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INFORMAL PROPOSAL  
FOR  
COMPLETION OF MULTICS AED

Submitted to:  
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Cambridge

by  
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July 17, 1969

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Informal Proposal for Completion of Multics AED

Summary

In response to a request from M.I.T., SofTech, Inc. proposes to supply manpower to complete the initial bootstrap of the Public AED-1 Compiler for the AED-0 Language to the Multics System and to provide basic user and support documentation. The plan of work is proposed in two stages: the month of August, and after August. During August, SofTech will be able to apply extra skilled manpower, a crucial program may be completed by the Multics staff, acceptance tests can be devised, experience can be gained with initial tests of AED programs in Multics, and remaining work can be estimated more closely. After August a more normal three-man effort with supervision will complete the work. SofTech also agrees to provide maintenance for the resulting system for one year at per diem consulting rates on an as-needed basis.

M.I.T. computer and office facilities will be supplied by M.I.T. during August. It is estimated that 20 man-weeks will be charged at an estimated cost of \$20,000. (\$1,000 per man-week.) After August the rate per man-week will be somewhat higher. It is now estimated that an additional 44 man-weeks plus 7 secretary-typist-weeks will be required to complete the job. Thus the total cost of the project is expected to be about \$70,000 total, including August, and that the work will be complete by mid-December.

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Douglas T. Ross  
President

July 17, 1969

~~Description~~

## Current Status

A "half-bootstrap" from the 7094 CTS5 to 645 Multics is now running, but it contains two known bugs and has not been updated to correspond with the 7094-40-360 system, which is taken as standard. Reworking of this system must be completed before final bootstrapping of Phase 3 programs can begin, although some Phase 1 and 2 programs are unaffected by the needed changes and this can be bootstrapped with the present system.

About 75% of the run-time library needed for the compiler has been bootstrapped and checked out in the 6.36 environment. Assuming the 6.36 does indeed correspond with the 645 environment, these programs can be used directly. Two major programs must be written: the I/OBCP interface to the file system and the ASMOCL package for free format output.

Most of the worst files needed for the compiler have been done, but some must still be done. A few compiler files have already been bootstrapped but will not be used since their status is uncertain.

~~Write~~

## The Segment/Entry Problem

AED procedures have only a single name, but in the Multics environment must be represented as segment/entry names. In the already-completed bootstrapping of most of the AED library, the character ":" was added to the Half-Bootstrap character set and a combination of AED insert files and synonym statements performed the desired transformation without alteration of the original AED source programs. When this device was attempted for programs of the compiler proper, however, the large number of entries involved <sup>made this scheme</sup> ~~was~~ unworkable.

An alternate solution to the problem has been proposed by Mr. C. Garman of the Multics staff, in which the corresponding operation will be performed by the Multics binder, slightly altered. The scheme seems straight-forward and Mr. Garman's familiarity with the binder should make it possible to make the needed changes and debug before mid-August when Multics testing of AED should begin. This proposal is ~~based~~ predicated on the assumption that this work will in fact be accomplished by that time.

## Plan of Work

Completion of the initial Full bootstrap of the AED-1 Computer for the AED-0 <sup>language</sup> from the 7094 CTSS to the GE 645 Multics system involves

- Five phases:
1. Orientation of new staff
  2. Completion of the Half-Bootstrap on the 7094
  3. Bootstrapping of programs and assembly in Multics
  4. Debugging of Multics AED
  5. Completion of documentation.

Based upon current status, the total job has been estimated ~~Not at present time, the total job is expected~~ to require a total of 60 man-weeks of programming and debugging time and 10 man-weeks for documentation (to be completed in 20 calendar weeks).

These figures are based upon the job being performed by a team of three programmers with part time supervision by Dr. J. E. Rodriguez, chief architect of the AED computer. The estimate must be tentative, however, because much of the work will depend upon access to the 7094, ~~and~~ 360, and 645 computers at MIT, and the performance characteristics of Multics for this work are essentially untested at this time. Furthermore, a key item (the mapping of simple procedure names into segment/entry names) has not yet been programmed and checked out by Mr. C. Garman of the Multics staff.

In view of these uncertainties, and in view of the fact that office quarters for <sup>the full</sup> SoftTech <sup>staff</sup> will not be available until September 1, we propose to alter the original plan to add the part time services of Mr. C. G. Feldman and Mr. J. F. Walsh to the Multics task during the month of August <sup>and part of September</sup>, if MIT office space can be made available <sup>as outlined in section</sup>. The addition of approximately 5 man weeks of their time to the project will

save approximately 4 man weeks of <sup>additional</sup> effort from the total job, because of their extra skills, and also will shorten the total job <sup>by</sup> ~~by~~ <sup>about</sup> 2 calendar weeks. In addition, SoftTech overhead during the month of August will be lower ~~due to SoftTech going out of the needed office space~~, so that still further savings accrue to MIT. Finally, if Mr. Garman can complete the segment/entry name task early in August, and if initial Multis running tests can be made, then more accurate estimates for job completion after September 1 ~~can be made~~ will be possible.

