FUTURE COMPUTER NETWORKING FACILITIES FOR REMOTE ACCESS OF SSC DATA

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INTRODUCTION

The intent of this paper is to identify future services for remote access of computer resources that may be available for the HEP community within the time-frame of the operation of the SSC. The communications industry is now changing very rapidly, thus predictions on future services based on current trends has a large element of speculation. I will try however to at least identify the need for certain network requirements and project possible future services based on these requirements.

HIGH ENERGY PHYSICS NETWORK (HEPNET)

I assume in this note that there will already be a HEPnet in place and in operation well in advance of any SSC development. HEPnet functions have been described in several other documents pertaining to the future computing requirements for the HEP community so I will not describe it here. I will say however that I feel that a minimum of a T1 (1.544 Mbs) backbone would be required to handle the combined traffic load of the HEP community as it exists with the addition of the SSC requirements. I would also speculate that the topology of HEPnet might change where each HEPnet distribution point (west, central, and east) would probably need an individual link to wherever the SSC is located. This would imply T1 circuits between existing HEPnet nodes, and between the SSC and each HEPnet node. (See figure

1.) This configuration would allow the pre-SSC HEPnet to be an effective distribution means for SSC development activity, and when there is SSC data to move, add the new lines so that the pre-SSC HEPnet is not swamped by the additional load. Doing this will allow SSC users to utilize their existing HEPnet connection (again assuming that HEPnet is in place) to also gain access to SSC computer systems. The existing HEPnet would benefit by having additional bandwidth available for its use.

The upgrading of the HEPnet backbone links assumes that there will be more cost-effective T-1 circuits than there are today. We have to hope that the current installation of fiber-optic trunk lines across the country will drastically affect the cost/performance ratio of these circuits.

UNIVERSITY CONNECTIONS TO BACKBONE

Today the typical university connects to their favorite laboratory(s) by leasing voice grade analog data circuits that can typically support 9.6Kb with inexpensive modems. Given that there is a HEPnet, a single connection to the backbone should be all that is necessary for the users to get to the laboratory or university required, assuming that the bandwidth requirements are minimal. The bandwidth to the backbone should be the limiting factor in performance. One must assume that there needs to be increasing bandwidth for the university to backbone links as well. Part of the increase will hopefully come from technology where DDS (Digital Data Service)-like services become more cost-effective as more bandwidth from fiber-optic trunks becomes more available. This should create a competitive atmosphere that would reduce the costs. It is reasonable to speculate that within the time period of the SSC taking data that one might expect that there will be 56 Kb channels available for the current price of two 9.6Kb lines.

SATELLITE BROADCAST SYSTEM

Any increase in speed between the HEPnet backbone and the university will probably not be enough to allow for bulk movement of files. I believe that this might have to be done through the use of satellite broadcast. Satellite data transmissions in general will have a lot of competition from fiber-optics within this time-frame. One area where satellites will always be more cost effective is in broadcasting over a physically wide area. High energy physics has run experiments in Europe for moving tapes-worth of data via satellite. These experiments have shown that satellite-based systems can work effectively.

I would propose that SSC take advantage of satellite broadcast for the movement of bulk data between the central file storage resource and the university. To do so would require that there be an earth station installed at the SSC site. A receive-only earth station would have to be installed at each university interested in taking advantage of this system. I would propose that T-1 speed (1.544 Mbs) be used in the initial implementation. T-1 would give an affordable performance increase over the possible 56 Kb link from the university and the HEPnet backbone.

To utilize a satellite in a broadcast mode, one would need to establish a communications link between the university and the SSC using the satellite up and down links from the SSC to the university, and a lower speed (56 Kb or 9.6Kb) HEPnet connection for the return path. (See figure 2.) This asymetric speed arrangement will require that software protocol be written specifically to exploit its potential. This would be a shared resource where requests for file transfers would be queued at the SSC, and sent out in a pre-determined order. The protocol at the university and SSC would guarantee error free transmission. Even at T-1 speeds, the time to transmit a 6250 BPS tape will be about 13 minutes. For this reason, I would expect there would be a need to set priorities for file transfers based on size and need. We could increase the speed of transmission by factors of 2 or 4, but that would increase the cost of the hardware both at the universities and the SSC substantially.

