

**NATIONAL RADIO ASTRONOMY OBSERVATORY**

VLBA Project Office  
Socorro, New Mexico

**M E M O R A N D U M**

Date: August 23, 1990  
To: Distribution  
From: Ken Stetten  
Subject: VLBA Monitor and Control Network

The available technology and cost environment for data communications has changed significantly since Shalloway's VLBA Memo 299, "VLBA Communications" in December 1983. The purpose of this memo is to briefly present and justify the current design concept for VLBA Network communications developed over the past two years. Its core is the use of the NSF supported Internet and its related technology. This option and others could not be realistically considered at the time Shalloway wrote his memo because the fast pace of change in data communications services, costs, hardware, software, and related computer capabilities has been and still is dramatic.

Attached to this memo are two block diagrams of the basic Network components soon to be installed and tested. The first is the canonical primary network shown for one antenna site; the second is identical except for the addition of the two most promising "emergency" backup communication paths. The configurations will likely change somewhat with experience, and later to take advantage of the operating capabilities expected with future Internet changes (e.g. the OSI protocol) and, eventually, replacement data networks (e.g. the NSF supported 45 mbps National Research and Education Network now under development). A related document, VLBA Memo 668, "Likely Hosts, Costs and Topology of the VLBA Network" being issued simultaneously provides further design elucidation. The latter will be updated periodically as Network site implementation occurs.

The Shalloway memo evaluated the costs of leased telephone line networks and Very Small Aperture Satellite (VSAT) Networks. In 1983, his typical quotes were about \$14k/month for leased lines to network the array; \$29k/month for a VSAT network. Associated equipment costs varied; typical was \$150 - 200k for the array.

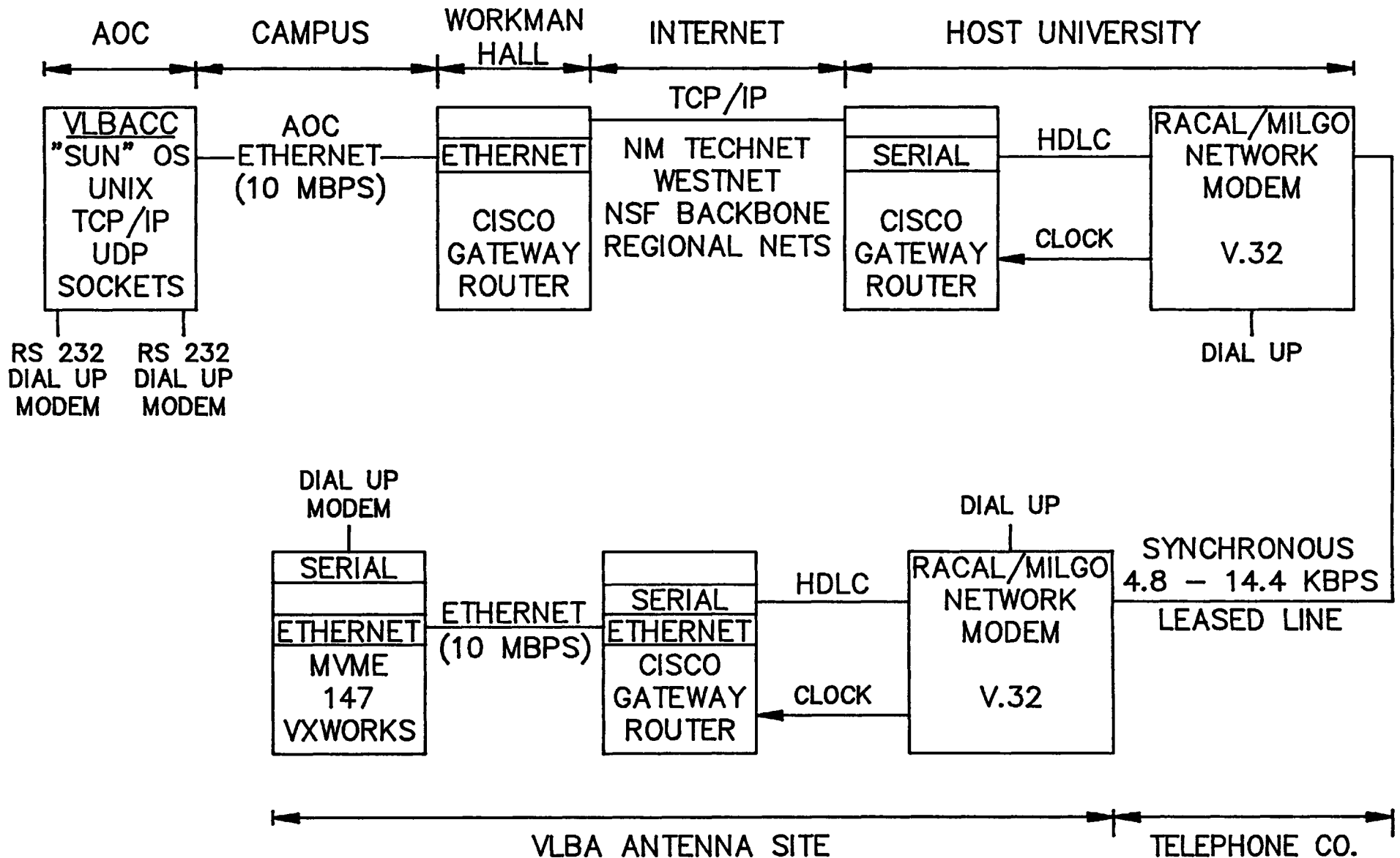
Costs for these options, as well as commercial packet switched data network costs were updated by K.J.S in 1988. It was found that the costs of leased lines had increased dramatically (more than 2X) in five years, due partly to inflation, but mostly to deregulation (contrasting with rapid decline in costs of long distance dial-up service during this same period). The quotes, of course, varied with bandwidth, BER guarantees, length of time of leases, installation costs, and site phase-up duration during construction. A major

disadvantage of all the quotations was the "locking-in" of long term lease commitments, and/or investing in major installation costs despite a rapidly changing communications environment, even to try a single test site.

The 1988 commercial cost quotations for a ten station VLBA communication network in 1988 were in the range of about \$20k/month (for VSAT service) plus an unknown premium to relay to additional satellites for the island sites, to about \$45k/month (for a commercial packet switched data network). The VLBA operations budget allocated in the current plan for this service in 1990 dollars is about \$22k/month.

In contrast, the array operating costs for the Internet design are currently estimated to be only \$3 - 4k/month, largely for the lease of telephone lines between the antennas sites and the nearest Internet node, plus possible regional network charges. To this must be added the costs of NRAO managing and maintaining its Network. Our experience of high reliability with the Internet, the relative ease and low costs of increasing the bandwidth of the leased lines (and hence the effective Network bandwidth) if desired, the international connectivity of the Internet, and NRAO having the ability to take advantage of the evolution of network technology are other likely advantages of the Internet approach. Also, it is interesting that other research organizations are using the Internet for remote control of their observatories (e.g. for the Hat Creek radio telescope and the Apache Point optical telescope).

# PRIMARY VLBA MONITOR & CONTROL NETWORK



# PRIMARY VLBA MONITOR & CONTROL NETWORK PLUS BACKUPS

