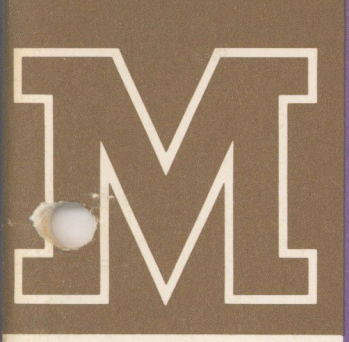

IBM

General Information Manual

9090 Airlines Reservation System

IBM

General Information Manual

9090 Airlines Reservation System

Preface

The reservation process is not unique to the airlines industry. Similar procedures exist in the railroad, hotel, trucking, car rental, consumer credit, and many other industries. These activities require close matching of demand with accurate current inventory and maintenance of readily available customer records.

The general purpose of the IBM 9090 Airlines Reservation System is to serve the air traveler swiftly and effectively and to offer the operating airline increased sales effectiveness and better use of passenger space. To do this, the 9090 automatically stores and maintains passenger name records, seat inventories, and quantities of other information in an integrated system that is tailored to the airline's operations.

The IBM 9090 stores electronically, for instant recall by any agent in the system, not only inventories of reservations and seats available, but also complete passenger data including the complete itinerary, and other report information. The elements that constitute the completeness of 9090 coverage vary from one industry to another and from company to company within an industry. In the airline industry, for example, completeness of control would include varying proportions of such factors as:

Maintenance of passenger name records.
Inventories of reservations, seats, aircraft components.
Computation of crew time and scheduling of crews.
Inventories of catering supplies. (The 9090 would automatically calculate needs and actually place orders.)
Checking of flight progress, with automatic alarms on failure to receive call-in at check points.
Flight plan updating while flight is in progress and printout at locations affected.
Scheduling of maintenance services available at different locations, of cargo space, of related available reservations (hotels, car rentals, air taxi services).
Dispatcher assignment files.
Craft assignments according to maintenance and other safety factors.
Routing.
Fuel planning.
Ticketing.
Computation of airborne time.
Automatic fare quotation.
Administration message traffic.
History files (both required and prognostic).

Address comments concerning this manual to:
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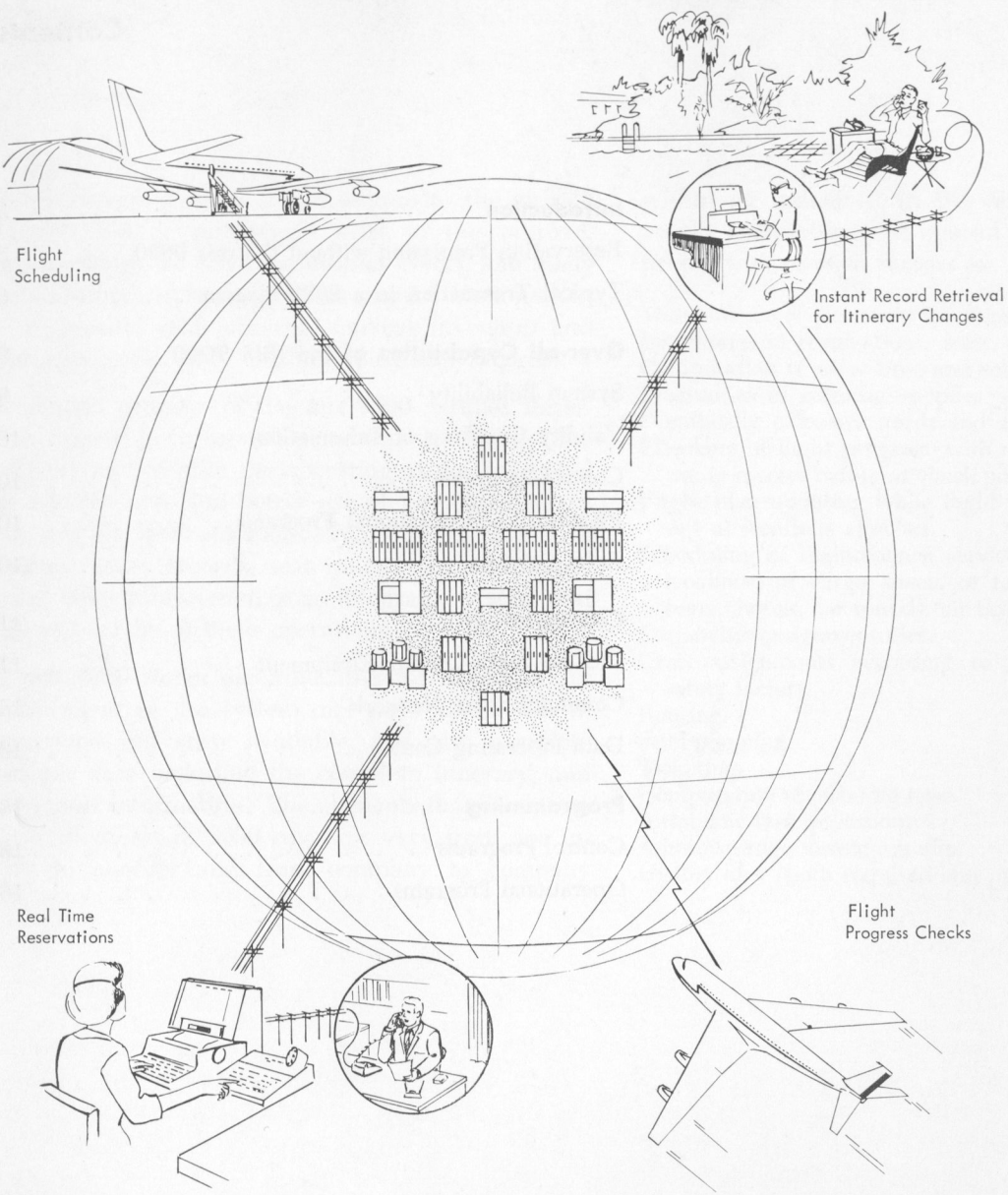
P.O. Box 390
Poughkeepsie, N. Y.

