

J. A. Saltzer

TO: Multics/MAC Planning Committee

DATE: 1/13/69

FROM: F. J. Corbató, J. H. Saltzer

SUBJECT: MAC Management Plan

This is a cover letter for two documents.

1. The first document has been previously distributed as a rough draft of a management plan for Project MAC and Multics as a basis for discussion.
^{that}
(~~This~~ document is erroneously dated January 6, 1968; it should be 1969.)
2. Enclosed is an outline of points in response to discussion of that plan and to proposals made by the General Electric Company on January 9, 1969. These points are intended as input for discussion and possible incorporation in the overall management plan for Project MAC which remains to be developed in full.

January 13, 1969

date _____

Points to be Integrated into MAC Management Plan in Response to GE Proposal

- I. Preferred plan from point of view of M.I.T. and Project MAC.
- a. M.I.T. rents smaller ("A") machine } until ready to
GE rents larger ("B") machine } start Multics service.

Criteria for readiness: ~ 30 user capacity; stability good enough to ask people to pay for service, enough facilities to permit production use.

The "A" machine would be upgraded to speed development work by adding a fire hose drum. (Additional core memory in the amounts specified will have too small an effect on development to be worth the cost.

- b. After readiness criterias are met (about 9 months, 3 Q 69)
- Rental flips. M.I.T. takes over large ("B") machine, begins to start Multics service for M.I.T. and MAC users. G.E. takes over "A" machine, keeps it configured to whatever extent appropriate for rate of development work at that time.

Hardware considerations:

- i. "A" machine serves as a processor and memory backup for the "B" machine on a module-by-module basis.
- ii. ^{Second added} "A" disk ~~moves~~ to "B" machine since development disk needs diminish) and service needs grow. (Possibly parallel from the "A" machine since
- iii. Orders placed for third and fourth disk to arrive on schedule to upgrade capacity to 51 megawords,

then 68 megawords.

Pricing considerations of Multics Service

- i. MAC sets prices to M.I.T. and New England colleges and distributes services via IPSC.
- ii. MAC underwrites the cost of the unused saleable portion.
- iii. MAC subsidizes use of Multics for software tool building originating within MAC.
- iv. MAC subsidizes ordinary MAC usage of Multics.
- v. MAC subsidizes ARPA contractors experimental usage via network or direct dial-in, up to some limit (say 10 percent).

Expectations

- i. Operation should follow this pattern for at least nine months before GE makes an evaluation for marketing purposes.
- ii. Critical issue is involvement of people: a research worker's most precious resource is his own time and effort.
- iii. Software support during this period is by MIT/GE/BTL group; it is presumed that GE will use the time (and practice) to develop a commercial maintenance team, to be prepared for later commercial offerings.

II. GE Service Bureau Alternative

a. "test marketing" psychology could suggest tentativeness of Multics existence at M.I.T. unless specific guarantees are made in advance. There must be an important attitude that the service will not stop. Student theses as well as large research projects require this commitment - say a minimum of three years. (CTSS history provides an example of how not to do this.)

*b. The motivation of
to sell the Multics
- Service of M.I.T.
Buyers able to
encourage student
service at M.I.T.
to make a profit
since it would be
the basis of why
people buy -
GE products rather
than asking them to
help support computer
facility.*

c. Concern about price coming out right - GE should expect to be compensated for underwriting, and should make a profit, if they are going to hold the bag; they have the right to concern themselves with precedents. (See note at end.)

d. What is the basis for setting a preferred rate - how does one resolve quibbles over who qualifies. (Extra grey areas leave possibility of much negotiation and extra thorns .)

e. Overtones of M.I.T. helping GE making a profit (The preferred rate for MAC usage accentuates this concern.)

- i. M.I.T. Policy issue
- ii. Programmers morale issue
- iii. ARPA concern - government giving GE a profit.
- iv. GE selling Multics back to M.I.T.

d. The ability to change the system easily is a concern since requirements of reliability for commercial service could inhibit the installation and development of improved versions of the system.

e. Ability to choose the audience and thereby control somewhat the instability tolerance of the community; difficulty of user at a distance when system is new.

- f. Number of services prerequisite for a success. (GE service bureau implies better support.)
- g. Who decides whether or not success is manifest? The answer could be tangled with the GE decision to enter the service bureau business for real which may have little to do with the value of Multics to M.I.T.
- h. Question of how billing to M.I.T. community would be handled? Does GE bill MAC or bill the individual?

III. Follow on Hardware Arrangements

- a. Decoupled from previous questions (should be kept this way).
- b. Should negotiate start of hardware design discussions based on a letter of intent "pending support from ARPA and satisfactory conclusion of specs."
- c. Timing: begin discussion of specs now, initiating 18 month hardware development and delivery period. After three months if specs are satisfactory, funding is available, and there is satisfactory progress on Multics, initiate remaining 15 month of work with a firm order.

