D. L. Shell (General Electric): How long does it take an arm to seek the same track as present location, and how long to seek the same track number on the opposite side of the same disk?

Mr. Royse: We have found that whenever we resend, it takes a little less time than we thought it would originally and this time is in the order of one hundred milliseconds for the complete search of the surface. In other words, in answer to the second part of the question, you have already seeked the track and you have forgotten about it and you try to seek the same location. This takes of the order of fifty milliseconds to accomplish. We must go through all the checking procedures. In seeking the same track number on the opposite side of the same disk is approximately the same time, five milliseconds.

C. F. Summer (RCA Missile Test Project): Would it be possible to address individually any word on any disk? Further, how far apart physically are the channels on each disk?

Mr. Royse: In answer to the first part of the question, no, not directly. The way we handle this is to read an entire track into the core memory and there we have very powerful editing ability. We can make a block transfer of ten or fifty words. From core memory, we can make block transfers in any amount, which includes words which are successive words between core memory and the drum. In addition, we can pull out one word and we can do the reverse. So, what we do to change one word is to read out a track into the core memory, alter the one word, and rewrite the contents of the core memory on the same track. To the last part of your question in regard to how far apart physically are the channels on each disk, they are five thousandths apart.

W. L. Martin (Marchant Research): Does 838 typewriter have a mechanical matrix for automatic typing or are the keys each activated by individual solenoids?

Mr. Reitfort: They are activated by individual solenoids.

A. A. Cohen (Remington Rand UNIVAC): Please expand on how rotation is controlled in servicing waiting inquiry stations.

Mr. Reitfort: As each increase station makes a request, information is stored in relays. Once this station has completed its inquiry and released the typewriter, then we look to see what next station has a request for.

The IBM 650 RAMAC Inquiry Station Operation

HENRY A. REITFORT†

Quick Access Via Inquiry Station Typewriter

A FEATURE of the IBM 650 RAMAC important to “in-line” processing is the facility for quick access to the data processing system from remote locations without interfering with the daily routine. This interrogation of the RAMAC is done through the IBM 838 inquiry station typewriter from locations up to 500 feet from the computer. (See Fig. 1.)

The inquiry station typewriter provides transmission of data to the 650 system and automatic typing of data replies from the system. Up to 10 inquiry stations are available, arranged in one control or in two controls. Each control independently communicates with the 650 system through its own inquiry station synchronizer. Thus, by having two controls, up to twice the volume of inquiries can be handled. By proper programming of the two controls, inquiries and replies can be functioning from both controls at the same time.

Several operating keys and lights are located at each inquiry station which allow the operator to control the various functions of the machine. The unit also contains a regulated power supply and a small relay gate.

Flexibility of Inquiry Stations

The inquiry stations are completely flexible since they can inquire into any record in the 650 system. By means of the typewriter keyboard, data and instructions can be provided to the system. Automatic typing of replies to inquiries, miscellaneous messages, or productive output printing can be accomplished.

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Each typewriter is addressable from the 650 program, thus an inquiry received from one station can reply at a different station, if desired. A program tape on each inquiry station provides for format arrangement of the inquiry and reply. The program tape also contains a control word that identifies the station and specifies the 650 program routine to be followed for the particular inquiry.

The inquiry stations are connected by multiconduc-
tor cables to the IBM 652 control unit, and to each other. Separate transmission channels are provided for inquiries going to the 650 and for replies coming from the 650 to the 838 unit. Thus, while one station is making an inquiry, another station can be simultaneously typing a reply for a previous inquiry.

The control unit contains a small relay gate and an electronic chassis to synchronize the inquiry station with the computer. This unit also contains the 838 checking circuitry. All information from the 838 is buffered with relays in the control unit prior to combining it in the electronic chassis with timing pulses from the computer.

The 652 control unit is an integral part of the 650 RAMAC system. The 650 computer contains the inquiry station input-output synchronizers which are specific bands on the magnetic drum. Each 838 control unit has its own assigned inquiry and reply synchronizers in the computer.

The control of the synchronizers used for inquiries and replies is designed to accept and transmit one character at a time. On an inquiry, the 838 sends one character at a time to the inquiry synchronizer as it is typed by the operator. A reply to an 838 from the 650 consists of transmitting one character at a time from the reply synchronizers to be typed by the 838 at a rate of 600 characters per minute. Each synchronizer contains 100 digits of storage or 10 words of 10 digits each.

