INTERDEPARTMENTAL

MASSACHUSETTS INSTITUTE OF TECHNOLOGY *CAMBRIDGE, MASS. 02139*

from the office of

December 1, 1970

Mr. Morton Berlan
Telecommunications Office
E19-204

Dear Mort:

This letter outlines a proposal for reconfiguration of the present M.I.T. data switch which, though occurring late in its life, stands to save a substantial amount of money. Although I realize that the present configuration was frozen over a year ago, two essentially new factors now appear: 1) there is increased pressure on finding ways of saving money, and 2) I have discovered a configuration which I had not thought of before, and which has some very important desirable properties, which include cost savings.

The fundamental difficulty the proposal seeks to attack is that the present data switch configuration forces us to provide a much larger number of trunks, datasets, and computer ports than can ever be utilized simultaneously. This difficulty shows up in large trunk groups, such as the 64-trunk group currently used for 2741 access to the GE-645 (Multics) computer. With the initial trunk grading, this trunk group provided a measured busy probability of 5% whenever more than 32 of the 64 lines were in use. The best efforts at grading will produce an unacceptable busy signal probability when only 48 of these lines are simultaneously in use. As we look ahead to the configuration necessary to support 60 simultaneous 2741 lines, (needed in Spring, 1971 to meet our anticipated load) we find that we must provide 80 trunks, datasets, and computer ports, of which 20 represent a surplus forced by access limitation in the data switch. When the trunk numbers were smaller, the issue did not appear so significant, but the economics of the surplus are beginning to appear unreasonable. At present rates, we are paying on a per-port basis:

$9/month	for the telephone trunk
$25/month	for the 103E dataset
$50/month	for the GE-645 computer port
$84/month	total direct cost of a computer port

These figures do not include the overhead costs of floor space, electric power, core memory to store tables used by port control programs, and other operations costs; in computing rates to charge users, we normally compensate for these overhead items by multiplying the direct charges by a factor near 2.0. Thus, to attach 20 surplus ports to the GE-645, our cost is

20 X 84 X 2.0 = $3360/month

This figure represents an upper bound on the amount one could afford to spend on data switch reconfiguration. (Perhaps we should lower it by $500 to account for the possibility of using Tuck datasets). As I recall, individual switches in the exchange rent for about $5/month, so this rent would cover about 600 such switches. This proposal outlines a way of achieving a totally non-blocking configuration by the addition of only 180 selectors to the present configuration. The implication of the non-blocking configuration would be that no surplus of computer ports would be needed.

The basic strategy of the proposal is to return to a pattern we discussed once before, with 2-digit numbers, each of which results in a hunt over only 10 computer trunks. Thus, for a 60-trunk group on level 8, one would dial numbers from 81 through 86. This technique requires addition of "second selector" switches to level 8 to accept the second digit of the number. For maximum flexibility there would be no partial grading used. That is, all second selectors would scan the same identical group of ten trunks in response to the dialed number "81". This ungraded arrangement permits predictable dialing to specific ports in case of trouble, methodical scanning of all 60 trunks by dialing 6 separate numbers, ability to dial to an alternate trunk if trouble is encountered, and change over of a trunk group from one class of computer port (say 2741) to another (say TTY model 37) without telephone company intervention, since in reality what has been provided is 6 10-line groups, each of which is independent of the others.

This approach leaves one with the problem of choosing the correct number of second selector switches. If this number is too small, a busy signal may be received as soon as the caller dials his first digit, when traffic is heavy. This is exactly the same problem as when dialing 8 to attach directly to computer trunks, except that we do not need to provide extra computer ports at $168/month: instead we provide extra second selector switches at $5/month.

Now we come to a remarkable observation: if one provides the right number of second selectors, one can provide 100% access. To see this, we must recall that first selectors come in "shelves" of ten or fewer. The significance of the "shelf" is that all of those first selectors must share a common second selector hunting pattern. If we provide ten second selectors, whose function is to service only those ten first selectors, it must always be true that a call originating on that shelf will not be blocked by lack of a second selector.

Extending this reasoning, we see that as long as there is one-to-one backing of first selectors with second selectors, there will be no blocking at any point in level 8. The present configuration has 180 first selectors, so one would provide 180 level 8 second selectors to achieve this effect. With this configuration, one could ultimately expand level 8 to up to 100 lines to which full access is always available. When more than 100 trunks are needed, it would then be appropriate to extend one of the other levels (say level 7) to a similar configuration of 180 second selectors.

In order to perform this change, there are clearly some other issues which must be thought about, such as the probable need to go to 11-foot racks in the telephone room. However, the potential dollar savings involved seems to be large enough that we should think about it.

Note that if this technique of configuration were used for a projected 1975 data switch with 900 terminals and 300 active computer ports, it would require

300 line finders
300 first selectors
300 second selectors on each of three levels = 900
total 1500 switches

It would provide us with a completely non-blocking switch, with ability to move trunks in groups of ten from one function to another with little effort, and with the important ability to methodically dial to a particular trunk thought to be in trouble. These are three properties which appear to be unavailable in the proposed Centrex switch. For the first time, I see a clearly usable (perhaps better) alternative to Centrex.

Your consideration of this proposal would be appreciated. If you have any questions, please give me a call. I would be happy to get together with NET engineering personnel to discuss it.

Sincerely yours,

Jerome H. Saltzer
Associate Professor of
Electrical Engineering

JHS/mw

xc: F.J. Corbató
W.J. Burner
R.H. Scott
T.H. VanVleck