A white paper outlining a reasonable architecture for the Computing and Networking Infrastructure at South Pole was written by former ASA employee Marty Lyons. Marty requested input from those science groups present at SP during mid-december 1991, and the resulting paper reflects those recommendations.

At the science meeting hosted by Johns Hopkins Applied Physics Lab last month, it was decided to send a copy of this report to all science users of the South Pole Station. Please send (preferably email) all comments to me by May 15 and I will include them in a final copy to be sent to NSF as a recommendation from the science community.

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Networking ---------- The South Pole net needs to be segmented both for reasons of fault isolation as well as future expansion. The network infrastructure buildout will lay the foundation for the next several years of adding additional computing resources and services.

Jane Ozga had spoken to Synoptics and cisco, and received information from them on a Synoptics hub which supported slide in cisco router cards, as well as a Farallon card to drive a Appletalk network. That chassis would form the foundation for the new South Pole network.

What we would like to see would be:

- FDDI Fiber run to CARA, with a Synoptics hub in CARA itself, with 8 Ethernet ports on a concentrator card, as well as the Farallon card, to allow us to plug in Macintoshes directly and utilize the features of Localtalk (Printer and file server accesibility). CARA will be placing a heavy load on the network in terms of file transfer back into the dome, as well as TCP based connectivity tools (X, Telnet, etc), and will be using quite a bit of bandwidth. Hence, the FDDI connection.
- Ethernet fiber run to Clean Air facility, with an 8 port Ethernet concentrator, as well as the Farallon card, available within Clean Air.
- Ethernet fiber run to the SPASE shack, with an 8 port Ethernet concentrator, as well as the Farallon card, to allow direct Macintosh Localtalk connectivity. Teflon thickwire Ethernet cable run through the Power Plant and on into the Garage Arch, Cargo Arch, and Balloon Inflation Tower.
- Teflon thickwire Ethernet cable run to BioMed.

Most places within the dome can utilize existing phone circuits to build a Macintosh Localtalk network as required. Remote sites where we will be installing fiber should utilize that as the primary media for as many types of communications as possible (data, voice, video, etc.)

The computer center, located within the dome, will be the termination point for all individual network segments. What we would like to see in the computer center rack would be another Synoptics hub with:

- FDDI cisco router card, to drive the connection to CARA. If possible, and I don't know if cisco makes this, it would be ideal for this to be a multi port FDDI router card, so we could plug in more FDDI stations. I'd like to be able to plug the main Sun server into that card, for example. Alternatively, we would have to purchase the FDDI router card, then a separate FDDI multi port card.
- Fiber Ethernet cisco router card, to drive the Clean Air segment
- Fiber Ethernet cisco router card, to drive the SPASE segment
- Dual port Ethernet cisco router card, to drive the Power/Garage/Cargo/BIT segment
- Dual port Ethernet cisco router card, to drive the BioMed segment
- Farallon Appletalk card to allow us to plug Macintoshes directly into the network within the Computer Room

- At least 2 spare Fiber Ethernet cisco router cards
- One spare FDDI cisco router card
- Two spare Dual Port Ethernet cisco router cards
- Two spare Farallon cards
- Other spares (power supplies, etc) as appropriate.

Hardware -------- Beginning with a informal survey I took at the Washington, D.C. pre-deployment conference, the wishes of the science community directed this design towards a more distributed computing environment. It is clear, especially here at Pole, that the needs of the science community are not being served by the centralized model of computing. Rather, teams are coming from university and research environments which make available, and stress, a hierarchal model of computing, which yields a much greater amount of flexibility to the end user.

The expansion of the Pole computing environment should progress in two distinct, albeit complementary directions. First, the expansion of the network to include distributed computing platforms, and second, the expansion of the existing VAX/PC environments to handle the increased loads of the expanding network.

In terms of distributed systems, science has made it clear that the systems which are predominant in their home institutions are Unix workstations and Macintoshes. In particular, Sun workstations, high end Macs and PC's.

Towards this end, I believe South Pole should procure the following hardware to give us a broader and more powerful computing base:

- A high end Unix server system, which should be able to run to run all popular software, as well as form a solid platform to drive its client workstations.

  I recommend a high end Sun server, such as a 4/470, or 4/490, with a minimum of 64 Megabytes of memory, and a minimum of 6 Gigabytes of disk space. The large memory requirement is to allow the system to drive lower end workstations remotely, or X terminals, as well as run large compute intensive tasks such as mathematics, data reduction, and visualization. This system would be the real workhourse for any large CPU or disk constrained job. With most workstations at Pole running X, I envision this as the one machine which will be doing a lot of number crunching, and file transfer, since it will house the disk farm.

  The large disk space requirement is to allow the system to hold enough data online for analysis, to allow us to load an entire Exabyte tape (2.3 Gigabytes), for storage of copies of the operating system for its diskless clients, such as X stations, and also for storage of all software products, which will then be made available to the rest of the network by file sharing software such as NFS or Andrew File System (AFS).

