

Memorandum M-2359

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By: A. L. Everett  
Date: 2-1-60

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SUBJECT: PROJECT GRIND MEETING OF JULY 15, 1953 (Seventh Day)  
To: AN/FSQ-7 Planning Group  
From: A. P. Kromer, R. P. Mayer  
Date: August 13, 1953

Abstract: Topics discussed at this meeting were mapper subcontracts, cross-telling, review of the drums, card and paper tape machines, input counters, manual inputs, and power supplies. It was generally agreed that paper tape will not be used in AN/FSQ-7 unless someone has a real reason for wanting it. (Refer to M-2266, M-2267, M-2268, M-2283, M-2284, and M-2285 for minutes of previous days meetings on Project Grind.)

Members Present:

- |                 | <u>MIT</u> | <u>IBM</u>           |
|-----------------|------------|----------------------|
| * H.E. Anderson |            | M.M. Astrahan        |
| R.R. Everett    |            | * W.L. Batchelor     |
| * R.G. Farmer   |            | * P.A. Beeby         |
| * J.J. Gano     |            | * J.M. Coombs        |
| J.F. Jacobs     |            | R.P. Crago           |
| * R.C. Jeffrey  |            | * D.J. Crawford      |
| R.P. Mayer      |            | * W. Fitzgerald      |
| K.H. Olsen      |            | E.H. Goldman         |
| * G.F. Sandy    |            | * B. Housman         |
| N.H. Taylor     |            | * E.J. Keedy         |
|                 |            | * W.M. McMillan      |
|                 |            | * E. Moyer           |
|                 |            | * M.J. Raffensperger |
|                 |            | * P.W. Rocco         |
|                 |            | * D.C. Ross          |
|                 |            | * H.D. Ross          |
|                 |            | * D.B. Thompson      |
|                 |            | * G.E. Whitney       |

NOTE: These notes summarize discussions of joint IBM-MIT study of the problem and represent the best engineering information currently available. Comments from all parties concerned will be appreciated. Decisions in final form will be given in writing by Lincoln Lab., Division 6, acting on behalf of the Air Force

\* Part time

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

### I. Mapper Subcontract

A. number of manufacturers are now submitting their quotations for subcontracts for the video mappers. It was suggested that the following companies be contacted if they have not been contacted already: Bendix Radio Corporation (in Baltimore), Hazeltine, Airborne Instrument Laboratories, Zenith, Westinghouse, RCA, Philco, Raytheon, Dumont, and General Electric.

Three phases were suggested for the production of the video mappers by subcontract:

- (1) General engineering consultation with the subcontractor to acquaint both IBM and the subcontractor with each others problems and techniques.
- (2) Mechanical and packaging design by the subcontractor, perhaps with a model and with full assembly drawings. (This might include some electronic design).
- (3) Production of about 25 units.

It was pointed out that the main interest here is to get a subcontractor who will provide good packaging and maintenance accessibility for the equipment. Electronic design is also important because the subcontractor may feel it necessary to change some of the circuits that we have designed. It would also be convenient if the same company would manufacture both the video mappers and the display consoles.

### II. Crossteling

The crossteling system must be studied so that we will know how to design other parts of the system in such a way that the crossteling will not be a major problem later on. D.C. Ross will write up the system that was generally accepted at the Project Grind meeting. This system will not be finally accepted until it can be shown that it will be all right under the heaviest load conditions.

The proposed system works roughly as follows: 3 sets of read amplifiers will be time shared between the crossteling and display systems. Each set of read amplifiers is on one of three physical drums. The first two physical drums each contain 4 fields for track display and crossteling and 2

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fields of auxiliary memory (not crosstold nor displayed). The third drum contains displays which are not to be crosstold (uncorrelated data, geography, etc.). The crosstelling system will not scan through all of the slots (1 slot contains information about 1 track) but will abandon a drum field when that field is empty. In general, the crosstelling system will usually use the physical drum not being used at the moment by the display system. When the display system is using the uncorrelated data drum the crosstelling system can use either of the other 2 drums.

Three words per track will be crosstold. The first word contains  $x$  and  $y$ . The second word contains  $\dot{x}$ ,  $\dot{y}$ , (8 bits each), and a track status character along with some spare digits. And the third register contains 4-bits for identification, 12 bits for track number, 5 bits for category, and 10 bits for pair number. These three words are to be in adjacent registers on the drum and they will be read out to shifting registers for crosstelling. (The display system will probably also use core stepping registers to obtain desired words at proper times). A pair of status tracks will indicate what data is to be crosstold and these status tracks will be set up by the computer from one of the display assignment digits.

Nine telephone lines will operate in such a way that all the data will be stored on the drum at the receiving center without the need for indicating that it is time to send another word. The 3 words for track ( $m$ ) will be sent on 3 phone lines simultaneously (over a 44 ms interval) and the next 3 words for track ( $m+1$ ), will be sent on the next 3 phone lines beginning at least 16 milliseconds after the start of the transmission of track ( $m$ ). The parity check system is automatically taken care of (from one M Buf to the other) if 33 bits per word are handled all the way, but the result of an alarm on this check has not yet been worked out.

If the receiving center is disabled, a field switching scheme will be used between the crosstelling input buffers and radar input buffers to allow filling an empty drum while the display is using a previously filled drum. This system requires a signal indicating the end of each computed scan cycle. The emergency R $\theta$  to xy converter is not abandoned, but the crosstelling system is more urgent.

