

July 25 1969

To: Prospective participants in the Cambridge Project
Subject: Series of lectures (starting Thursday, July 31) on computer systems and network arrangements on which the Project might decide

A goal of the Cambridge Project is an "integrated, on-line, working system" that will include facilities of the seven kinds described in the Proposal. This goal seems to imply that sooner or later the Project will have to concentrate its efforts on one computer, or use a network of computers. Any decision about what route to take must be deferred until the fall, but it has been decided that during the rest of the summer an attempt will be made to gather information on which a decision can be based.

So there will be a series of weekly lectures on alternatives that need to be considered. The first lecture will be on the Compatible Time-Sharing System (CTSS), which is in a way the standard with which other systems must be compared. The next four will cover four important possibilities (not necessarily in this order): acquiring a PDP-10, using Multics, using an IBM 360/67, and pushing rapidly toward a network.

The lectures should present enough technical detail so that prospective participants in the Project can begin to ask searching questions about the way in which the work in which they are interested would be affected. Since many of the participants will be out of town in the next few weeks, the speakers will be asked to hand out some fairly specific notes, and Dr. Raymond Wiesen (of the Psychology Group at Lincoln) will summarize any important points that arise in discussion, and will circulate his summary with the notes. The lectures will probably be tape-recorded too.

The lectures will be given on Thursday afternoons from 4:00 to 5:00, and the Thursday social session will follow immediately. The first is scheduled as follows:

Time:	4:00 p. m. , Thursday, July 31
Place:	Room 230, William James Hall
Subject:	CTSS
Speaker:	W. D. Mathews, Project TIP

There is no point in encouraging an attendance so large that technical discussion becomes difficult, but an announcement is enclosed for you to post or pass along if you wish to do so.

For further information, call:

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Lincoln Lab. ext. 5381

DBY:af

Suggested Outline of Handout

Each of the speakers is requested to hand out several pages of telegraphic notes following, to the extent possible, this outline. The notation "n. & s. i." means "now, and scheduled improvements." It is repeated to emphasize that the participants in the Project will be interested both in the present state of the system and in any firm plans for improvements.

- 1) Thumbnail description of the hardware (n. & s. i.).
Word-length, speed, etc., about at the level of the quarterly Key Data manual.
- 2) Facilities for sharing files between users (n. & s. i.).
- 3) Other significant features and shortcomings in the operating system (n. & s. i.)
- 4) Major software subsystems (n. & s. i.)
Compilers and other programmers' tools.
(Bizarreness of the Fortran and PL/1 is especially relevant.)
Major user-oriented subsystems
- 5) Terminals accepted (n. & s. i.)
Kinds (including CRT) and numbers of each
- 6) On-line storage (n. & s. i.)
Total amount, and amount (or number of files, or whatever) typically allotted to one user
- 7) Tapes and mountable disks (n. & s. i.)
Number of drives. Restrictions on time of day in which they can be used. Subsystems that cannot use them.
- 8) Some sort of data from which the cost of a terminal-hour can be inferred (n. & s. i.)
- 9) Number of simultaneous users (n. & s. i.)
Theoretical number. Number of happy users.

DRAFT
D. B. Yntema
30 July 1969

NOTES ON THE IBM 360/67 AT LINCOLN LABORATORY

(This summary is presented as auxilliary information. Where Lincoln's facilities are especially appropriate, the Project may be able to arrange to use them.)

1. Hardware

Two CPU's and four 262k-byte core-boxes (overlapped access).

Add time: 1.3 μ sec (4-byte word). Storage cycle: .75 μ sec (8 bytes at a time).

16 general registers, used both as accumulators and index registers. Address size: 24 bits. No indirect addressing.

Floating-point precision: 6 significant hexadecimal digits in single-precision, 14 in double.

Operation codes: about 145, including byte manipulation, translate-edit, floating-point arithmetic (single and double), logical operations, and the special list-processing instruction. Double-indexing (i. e. , base register and index register) in some instructions.

Features for time-sharing: 8 μ sec clock, program interrupt (i. e. , jump to specified location on specified interrupt), memory protection, dynamic page relocation (Not used by I/O. Page = 4096 bytes), supervisor mode. Does not have base-address relocation.

Aux. storage: 16 IBM 2401 tape drives (eight 7-track and eight 9-track). Three IBM 2314 disk-pack units (8 drives per unit). Two IBM 2301 drums.

Off-line: IBM 360/40 used for card to tape, paper tape to magnetic, printing, plotting, etc. SC-4060 for output of graphical material on film and paper.

Only one CPU at a time can be used for time-sharing. With it are usually two of the core-boxes, both drums (used only for page swapping), two of the disk-pack units (total of 16 drives), two 7-track tape drives, and two 9-track tape drives.

