

To: Larry Murdock, Chair Backbone Engineering Group
From: Elise Meyer, Chair CalREN-2 Implementation Group
Date: October 24, 1997
Re: CalREN-2 Campus Fiber Issues

The CalREN-2 Implementation Group is facing limitations with building a new high speed backbone connecting our research groups to the off-campus CalREN network due to both the topology and capabilities of our existing campus fiber plant. The new network that we plan to build in order to support the bandwidth required for all of our research projects needs to use fiberoptic cable. Since the plan is for the CalREN-2 off-campus network to be operational in early 1998, these issues must be addressed immediately.

The first problem is that the Electronic Art and Theory Lab which is participating in this project does not have any fiber optic cable connecting the Arts building to the campus fiber plant. There are two possible solutions to this problem, either run fiber optic cable to the building or move the server to a building that already has fiber.

The second problem is that there is no reasonable solution to provide adequate bandwidth to all of the CalREN-2 research groups without augmenting our existing fiberoptic cable plant. The majority of the research groups are located on Fiber Ring 2 which only has multimode fiberoptic cable. There is a cluster of research groups located near North Hall, and there is a cluster of research groups located near Engineering I. We must locate one switch in North Hall to make use of the singlemode fiber between that building and Public Safety, in order to provide a high speed connection to the CENIC ATM switch. We investigated the following options using multimode fiber:

- 1) A single switch located in North Hall with point-to-point connections to each research group. This will not work because the decibel (dB) loss between North Hall and the farthest research group greatly exceeds both the OC-3 and Full Duplex Fast Ethernet dB loss specifications.
- 2) Two switches using multiple low speed connections over multiple fiber pairs as a backbone with point-to-point connections to their respective research groups. This still will not work because even if we extend the second switch out as far as OC-3 dB loss limits will allow, the dB loss between the second switch and the farthest research group still exceeds both the OC-3 and Full Duplex Fast Ethernet dB loss specifications.
- 3) Two switches using a single high speed connection as a backbone with point-to-point connections to their respective research groups. This solution won't work because the distance limitations for OC-12 and Gigabit Ethernet are much shorter than for OC-3, so the second switch would be even further away from the farthest research group in option #2.

With our current fiberoptic cable plant, we can neither reach all of our research groups from one location, nor have two locations that are far enough apart to reach all of the research groups. There are two possible solutions that involve running more fiberoptic cable. The first would be to run singlemode fiber to a strategic location near the farthest research groups and locate a switch there that was connected back to North Hall via a high speed connection using either OC-12 ATM or Gigabit Ethernet. The second solution would be to run multimode fiber to split Fiber Ring 2 in a strategic location so that all of the research groups would then have a short enough path back to a single switch located in North Hall. We are initially concerned with providing either OC-3 ATM or Full Duplex Fast Ethernet to each research group and aggregating the bandwidth back to the CENIC ATM switch, however we may need to deliver OC-12 or Gigabit Ethernet bandwidth directly to some of the research groups before the end of this project and neither of our proposed solutions would allow that capability.

Since singlemode fiber has better distance and transmit capabilities than multimode fiber we recommend the solution that provides singlemode fiber to connect our backbone equipment which would allow us to use high speed technologies such as OC-12 ATM or Gigabit Ethernet. The cost to extend Ring 4 to the Arts building is around \$100,000 so the Electronic Art and Theory Lab is willing to move their project's server into a building that already has a fiberoptic cable for their connection to the CalREN-2 network, but they are continuing efforts to try and get fiberoptic cable run to their own building. Both of our solutions

only address current problems, they do not provide for higher bandwidth capabilities to the CalREN-2 research groups which would be possible with future expansion of the fiberoptic cable plant.

Since the CalREN-2 off-campus network will be operational in early 1998, we need to have any fiber installations implemented as rapidly as possible. We would like the CalREN-2 sites addressed in this memo to have a high priority in any future fiber installation plan.