~~Therefore SoftTech proposes to complete the Multis AED Sull bootstrap in two parts, both of which will be under the direction of Dr. Rodriguez. During the month of August, assigned staff will be Rodriguez (70%), Feldmann (50%), Walter (60%), Coe (100%), Egan (100%), and Bigelow (100%). These personnel will be housed at MIT and will be billed hourly at salary + actual SoftTech overhead to which a profit of ~~10%~~ will be added.~~

Based upon this revised schedule of manpower assignments, the estimated manweeks to be applied to the Multis AED project ~~is~~ <sup>is</sup> as follows:

Project <del>is</del> <sup>is</sup> as follows:	<u>Prog + Suprv.</u>	<u>Direct Secretary</u>
August	20	—
September	17	1
October	12	1
November	10	3
December	5	2
Total	<u>64 manweeks</u>	<u>7 manweeks</u>

- Work to be Done
1.  $\uparrow$  Update and complete the half-bootstrap compiler (CTSS)
  2.  $\uparrow$  Complete run-time library: ASSEMBL and IOBCP plus a few minor library functions. (CTSS, Multics)
  3. Compile and bootstrap 76 AED machine independent programs (CTSS)
  4. Write and compile 5 AED machine dependent initialization programs (CTSS)
  6. Prepare, compile, and macro-process 4 AEDJR-generated tables (CTSS, 360-65)
  6. Write, compile, and assemble 7 AED and Assembly utility programs (CTSS, Multics)
  7. Assemble, test, and debug entire AED-4 System in the Multics environments (Multics with CTSS Exchanges)
  8. Complete documentation.
  8. Pass acceptance tests or enter maintenance period.

## MIT Facilities Required

Since MIT computer facilities will be used, two offices will be required in the Information Processing Center, along with access to computer console facilities. (After October 1, only one office will suffice.) SoftTech will supply secretarial services needed for documentation.

Computer resources needed are estimated as follows:

	<u>Computer time</u>	<u>Storage</u>	<u>Console Hours</u>
CTSS	7 hours	1650 records	200 hours
Multics	15 hours	proportional but unknown	
360-65	1 hour	none	none

It is assumed that SoftTech would not be involved in the billing for any of these MIT facilities needed to perform the work (except to confirm amounts used).

Also three CTSS Programmers<sup>numbers</sup> and three Multics Programmers<sup>numbers</sup>, with good access will be required for the total job.



## Documentation

SoftTech agrees to supply to MIT the full source listings of all programs of Multi AED, suitably annotated to allow personnel trained in the intricacies of the system to understand its operation. In addition, documentation comparable to and parallel with (on a document to document basis) that prepared for the Public AED release, <sup>for the IBM 360 computer</sup> (except possibly for neat hand-drawn rather than drafted figures) will be supplied. Included in this documentation will be an appropriate section for the Multi manual describing how to use Multi AED. Documents will be supplied in a form suitable for reproduction.

## Non-Exclusive Rights

SoftTech will have full rights to unrestricted further use of programs and documents developed under this contract except for direct sale as a product. In particular, improvements in the AED compiler which may be incorporated into Multi AED for the first time may be transferred to other AED compilers ~~without~~ or may be used in other AED systems without restriction.

## Acceptance Testing

Organized test cases exist at present only for a subset of AFD language features. During the month of August, additional tests will be devised in an effort to arrive at a test base (not necessarily exhaustive) that can be agreed to by both MIT and Softech as an acceptable criterion for completion of the Multics AFD compiler in working form. It is to be understood that like any large software system, ~~AFD~~ Multics AFD never can be expected to be completely bug-free, so that these test criteria will be geared <sup>only</sup> to give as complete a test as possible of those features and constructs most likely to be used by AFD programmers. In any case, the job will be judged completed (and the maintenance period begun) whenever the applied manpower to keep the system running, including correcting known bugs, reaches a level of one man-week billed per two calendar weeks.

## Maintenance

Softech agrees to provide maintenance assistance for the initial Multics AFD system on a per diem basis at its standard consulting rates for a period of one year from completion of this contract.

## August Billing Estimates

Effect Annual Overhead is estimated @ 161%

Assume 30% reduction in Aug due to

lower rent and omitted <sup>overhead</sup> salaries = 48%

Estimated August overhead = 123%

Estimated total salaries (August only) \$ 8,000

Overhead (August only) @ 123% \$ 9,860

\$ 17,860

Profit @ 12% \$ 2,150

August Estimated total charge \$ 20,000

For 20 man weeks

← Hence <sup>SATU</sup> will charge actual man weeks applied:  
@ \$1,000/man week for the month of August.

## Proposal Reconsideration

During August, a number of aspects of the after-August phase must be clarified. It is understood that all estimates in this proposal for the after-August phase are tentative and non-binding ~~depending upon reconsideration at the end of August.~~