Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: PROJECT GRIND MEETING OF JULY 1, 1953 (Fifth Day)

To: AN/FSQ-7 Planning Group

From: A. P. Kromer, R. P. Mayer

Date: July 7, 1953

Abstract: This meeting concerned crosstelling, output drums, output links, digital information display, maintenance console and mechanical design. Details on the output links must be decided soon because many people outside of the project are concerned with this problem. The crosstelling system can be solved entirely within the project and so details are not so urgently required at this time.

Members Present

MIT	IBM
* W.H. Ayer	M.M. Astrahan
* J.D. Bassett	* C.M. Balliet
R.R. Everett	* J.M. Coombs
* R.C. Hopkins	R.P. Crago
* D.R. Israel	* D.J. Crawford
J.F. Jacobs	N.P. Edwards
R.P. Mayer	* B. Houseman
K.H. Olsen	* J. Montgomery
* E.S. Rich	* D.C. Ross
N.H. Taylor	H.D. Ross
* C.W. Watt	* B.L. Sarahan

The reader is reminded that the object of the minutes of the Project Grind meetings is to put on record some of the decisions made and some of the reasons for these decisions. Any problems will be brought into the open so that decisions can be made as soon as possible. If there are any errors or ommissions in the minutes they should be called to the attention of A.P. Kromer or R.P. Mayer.

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* Part time

I. Crosstelling

IM #31 summarizes the proposed crosstelling system. Crosstelling will be a low priority item on XD-1 although XD-1 will eventually cross tell to itself, to WWI, or to XD-2. IBM will make a concrete proposal, including block diagrams and an explanation of the range of operational possibilities. This will be circulated and MIT will consider what to do about it. In addition to operational crosstelling, the crosstelling system should provide for maintenance of displays in emergencies (details of the emergency system can be designed later). Three drum fields are required for crosstelling track data, not including display assignment words nor history.

II. Output Drums

The output buffer system will be a somewhat low priority for XD-1, but the detailed and specific design must be worked out very soon because many other people are designing links to work with it.

Each slot on the drum will have 2 words in adjacent pockets. The computer will write on the drum in random locations (by status) and the output will remove data by status and identity.

Outputs include special crosstelling, weapon data links, AAOC, and a high-speed printer. It is proposed that each identified output should have an independent message-number-identification circuit for proper sequencing of messages. About 350 tubes per circuit are needed for this, although only 180 tubes might be required if magnetic cores were used wherever possible. If it turns out that a large number of such circuits are required, it may be desirable to work out a different technique. Low-density phone lines could time share some of this equipment. Two or three drum fields are required, and they could operate independently.

III. Output Links

The number of phone lines used for output equipment will depend largely on the method of distributing messages: messages could be sent to different destinations over separate lines, or a single line could go to all destinations (with a destination selector at each destination). For purposes of designing the output drum, we might assume that a few destinations are served by each line and that 8 such phone line systems are required at each computing center as follows:

(1) 1 phone line system should be enough for special crosstelling, crosstelling to higher headquarters, remote teletype, etc.

(2) 1 phone line system for the output printer (low priority: directly connected at first, via the drum later).

(3) 1 phone line system using AN/TSQ-7 data links should be enough to provide outputs to 4 or 5 AAOC's.

(4) 2 phone line systems should be sufficient for 8 Bomarc sites.

(5) 1 phone line system should be sufficient for return-to-base and landing-aids control.

(6) 3 phone line systems should be sufficient to control the multiple transmitter system for the interceptors.

A GE link has been assumed for the interceptors (until a joint system is finally accepted). It is possible that 16 time-shared transmitters per sector will be used. Each transmitter transmits as many as 25 subcarriers, each of which can handle as many as 16 aircraft. The proposal is to send each message to an aircraft by way of the transmitter closest to the aircraft. Only one transmitter can send a message (or 25 messages, if all subcarriers are used) at any one time (a message takes 200 milliseconds). The problem of how to cycle through the transmitters and interlock the computer-control of transmitters and subcarriers cannot be decided until we know more about how transmitters are to be used. (Perhaps a single-side-band system, which might allow 2 transmitters to be on the air at a time, could be used).

IV. Digital Information Display (DID)

Only cathode-ray tube DID units were discussed. One drum will be used for this system and it will contain 256 slots (each slot holding 48 characters - 5 bits each). Some of these slots will contain intercept-pair data. Each console (plus each radio communicator and each height finder clerk) will have at least 1 slot assigned to it. A number of slots will contain summary data.

Any DID scope can display any of these slots, a coincidence selector (8 bits) at each scope allowing the scope to display only one slot at a time. A keyboard allows each operator to request any DID.
The requested display will appear in that operator's assigned slot, where he or anyone else can select and look at it.

