. Haystack and NRAO produced MK III's cost about 150 K$ (including recorder) each, which is close to the data acquisition cost in table VIII - 5 of the proposal.

Additional notes:

1) Maximum channel bandwidth might be changed from 8 MHz if recorder channel can support more or less
2) If necessary the formatter might have a new non data replacement mode in which extra data blocks are added.

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* 1 band = 2 channels (adjacent upper and lower sidebands)

\# Although the simpler fixed assignment between tracks and channels is probably preferable