

COMPLETION OF MULTICS AED
Proposal 8023
for
Information Processing Center
Massachusetts Institute of Technology
Cambridge, Massachusetts

1. Assemble language output
2. Does it include AED-JR?
3. Can we put performance specs on or well, as part of acceptance TestB?

Presented to
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by

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1. SUMMARY

For the past few years, several advanced projects and many thesis activities have relied upon the AED language and system-building systems as primary programming vehicles. The investment in money and effort in these programs is by now very large and many projects are critically dependent on the unique facilities of AED for their effective realization. Furthermore, other new projects and research efforts, particularly those employing complex data structuring, on-line interaction, or computer graphics could benefit greatly from the advanced software engineering approaches made possible by AED.

At the present time, AED is operational at MIT on the CTSS and CP-67/CMS time sharing systems, as well as the OS/360 batch system, but not on the MULTICS system. Since MULTICS has recently been selected as the prime source of time-shared activity for the next several years, it is now appropriate to reconsider the completion of the bootstrapping of AED from CTSS to MULTICS partially completed in the spring of 1969. The decision not to proceed with MULTICS AED in August, 1969, was based primarily on the assumed continued availability of CTSS and a lack of conviction on the part of AED users that MULTICS was going to be the surviving IPC service base. Since the converse is now true, the question merits careful re-examination at this time.

SofTech feels that MIT can benefit substantially if the AED software building system were made available to the current AED users and future MIT computing community on MULTICS.

The availability of AED can have a significant impact on reducing conversion costs of the present AED users. The operational efficiency of AED should also be another favorable consideration. The present CTSS-AED system has shown extremely high maintenance reliability and the same high level of reliability should be expected from MULTICS-AED. The 360-AED compiler performance is extremely favorable when compared with 360-PL/1 and FORTRAN and we expect that AED compiled code will be at least equal to MULTICS PL/1 in speed and size.

An important consideration for MIT is that AED built systems are truly portable. This feature will be most valuable when the next computer hardware system is to be utilized at MIT and large cost savings can be realized.

As the most advanced software technology existing today, AED can play a valuable role in continuing to help keep the MIT community on the forefront of computing technologies and methods. AED forms the primary focus of SofTech activities; thus MIT can look with confidence to SofTech to continually provide maintenance and enhancement support.

In order to accomplish this effort in keeping with the current CTSS replacement schedule, the work to complete MULTICS-AED should be started now. The current CTSS and CP/CMS users could begin to transfer their systems to MULTICS in the second month of the project (once the one half bootstrap and run time libraries are completed).

The total AED bootstrapping effort will require 5 calendar months and 20 man months of effort. SofTech proposes that MIT provide one half of the labor in the form of 2 full-time personnel available for the 5 month period. SofTech will work on a "not-to-exceed" price basis for the project in order to insure to MIT that cost overruns will not be incurred. The time and expense price is \$50,000.

We hope that MIT decides to complete this effort and continue to make the facilities of AED available to the MIT community. We stand ready to provide the full level of support necessary to make MULTICS-AED a cost effective reality.

2. CURRENT STATUS

A "half bootstrap" AED compiler exists in CTSS which produces assembly language code for the GE 645/MULTICS machine. AED programs compiled with this processor consist of one data segment and one or more procedure segments. AED procedures can communicate with standard MULTICS procedures using the existing half bootstrap compiler. However, the total MULTICS environment is not directly accessible from an AED procedure. The single data segment design was chosen to facilitate an initial bootstrap of the AED system. It had been planned to perform a second bootstrap to

correct these shortcomings once the AED compiler had been made operational in MULTICS.

The work outlined in this proposal is based on abandoning the concept of an initial limited bootstrap as described above. Instead, it is proposed to redesign the half bootstrap compiler to produce code which gives full access to the MULTICS environment. It is expected, of course, that substantial portions of the existing bootstrap compiler will be reused.

The output of the final delivered AED-MULTICS compiler will be assembly language.

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3. PLAN OF WORK

Completion of the initial full bootstrap of the AED-1 compiler for the AED-0 language from the 7094 CTSS to the GE 645 MULTICS system involves 10 phases:

1. Update and complete the half bootstrap compiler (CTSS).
2. Complete run-time library (CTSS, MULTICS).
3. Compile and bootstrap 76 AED machine independent programs (CTSS).
4. Write and compile 5 AED machine dependent initialization programs (CTSS).
5. Prepare, macro-preprocess, and compile 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-1 System in the MULTICS environments (MULTICS with CTSS for changes).
8. Pass acceptance tests or enter maintenance period.
9. Complete documentation.
10. Consult with AED users on transfer of current CTSS resident systems to MULTICS.

Based upon current status, the total job has been estimated to require a total of 20 man-months for the programming and documentation to be completed in 5 calendar months.

These estimates are based on having adequate access to the 7094, 360 and 645 compilers at MIT and upon the availability of two qualified MIT personnel to participate in the effort.

The following is a manpower milestone schedule for the project:

Calendar Month	Task No. Started	Task No. Completed	Labor (Man Months)		
			SofTech	MIT	Total
1	1, 2		2	2	4
2	3, 4, 5, 6	1, 2	3	2	5
3	7	3, 4, 5, 6	2	2	4
4	8, 9	7	2	2	4
5		8, 9	1	2	3
Totals			10	10	20 man months

Task 10 user consulting should be done on a separate basis as no concrete estimate can be made at this time.

5. MIT FACILITIES REQUIRED

Since MIT computer facilities will be used, office space will be required in the Information Processing Center, along with access to computer console facilities.

Computer resources needed are estimated as follows:

	<u>Computer Time</u>	<u>Storage</u>	<u>Console Hours</u>
CTSS	7 hours	1000 records	200
MULTICS	15 hours	proportional but unknown	
360-65	1 hour	none	none

Also, three CTSS programmer numbers and three MULTICS programmer numbers with good access will be required for the total job.

It is assumed that MIT will bear the expenses for any of these MIT facilities needed to perform the work.

6. DOCUMENTATION

SofTech agrees to supply to MIT the full source listings of all programs of MULTICS-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 for the IBM 360 computer (except possibly for neat hand-drawn rather than drafted figures) will be supplied.

Included in this documentation will be an appropriate section for the MULTICS manual describing how to use MULTICS-AED. Documents will be supplied in a form suitable for reproduction.

7. NON-EXCLUSIVE RIGHTS

SofTech 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 MULTICS-AED for the first time may be transferred to other AED compilers or may be used in other AED systems without restriction.

8. ACCEPTANCE TESTING

During the first month of the project, 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-AED compiler in working form.

9. MAINTENANCE

SofTech agrees to provide maintenance assistance on an as required basis for the initial MULTICS-AED system on a per diem basis at its standard consulting rates.