IV. Concern for BTL Participation

- a. GE makes continued BTL participation a condition of continued GE interest. Since BTL participation is not very strong at this time, an effort must be made to increase or strengthen BTL involvement with the project.
- b. Successful acceptance of the system by the outside world requires that BTL not only have 645 hardware but that they also use and operate the Multics system on a regular basis. This operation should preferably be on-site at Murray Hill, to assure

- i. contagioⁿ of enthusiasm at Murray Hill.
 - ii. Murray Hill ability to judge success of Multics at close range.
 - iii. Keeping involved key BTL participants to be prepared for success.
 - iv. To maximize speed of system development in the areas of I/O system, Fortran IV, TMG/EPL.
- c. An alternative is to permit BTL usage of M.I.T. system. flaws:
- i. initially we are not running a public service.
 - ii. Pressure/temptation to devote resources which should be used for development to sustaining BTL interest.
 - iii. Undermines BTL confidence in ability to run the system locally.
- d. Other alternatives which haven't been mentioned but which should be explored:
- i. Run Multics part of the time on one machine at BTL. (E.g., B machine alternates with GECOS III and Multics.)
 - ii. Embed TSS645 within Multics, using interface programs to file system and typewriter I/O. This would permit an in-house Multics system to supply the equivalent of a very substantial BTL usage of commercial time-sharing services.
 - iii. Embed a GECOS III TSS functional subsystem in Multics. (This alternative need not preclude

doing item ii.) This permits some BTL users to develop programs without dependence on Multics, thus preserving the option to move programs to other BTL installations using GECOS III, or to a Murray Hill machine dedicated to GECOS III when usage warrants.

Notes on Pricing Issues

Pricing by GE takes into account

- a. Competitive offerings (or lack thereof)
- b. Precedents for future charging policies
- c. Underwriting costs when initially starting up, and for unused part of machine.
- d. Profit motive.

It is fairly clear that c and d imply that one can economically buy from a commercial service almost regardless of price; for a whole machine's worth it is almost certainly cheaper to go in-house. It is our belief that the potential M.I.T. market is large enough to warrant in-house operation. This belief should be substantiated by a survey.

Examples of pricing at cost, based on console-hour charge and CTSS-like performance, would be

(28-day month)	160 first shift hours @ 25 users
	160 second " " @ 15 users
	160 third " " @ 5 users
	192 weekend hours @ 5 users.

$160 \times 25 + 160 \times 15 + 160 \times 5 + 192 \times 5 = 8160$ console hours

for a cost of \$100K/month, this works out to an average
 of about \$12.30 per console hour.

It is presumed, of course, that more sophisticated accounting facilities of Multics will actually be used, to permit charges according to resources used, with separate accounting for:

- a. central processor usage
- b. secondary storage usage
- c. paging activity
- d. console time.

Relative charges for each of the components should be such that increased usage of a single resource automatically brings in revenue sufficient to increase the amount of that resource. This type of charging scheme has worked out well in CTSS and is preferred because it allows a system to grow in an orderly way in response to demonstrated needs of its users.

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MIT - 645 PROPOSAL

- o GE assume ownership of 645-B system
 - Operator support and facilities supplied by MIT
 - Function as in-line MULTICS development machine until operational date
 - Function as on-line machine for GE supplied commercial service after operational date

- o MIT assume rental responsibility for 645-A system
 - Function as off-line development machine for compilations, assemblers, checkout, etc., throughout 1969
 - Augment with additional ⁶⁴32K memory and Extended Memory drum until new file system is complete (Est. 7/1/69)
 - Approx. \$72K/Mo. 1st half 1969 and \$60K/Mo. 2nd half 1969, vs. current \$85K/Mo. cost to MAC

- o MIT System developer access to GE machine (hands-on or terminal user) at no cost

- o Non System developer terminal use after operational date on charge basis
 - Project MAC personnel at preferred rate
 - All other at full commercial rate

- o Advantages to MIT
 - Reduced 1969 equipment rental costs (Approx. \$225K from \$1 Meg)
 - MIT retains control of smaller, but adequate, machine for continuing development of MULTICS
 - GE commitment to commercial offering 3rd quarter 1969 of MULTICS service; available to overall MIT community plus Project MAC availability at preferred rate.

C. W. Dix
1/7/69

Unofficial
per R.L.Z.