  The system should also be purchased with both an Exabyte tape drive, model EXB-8200 (the 8500 has known firmware problems as of this writing), as well as a 6250/1600 bpi 9-track tape drive, CD-ROM drive, and a FDDI board.

- A minimum of four high end Sun workstations, such as Sparcstation 2's, with 19" color monitors, 16 Meg memory, large disk drives. and 160Meg 1/4" cartridge tape (QIC-160 format). Two of these systems would be installed at the CARA facility, the other two in the Computer Room.
- A minimum of four Sparcstation SLCs, to be used for less CPU intensive tasks. They should have minimum 8 Meg memory. These SLCs would be diskless, and driven by the main Sparcserver system. They would all be placed in the Computer Room at this time, although some might be loaned to CARA during the summer as required.

- A minimum of four Macintosh IIci (perhaps quadra) systems, with 19" color monitors, 8 Meg memory, large hard drives, and DAT tape drives. One of these systems would be placed at the CARA site.
- Two Postscript printers. One should be a QNS Color Postscript printer, which will be installed in the Computer Room. The second should be an Apple Laserwriter II which will be installed at CARA.
- PCs. Currently at Pole we have only one general purpose PC available in the Computer Center. We should purchase at least two other 386/486 based systems, preferably with large (120 Meg) hard drives, 4 Meg memory, VGA monitors, Ethernet cards (suggest 3Com 3C503 cards), Mouse, one 5.25" floppy, one 3.5" floppy, and a 120 Meg tape backup unit. More than likely these should be Compaqs, if for no other reason to allow us to swap parts between systems when one of them breaks.
- The existing MicroVaxes already have equipment on order for their upgrades. In particular, I ordered disk expansion for each system, adding two 600 Meg drives to each, for a total of 1.2 Gigabytes in each system. I also ordered an Exabyte drive model 8200 for each system. We are reviewing now the possibility of clustering the two MicroVaxes, which would give us an even greater amount of available disk space.

  We would like to consider and should get a quote on the cost of upgrading the CPUs in the two systems. We have installed Multinet (TCP/IP software for VMS) on both systems, and they are now being connected to, and will be serving more remote stations because of the TCP accesibility.

  Also note that I ordered two additional terminal servers at the beginning of this season, from Lantronix, which support both LAT compatibility and TCP/IP in the box.

Software -------- Much of the software to enable South Pole to take advantage of the power of distributed computing is available free of charge over the Internet. In particular, things like CAP (Columbia Appleshare Protocol) allows the sharing of Unix and Macintosh resources, such as disk drives and printers; NCSA Telnet for both PCs and Macintoshes provides TCP/IP Telnet and FTP support for those platforms; the X Window System gives a TCP based windowing platform to many different machines; and so on.

Software which should be purchased includes:

- A site license for the MacTCP driver from Apple ($2500). This will enable us to use the MacTCP driver in Macintoshes with Ethernet cards, to allow them to work with the NCSA Telnet software. (marty,..don't necessarily need MacTCP to work with NCSA Telnet...We only needed it for the TCP/IP interface currently being used on Vax. However, it is still reasonable to get the site license-rfl)
- X Window System:
  - Open Look (which is an X base) is shipped automatically now with all Suns
  - We have Mac X as part of the Pathworks Software for Macs
  - Should purchase Desqview for X from Quarterdeck Software for PCs
- Graphing packages:
  - PAW, from CERN, Switzerland, Public Domain (we have this now)
  - SAS/GRAPH, for Suns, PCs, and Macs
  - TEMPLATE, for Suns and Vaxes
  - MONGO, for Vaxes (Public Domain)
  - FITS
- Mac packages:
  - Word processing: MacWrite, Microsoft Word
  - Drawing: MacDraw, Superpaint
  - Communications: Versaterm, NCSA Telnet)
  - Graphic/frame grabbing software and hardware boards
- Programming: C, FORTRAN, Pascal (Suns, PCs, Macs). We already have these languages on the VAX.
- Mathematics:

- Mathematica (from Wolfram Research) - for Suns, Macs, PCs
- IDL (for Data Analysis) for Suns and Macs
- IMSL (subroutine libraries) for Macs, PC, Suns, and VAX

Satellite Communications ---------- The subject keeps coming up, and it will get to be a pain for everyone very soon unless we get more bandwidth. Already the CARA group is talking about a requirement of moving 200-600 Megabytes a day of data back to the states. Even without the CARA load, overall needs of science continue to grow, the amount of email traffic is increasing, and we are making life difficult all around by not having a high speed satellite link. A minimum of a 9.6kb/sec link, and equipment to drive the link as a synchronous channel so Pole could be on the Internet during satellite visibility, should be a minimum requirement. The level of service we could provide to our customer base here at Pole can increase exponentially merely be being able to connect to the Internet, even if just for a few hours a day. (GOES2 -56kb for 2 hours) ----------//----------