The computer will write on the drum by address, interleaving the 8 registers per slot for efficient display. One deflection system will probably be able to cycle through all the slots in 1/2 second, but it may have to be slowed down for psychological reasons. The deflection voltage generator used in the track display scopes cannot be copied because the DID characters will occupy a greater percentage of the scope's screen. The track-display character-forming circuits can be copied except that 2 of the 32 characters will be used for spacing and for end-of-line. Space and line counting decoders will position each character. The DID screen size will be decided later, but a 3" rectangular tube was mentioned.

V. Maintenance Console

The maintenance console will be used for machine maintenance (and should be approved by N. Daggett) and, in XD-1, will be used for program debugging (controls to be suggested by D.R. Israel).

There will be no neon lights near each pluggable unit, but each flip-flop will have 2 lights on the maintenance console. All lights will have the same color. The "1" lights will project beyond the panel. The "0" lights will be recessed, and a sliding mask will shield them from view. Both of the lights, the register names, a clock, and a calendar must be plainly visible in photos taken by the automatic camera. Both a Polaroid Land camera and a regular camera will be provided.

Control buttons will be provided for: starting directly from the present condition, starting from the first test storage register (register 8192), loading memory with air defense program from the drum, loading any program from the card reader, clearing all flip-flops, clearing memory (by using a "permanently cleared" IO unit), stopping on the next instruction (at a definite time pulse after the IO unit disconnects), performing one instruction, performing one memory cycle (i.e., in-out process is not completed before stopping), D-C sequence off, and D-C emergency off (sudden).

Switches will be provided for: power on, power off, marginal checking (secondary controls will not be mounted on maintenance console), locking out all controls except emergency off, determining the actions of alarms, cyclic program control (stop at a specified program step, pause, and start at first test storage register), and for complementing all flip-flops at a given frequency. Any control which starts the computer will automatically clear out all alarm indications.

A directly-connected display scope (perhaps 7") will be provided. The operator will not be able to select different displays on this scope. There will also be provided a standard display console and a complete set of manual control switches. This does not necessarily need to be mounted on the maintenance console but must be near it. The deflection system will be at some distance from this scope and the display might be of poor quality, although the proposed system might present no such problem. A video test scope will not be built in, but will be provided on an auxiliary test-equipment cart.

The maintenance console will also include test storage. This will be made up of 16 dead storage registers and 1 live register (which can be connected to replace any number of dead registers). A plug-board system will be used for test storage and at least 1 plug-board will be made up of toggle switches. There will probably be 2 registers of toggle switches conveniently located on the maintenance console which can be selected by the plug-board. The detailed design of test storage is now being worked out.

A card reader and a tape reader will be provided near the maintenance console. A loud speaker will be provided for listening to various points in the computer (a volume control and point selector switch will be included). A telephone system will provide communications to other people in the system. Video cables will be provided to various locations in the machine, some of which may be permanently connected to critical points (clip leads should not be used for making many of these connections). Some of these video cables will be used for a scope synchronizing system.

VI. Mechanical Design

It was decided that 2 standard mechanical designs for pluggable units will be used. One will contain 6 vacuum tubes and the other will contain 9 tubes. The pluggable unit will not include a cover.

The pluggable units will be mounted horizontally in specially designed bays. There will be 2 standard bays. One for mounting 6-tube pluggable units and one for mounting 9-tube pluggable units. Each bay will include plugs and slide guides for the pluggable units, a louvre type of cover for each pluggable unit (any one of which may be opened individually or along with others), ducts at the top and bottom for air conditioning and wiring, and connecting strips as explained below. Each 6-tube wide or 9-tube wide bay will be built as a separate unit. Bays will be assembled side by side as desired, and stringers will be bolted on to provide for shipping strength. Each such set of connected bays will be called a subframe in the remainder of this note. Each bay will provide room for 20 pluggable units. It can be assumed that 8 pins per tube is sufficient for the plugs.

The air and wire ducts should be designed so that they can be fed from the end of the frame (if it should be butted up against a wall), or from overhead ducts.

At each end of a subframe (i.e., wherever the frame is to be split apart when shipping) a vertical connecting strip will be mounted. All connecting cables which must be attached at the time of installation will be preformed cables. Solderless connectors and barrier strips (to be decided by the Standards Committee) will be used. Service wiring will be connected to the barrier strip at the end of the subframe and will run through the bottom duct to individual distribution and decoupling panels in each bay. Video lines will run through either the top or bottom duct to barrier strips placed at the top of each bay, or at the end of the subframe, or to vertically placed barrier strips mounted on special spacer columns. These special spacer columns will be designed to fit in the subframe between bays wherever necessary and their width will depend on the number of connectors required. Information transfer lines between bays in a given subframe need not travel by way of a duct.

Thus the following standard vertical components of a subframe are to be designed:

a 9-tube wide unit
a 6-tube wide unit
an end connecting unit
a standard spacer unit

It was decided that square aluminum tubing with thick walls will be used for the framework of the bays.

The Air Force will be asked their preference on the color of the units.

Signed A.P. Kromer
A.P. Kromer

R. P. Mayer
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APK/RPM:jrt