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GE POSITION - 645/MULTICS

- o GE will continue its current level of active support of and participation in the MULTICS development program.
- o At such time as the MULTICS system software is sufficiently stable to reliably support a nominal level of 30 simultaneous users with CTSS-equivalent response time, it is so declared as operational by GE, MIT and BTL, GE will make MULTICS service commercially available at a competitive price per terminal hour. In view of the unique functional capabilities of MULTICS, it is GE's contention that a premium price of approximately \$50 per terminal hour is highly competitive for this initial offering.
- o The above continuing participation in and commercial offering of MULTICS by GE is conditional upon: the continuing support of the MULTICS Program by ARPA; the continuing participation in the MULTICS development by MIT and BTL; and the achievement and declaration of an operational MULTICS status, as outlined above, by the 3rd quarter of 1969.
- o Assuming a satisfactory acceptance of the MULTICS service during its initial commercial offering, GE will accept the responsibility and attendant risk of improving the various hardware and/or software elements of the MULTICS System as required to maintain the MULTICS service at a competitive price and performance level.
- o The fundamental criterion for satisfactory acceptance (i.e., success or failure) of the MULTICS service offering is active use of that service by users outside of the MULTICS development project at a sustained average level of 10-15 simultaneous prime shift users within six months after the declared operational date. It is a necessary condition that a substantial portion of such users be from the overall ARPA-DOD Community.
- o In the event that any user of the MULTICS service requires a MULTICS System, utilizing improved hardware, for installation on his premises so as to provide an in-house MULTICS service capability, and that requirement exists prior to the time of a GE determination of the need for and a commitment to such improved hardware as a standard product, GE will provide such hardware on special order.

The provision and continuing maintenance of MULTICS system software for such installations will be the responsibility of the user, with the originating source for such software and its attendant documentation assumed to be Project MAC.

Outline of a Position on Multics

Jack B. Dennis January 6, 1969

1. The Advanced Research Project Agency appreciates the uniqueness and importance of MULTICS as the embodiment of advanced system concepts:
 - a. The most advanced realization of the "one level" memory idea in which the class of structure commonly known as a "file" is no longer a special case.
 - b. Procedure are universally recursive, shareable, and may acquire dynamically as much memory as needed to perform their function.
 - c. Nested activation of procedure with minimal prearrangement, "dynamic linking".
 - d. A precisely defined set of process control primitives that permit tight interlocking of data bases by user programs.
 - e. A modular organization of the supervisor program making full use of the above features.
2. The Advanced Research Projects Agency would like to see MULTICS "exported", that is, made widely available to groups outside Project MAC.
3. There are five paths by which the concepts in MULTICS could become widely known and accessible:
 - a. Make the Multics installation at M.I.T. available to selected groups to broaden operational familiarity with Multics features and their value.
 - b. ARPA contracts with an agency to replicate Multics an equipment equivalent to the GE 645 and sponsors installations to provide widely available service.

- c. The General Electric Company (or another computer manufacturer or an independent agency) elects (with or without ARPA support) to offer installations and/or service equivalent to Multics. Project MAC would make available all required technical information and act as technical adviser with ARPA funding.
- d. Project MAC trains manufacturer's representatives in Multics technology and acts as technical consultant. Manufacturers develop their independent version more or less equivalent to Multics.
- e. M.I.T.'s graduate educational program in computer science produces professionals with knowledge of fundamental principles of Multics like systems and experience in the technical problems of their implementation. These professionals eventually contribute to the development of systems that embody these principles.

4. Fundamental to all of the paths indicated above is the existence of an operational Multics system:
 - a. It cannot be duplicated unless it exists
 - b. A computer system specification is not likely to be credible without an operational installation.
 - c. The features of Multics will not be widely appreciated and demanded until they are widely experienced.
 - d. Good exposition documentation is required for training. It cannot be developed until the system is close to operational form.
 - e. Education of graduate students in system principles will be much more effective if they can experience working with an embodiment of them.

5. The shortest path to an operational Multics system is to continue development on the GE 645. Any diversion from the current objective of realizing an operational Multics on the GE 645 would create a moral^e_λ problem among the staff of such magnitude as to cripple the project. It is anticipated that many key staff members would leave the project if the 645 implementation were terminated.

6. The implementation of Multics on a second machine is not an appropriate activity for Project MAC. It is inconsistent with the objectives of the Project as an academic seedbed for the growth and testing of new ideas.

7. Program of Action

- a. Make Multics operational on the Ge 645
- b. Make the M.I.T. Multics installation available to selected evaluators.
- c. Document the system so that Multics technology is accessible to manufactureres and independent system development organizations.
- d. Offer training programs: i) For contributors of Multics subsystems
ii) For prospective reimplementation of Multics.
- e. Educate computer scientists with basic knowledge and experience with Multics concepts who will serve as nuclei for additional systems efforts with similar or more advanced objectives.