2. Facilities for sharing files between users

An account (i. e. , a user) can send a file to another (via "xfer"). The sender must be logged in when the file is sent, the receiver when it is received, but not necessarily both at once.

An account may access as many as five others; the links must be established after-hours by system programmers. The accessing account may give a command that temporarily appends to its file-directory the parts of the others' file-directories that describe files of Mode P2 (read-only), and the files (or parts of files) may then be copied straight into virtual memory (without using up space in this account's disk area); but if the owner alters the file in the meantime, havoc ensues.

Soon (early Sept.) the on-line user will be able to give a CMS command that establishes a link, without waiting to have it done after-hours.

3. Other significant features and shortcomings of the operating system.

The time-sharing system is separate from the interactive operating system:

CP shares the machine among users, handling the swapping and dynamic page relocation, and giving each account (i. e., each user) a "virtual machine" that usually has 64k full-words (4-byte words) of "core" and 900 records (800 bytes per record) of disk space. Dynamic page relocation is not available in the virtual machine. CMS (Cambridge Monitor System) is an on-line operating system that runs in the virtual machine.

CMS maintains a directory of the files in the account's disk area. Naming is not heirarchical: files have names, but with a few special exceptions (libraries of TEXT and of macros), parts of files do not have names.

No temporary disk storage: user is strictly limited to disk spaces permanently assigned to his account (unless he gets a disk pack of his own mounted).

"Exec procedures" in CMS permit the user to run off stored series of CMS commands. Very powerful: parameters, recursion, conditional statements.

Debugging aids are not symbolic.

Jobs for CMS may be submitted off-line.

Foreground-initiated background (early Sept.).

4. Major software subsystems.

For programmers: macro assembler, Fortran IV G-level, LISP, SNOBOL, PL/1 (early Sept.), AED, a good EDIT command with some context abilities.

User-oriented: Mediator and its library (including Lincoln Reckoner), LISTAR (info. storage and retrieval), BRUIN (like JOSS), facilities somewhat like Typeset ~~XXXXXXXXXXXX~~ and Runoff (via the above-mentioned EDIT command).

5. Terminals accepted

33 dial-up lines for the following, in some mixture: IBM 2741 (Reverse Break is only RPQ absolutely required), Model 33 and 35 teletype, and ARDS-II (running at teletype speeds). The mix is determined by switches set by the operator: usually, 32 IBM 2741's, and one ARDS-II or teletype.

In addition, not on dial-up lines, one IBM 2250 interactive graphics terminal (now), and four IBM 2260 non-graphic CRT terminals (middle Aug.).

In addition (perhaps in Sept.), facilities to use an ARDS-II for output only at 1200 to 4800 baud (speed, and whether on a dial-up line, not yet decided).

6. Auxiliary storage permanently on-line

An IBM 2314 disk unit (8 drives) is dedicated to time-sharing: the 8 disk-packs are left mounted. Two are for the system, 6 for users' on-line storage. Each pack holds 28M bytes. Usual allotment to an account: 900 records (including the account's file directory), with 800 bytes per record.

7. Tapes and mountable disks

Only four tape drives (two 9-track, two 7-track) are allocated to time-sharing. From 10 a. m. to 6 p. m. , an account may use only one drive at a time (and the user is exhorted to release the drive promptly); in the evening more than one is allowed. Each account may keep two tapes in the readily-accessible bins in the computer room.

There is an IBM 2314 unit (in addition to the one mentioned above) on whose 8 drives the users may have their own disk packs mounted.

8. Cost of an hour at the terminal.

Rates for use by the Project would have to be worked out.

9. Number of simultaneous users.

Total number of ports: 34 (rising to 38 in Aug.)

Number of simultaneous users kept happy: between 30 and 40, judging from experience with a temporary arrangement that provided extra ports, if the users are of Lincoln's present type (mainly editing, compiling, and testing programs).

CAMBRIDGE PROJECT

Lecture

- Time: 4 p. m. , Thursday, July 31
- Place: Room 230, William James Hall, Harvard
- Speaker: William D. Mathews, Project TIP
- Subject: The Compatible Time-Sharing System (CTSS)

This is the first of a series of weekly, informal lectures on systems that the Project might decide to use. The capabilities of CTSS are a sort of standard to which other systems will be referred in later lectures.

CAMBRIDGE PROJECT

Informal Lectures

TIME: 4 p. m. , Thursday, August 7, 1969
PLACE: Room 230, William James Hall, Harvard
SUBJECT: IBM 360/67
SPEAKER: Thomas H. Van Vleck, M. I. T. Information Processing Center

TIME: 4 p. m. , Thursday, August 14, 1969
PLACE: ... to be announced...
SUBJECT: Multics
SPEAKER: Jerome H. Saltzer, Project MAC