We would also use this facility to transmit graphics files from the SSC computer systems to the university user. One might move these files in a batch mode in the simplest arrangement, or directly to the terminal in a more complex implementation.

CONCLUSION

There will be new communications services available for use within the time of the SSC taking data. It will be important for us to track these services so that our strategy for providing remote networking can be adapted.

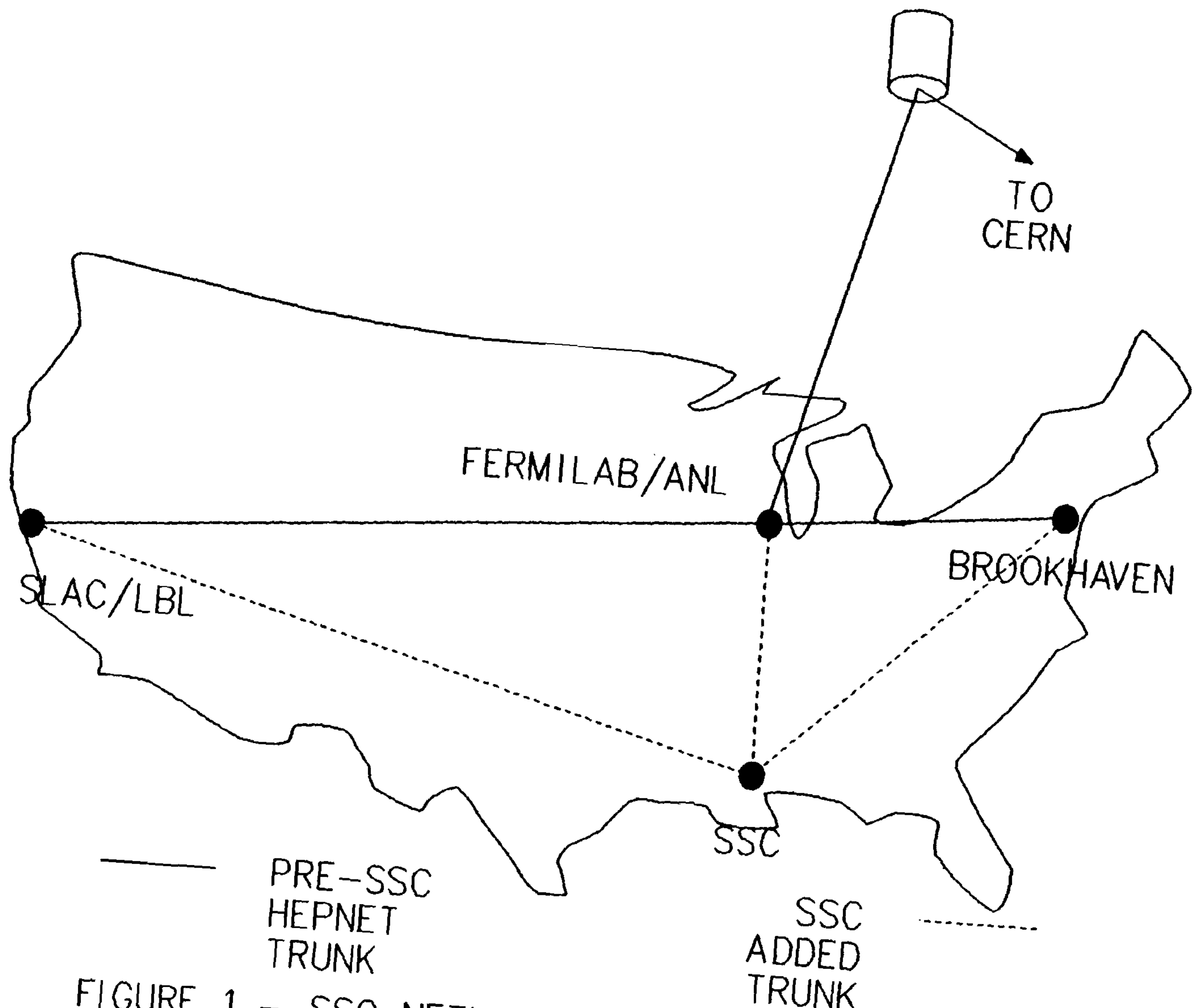

FIGURE 1 - SSC NETWORK ATTACHMENT TO HEPNET

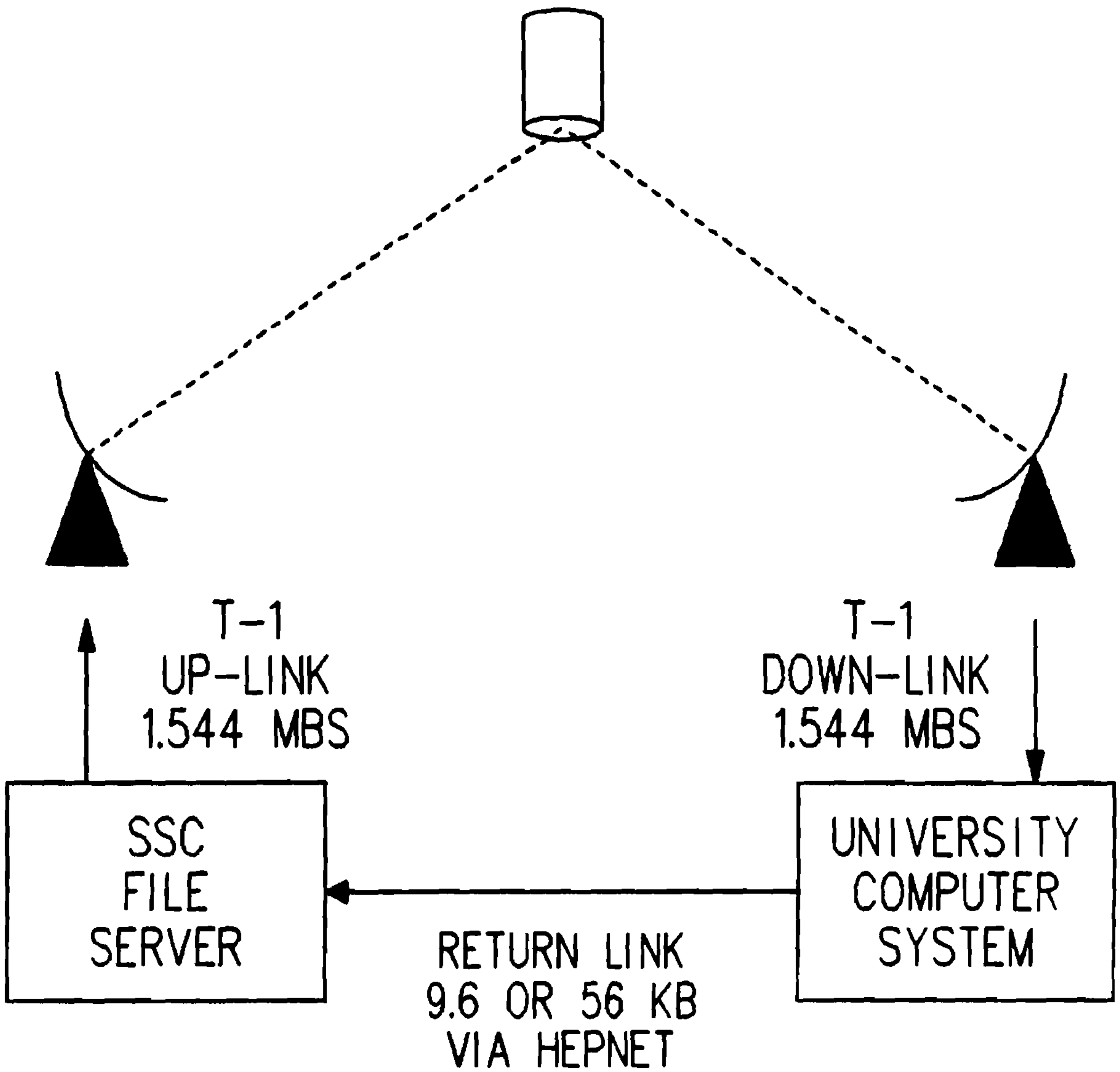

FIGURE 2 - SATELLITE BROADCAST SYSTEM