### III. A Review on Drums

The work on the drums is progressing rapidly but no spectacularly new things need to be reported. It should be mentioned that all heads will be identical and can be used either for reading or for writing depending on how they are connected or switched in the circuits. A low speed flip-flop has been developed to be used in connection with high speed gate tubes. This circuit appears to be satisfactory but will be studied further. A vote of confidence was given to the drum group and further work will be reported in a few weeks.

### IV. Card and Paper Tape Machines

It was generally decided that the paper tape system will not be included in the AN/FSQ-7. R.R. Everett will let IBM know if anyone at MIT

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wants to keep the paper tape system, but this does not appear to be very likely.

It is proposed that the card machines (including the high-speed line printer) will all be connected to a common core shifting register containing 36(32-bit) registers. The computer can shift into these registers directly from a card image programmed in the magnetic memory. The line printer and other card equipment can then read out of these registers treating them as a group of 12 (96-bit) core registers.

This system will presumably use core circuits similar to those in the rest of the in-out system. It was pointed out that such a core system may be too ambitious for inclusion in the preliminary XDI system to be ready next summer. It is necessary, therefore, to prepare a more concrete proposal and a time schedule. It may be necessary to work out a smaller core system for next summer if it is easier.

#### V. Review of Input Counters

The logic for the input counters is progressing rapidly but some trouble has been encountered in core circuitry. In particular, the core "adding" circuit so far has only 10% margins at 100KC (and 25% at 65KC). Work is progressing on this circuit. Another difficulty is that diodes are being driven harder than standards allow. One solution here might be to design a high voltage core circuit for reading out to the drum system and a low voltage core circuit for use in the counting shift register.

#### VI. Manual Inputs

A design for a diode switching system for manual inputs apparently requires 10,000 diodes and 2,000 cathodes. It was proposed, therefore, that a relay system be used instead.

The proposed relay system would use 200 cathodes and 300 relays. The relays would operate no faster than humans can push buttons and it is estimated that the life of IBM relays in this application is 400 years. The speed of entry with this relay system is 50 entries per second (1 entry being a keyboard setting from one console). The relay circuits are designed to lock out all keyboards except the one being inserted at the moment. The insertion button locks-in mechanically until the drum accepts the data being inserted. The operator can use the button drop-out as an indication of when his data has been accepted.

It was decided that it is all right to proceed with this relay system, and that the system should fail safe.

#### VII. Power Supplies

An estimate of the power requirements for the system had been made by both IBM and MIT, and these two estimates differed due mainly to the display console power. An attempt was made to rectify the difference and these revised figures showed that each display console will require 1,750 watts (this figure includes 900 watts of ac, and 850 watts of dc, of which 300 watts was from the

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500 volt supply. Blowers will be required in each console for cooling). The total resulting power for the equipment at one center was estimated to be 80 KW of dc and 130 KW of ac. This does not provide for expansion of equipment nor for air conditioning, lighting, etc. Total power required for an AN/FSQ-7 installation is estimated at 500 - 600 KW.

It was decided that a prime mover will not be included in the XDL system but that experience with prime movers can be obtained later by connecting such a unit to drive the motor-generator set (for emergency conditions it was mentioned that batteries could be used until the prime mover is brought up to voltage. It was pointed out that some diesel generators can go from complete rest to full voltage in 5 seconds. It is possible that, instead of batteries, the diesel will be run floating on the line during raids).

The system should be designed so that any single power supply can be by-passed in an emergency.

The power supplies must be turned on and off in such a way that no equipment will be damaged. The 120V regulated ac will be brought from zero voltage to full voltage in one minute. This regulated ac will be supplied to all filaments in the system except the auxiliary or servicing equipment, and will be supplied to the plates of the dc supplies.

After the ac has cycled on, the negative voltages will be turned on and monitored. The positive voltages will then come on.

A standby "off" condition will leave the filaments on but turn off all the dc, the positive voltages preceding the negative ones. Switching to the normal "off" condition will sequence all voltages off including the ac. Pushing an emergency "off" button will turn all voltages off simultaneously. (Each piece of auxiliary equipment will have its own power supply).

Voltage and temperature detectors will warn the operators when voltage or temperature is above or below normal and will sequence the power off if the voltage or temperature exceeds further limits. A spike detector on the power supply will also provide a warning signal to the operator.

It was pointed out that the power supply distribution system must be broken into two independent sections to supply the 2 major logical sections: The section which must be maintained for emergency display and the sections which are not needed for emergency display.

It was pointed out that 3 alternatives exist concerning standby conditions on the dc supplies. Duplicates of all supplies will be available, each one capable of operating in the place of its counterpart. The three alternatives are: (1) The duplicate supplies could remain idle, with bleeder load only, until needed. (2) They could remain connected and run in parallel with their counterparts. (3) Each supply could run at reduced load to supply approximately half of the system and in an emergency could be reconnected to supply the whole system.

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Fuses should be provided at the loads. Distribution relays will be provided for switching the power when a fuse blows, due to overheating, for maintenance, for marginal checking, and for switching standby dc power. It was suggested that these distribution relays be provided in each frame, but it may be more desirable to place them on a centralized frame.

Signed:

*A. P. Kromer*  
A. P. Kromer

*R. P. Mayer*  
R. P. Mayer

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