**Program Tape**

Each inquiry station has provisions for a program tape that provides flexibility for 1) forms control through carriage tabulations and spacing, 2) entry and exit arrangement for data transmission, and 3) control and identification of data for 650 processing.

The program tape is a 16-channel perforated plastic tape, the maximum length being four feet long. Each of the 16 channels has an assigned significance. Holes are punched in the tape channels to control the assigned functions. The tape is advanced in conjunction with the programmed movements of the carriage or the control keys on the inquiry station console. Separate program tapes are prepared for each application and are easily interchanged by the operator. (See Fig. 2.)

Each column of the tape is punched to correspond to a given position of the data being sent to the 650 system and all characters being typed in the reply. On an inquiry, as each character is typed, the program tape designates the word and digit position of the input synchronizer where the character is to be transmitted. On a reply from the 650 to the inquiry station, the program tape selects the word and digit position within the reply synchronizer that is to be typed in that location on the paper.

The ends of the program tape are joined together to form a closed loop permitting the inquiry station to proceed automatically from an input format to an output format.

**Word and Digit Locations**

The word and digit locations are punched in a 2-out-of-5-bit selfchecking code. Any word or digit which does not meet the requirements of the 2-out-of-5-bit code is recognized as an error to stop the station during an inquiry. In a reply status, a validity check error prints an asterisk in red in place of the character.

When a hole is punched in the control word channel, the function of the word channels 1-5 are changed from coded word to that of a digit emitter for that tape column for automatic entry of control word into the inquiry synchronizer.

**650 RAMAC Communications System**

The keyboard communication to the 650 RAMAC system provided by the IBM 838 units begins with the operator requesting permission to send the inquiry or data to the 650. This is accomplished by the operator depressing the request key. The request key checks that the program tape is stopped in the channel designating the start of the input format. If not, the unit automatically advances the tape to the input hole. If the request key is held down when the tape reaches the input hole, it then sends a signal to the 652 control unit asking permission to transmit a message.

When this request is received through the control unit, the 650 erases all information in the inquiry synchronizer from the previous inquiry. It then enters zeros in all positions of the 10 words, and automatically checks that the 10 words of the synchronizer contain...
Determination of the Output Format

To determine which station the reply is being sent to, a particular digit of the control word, which has been designated as the station number, is analyzed. This will connect the proper station to the output transmission lines by means of relay points. When the station is selected, the unit checks to make sure that the program tape is at the start of the output format prior to starting the reply. If not, the program tape is automatically advanced until it senses a hole in the output format channel.

The reply is started when the first position of the output format is sensed to determine the location of the first character to be printed. The word and digit position of the reply synchronizer, as designated by the program tape, is analyzed, and by means of relays the proper character is selected to be printed. As each character is printed, the program tape is advanced and the next character location is transmitted to the control unit for selection of the next character. As each character is selected, a validity check of the location relays and the information relays is made. If an error is detected, the ribbon control is operated and an asterisk is printed in red.

The reply continues to be printed until a hole is sensed in the input format channel. This is a signal to the control unit that the reply has been completed and the inquiry station is released. The system is now ready to process the next inquiry and reply.

Installation Components

An installation can consist of many inquiry stations and there will be occasions where several stations may simultaneously request permission to make an inquiry. The control-unit relay circuitry is designed to remember each request and accept only one request at a time. Each request is processed in sequence based upon the station number.

Conclusion

The system as outlined operates with a minimum of 650 RAMAC computing time. The interlocking of the system is such that the inquiry process time through the subroutine is the only time the 650 system is held up.

Two inquiry stations can be operated simultaneously with one control unit, one on inquiry and one in reply. If traffic from the inquiry stations is such that all inquiries cannot be handled fast enough, the second control unit can be added. This will permit two strings of stations allowing four to be used simultaneously, two on inquiry and two on reply.

The punched program tape provides the system with vast flexibility as to the number of formats that can be handled with a minimum amount of computer time since no rearrangement of data is required in the subroutine.

This system, therefore, gives quick access to any or all records in the IBM 650 RAMAC with the required security necessary for combined records. The IBM 838 inquiry station is one more step toward complete facilities for “in-line” data processing.