LIKELY HOSTS, COSTS AND TOPOLOGY OF THE VLBA NETWORK

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This document summarizes information from queries to a number of potential hosts, the design assumptions given, and any discussion of fees that might be charged by the hosts or their regional networks to support NRAO's use of the Internet to monitor and control each of the ten VLBA antenna sites in their respective region. The VLBA network design process is far from complete. This document gives a snapshot of the early stage status. A few generalities:

1. Little if anything seems in writing at host organizations regarding hosting policy.

2. As with telephone services (e.g. leased lines here), it seems so far that "orders" with the universities (and Los Alamos Laboratory) will continue to be placed verbally, and there may be no contracts or purchase orders. Since we seek "orders" with little or no dollar exchange with the host, a minor investment in periodic fence-mending visits may be planned at the host sites with Internet peers and host department level staff for problem amelioration and reiterating commitments.

3. A sponsor at the university or research organization (typically an astronomer) that vouches NRAO's credentials has often been important for a university's computer department to consider hosting NRAO.

4. Because of the above environment it seems that it will be counter-productive to seek written commitments from host organizations. Instead we think initial visits to the host sites are necessary to pin down as best as possible, relationships, commitments, details of interface, and possible charges. Such visits may be overlapped with installation, test and debug. Arranging long term maintenance procedures is also vital.

5. Things will change with time. In particular none of the above is meant to convey that there will not be pressures on regional networks to increase revenues as NSF support dwindles. But our NSF sponsorship, sub-netting to host organizations, and our modest traffic generation should keep the present approach far less costly than any apparent alternatives as long as something like Internet exists.

My conversations with potential host organizations gave them the following assumptions: NRAO would place a gateway/router at the VLBA antenna site to allow symmetrical Ethernet/Ethernet end-to-end TCP/IP communications; connection to the host would be a leased telephone line with appropriate modems; low speed (9.6 – 56 kbs max) synchronous communication between the serial port of an antenna's router and the hosts' router (typically at an Internet campus geographically closest to a given antenna site); an average round-the clock traffic load of 3 kbs from the antenna toward Socorro, NM; and 0.1 kbs to the antenna. NRAO, of course, would expect to pay for the antenna router, leased lines, modems, and an additional interface board for the host's router if required.

Following is a breakdown of the reactions of potential and current hosts to date, by VLBA site:

ARRAY OPERATIONS CENTER (AOC), SOCORRO, NM – NRAO currently pays $500/month to New Mexico Institute of Mining and Technology for the AOC's Internet connection via NMIMT's Ethernet interface of their Cisco router. Half of this sum amortizes Tech's equipment and maintenance costs, the remaining $250 contributes to Tech's monthly fee to our regional network: New Mexico Technet. Essentially all of

the AOC's Vax's, Convex's, Suns, workstations, terminals, terminal servers, VME's, E-mail systems, and PC's on the DDS etc. have and generate Internet traffic. One of the Suns (VLBACC) is the controller and monitor of all the VLBA antennas, but is presently limited to direct telephone communications with the five operable antenna sites until antenna site computers become Internet nodes. New Mexico Technet and NMIMT officials indicate there will be no increase in charges due to this modest VLBA traffic. In fact they are shortly upgrading Tech's Internet capacity from 56kbs to 400 kbs with no concurrent increase in rates planned from either organization.

PIE TOWN, NM - We expect to be connected to NMIMT's router via leased line. NM Technet says there will be no additional site fees charged by them for the Pie Town node. They also do not charge the university consortium remotely operating the Apache Point observatory through a router at the State University of New Mexico in Los Cruces, NM.
LOS ALAMOS, NM - We expect to be connected to Los Alamos Laboratory's router via leased line. Officials at LANL say there will be no charges. In fact LANL is paying for the leased line from their router to the antenna and their staff has provided significant consultation in setting up this first antenna on the Internet. They helped NRAO perform an initial test of Internet to our Los Alamos antenna using the Internet connection of one of LANL'S VAX's specially equipped with a dial up modem for local calls to the antenna. NM Technet says they will not charge NRAO or LANL for the VLBA antenna's site Internet node.

KITT PEAK, AZ - It is expected that this site will be connected to NOAO's router on Kitt Peak via a 1 mile leased telephone line. No regional network charges or other connectivity charges are expected by University of Arizona staff we have spoken with. However NRAO would share a part of NOAO's cost of a T-1 line to the mountain top funded by a consortium of users. An alternate is the equivalent of a conventional leased line directly from U of A's campus router to the Kitt Peak Antenna, again with no connectivity or regional network site charges expected. The University of Arizona presently does not charge NRAO's or NOAO's Tuscon offices, or NRAO's 12 meter antenna Ethernet on Kitt Peak for their present Internet connectivity (NRAO through Stewart Observatory).

FORT DAVIS, TX - The astronomy department at the University of Texas, Austin said their reliability experience was good with leased lines to their Harvard antenna near the VLBA antenna. They took for granted we could obtain easy access to UT campus routers to connect the VLBA antenna. Leased lines from the Midland-Odessa campus of UT appears to be the least expensive (perhaps $200-300/month), but more investigation is necessary. No connectivity charges were mentioned by UT staff.

NORTH LIBERTY, IA -The astronomy department at the University of Iowa indicated connectivity should be straightforward and provided appropriate contacts with their communication people. Leased line cost is expected to be approximately $300/month. No network charges were mentioned.

OWENS VALLEY, CA - Cal Tech's nearby (about 300 meters) installation has Internet connectivity over a multiplexed (9600 kbs Decnet plus voice) 19.6 kbs leased line (costing Cal Tech $600/month) from the main campus. Inquiries will be made to determine if the same line can be shared with routers at either end to serve the VAX Ethernet, VME Ethernet and voice through their existing multiplexer.

BREWSTER, WA - The University of Washington in Seattle is on the NSF-Net backbone. U of W staff says we can connect through their router without regional net charges. However the long leased line to the

VLBA site in central Washington is expensive: $1300/month. A closer router at the Washington State University in Pullman, WA reduces leased line costs to $800/month, still comparatively costly, but this connection in a state so sparsely populated with router sites would likely incur Northwest Net membership fees ($5000/year), according to U of W. The Proteon router at the Pullman site may also cause compatibility problems "talking" to the VLBA's standard CISCO routers. There are possible solutions to this, but more investigation is required.

HANCOCK, NH – Inquiries not yet made. Dartmouth University will be a starting point.

ST. CROIX, VI – Inquiries not yet made. The University of the Virgin Islands will be contacted first.

MAUNA KEA, HI – The University of Hawaii feeds a router on the summit. A leased line circuit from there to the VLBA antenna (approx. 3 miles) could feed NRAO's router at the antenna. A fallback is a leased line connection to another router on this "big island", in Hilo. We were told that the University has a $25,000/ month bill for its overseas connection to CONUS, and that all users of the Internet using its mainland connectivity are charged $500/month by the University to share this cost.