Contents



IBM 9090 Airlines Reservations System

IBM 9090 Airlines Reservation System

"What flights leave for San Francisco tomorrow afternoon?"

At a Detroit airline office, a sales agent checks flights for available space.

"We have first class and tourist space on flights at one and at five."

"Just a minute while I check. . . . Please make a reservation for Mr. Frank Emmons on the one o'clock flight – first class . . . and he'll need a return-trip reservation for the following afternoon."

The agent checks the San Francisco-Detroit flight schedule and suggests a two o'clock flight. Mr. Emmons's secretary makes this reservation also.

Now the agent asks for more passenger information – the spelling of the passenger's name, the name of the caller, business and home telephone numbers – and makes arrangements for the ticket to be picked up before 6:00 PM.

Jet aircraft have greatly reduced in-flight time; the IBM 9090 Airlines Reservation System has even more drastically reduced reservation processing time. It gives the most remote reservation agent in the system the use of the IBM 7090 Data Processing System, one of the most powerful computers in existence. In addition, the 9090 assures that queries and entries from any point in the system, however remote, will receive a response from the data processing center within seconds.

To see how the IBM 9090 greatly increases the efficiency of the reservation process, let's follow the handling of Mr. Emmons's typical reservation: first, as processed without the 9090 system, and then as processed with an IBM 9090.

Reservation Processing without the IBM 9090

As soon as the telephone transaction is finished:

1. The sales agent completes a record of the transaction and places it on a conveyor belt that takes it to a sorting center. (If the agent were in an outlying office, the record might be transmitted to a central office for sorting and filing.)

2. The reservation inventory must be updated as a result of the transaction.

The round-trip reservation requires a message to the San Francisco office. Therefore:

3. A copy of the transaction record must go to a message writer.

4. The message must go to a telegraph operator.

5. At the San Francisco office, a telegraph operator receives the message.

6. The message is transported to a sales agent.

7. The sales agent makes up another passenger record for Mr. Emmons's return trip.

8. The return-trip record now must be sent to the sorting center. (At some outlying offices and for some complex return trips, it would be necessary to send a message to a distant-city control office to record whatever segments might be involved.)

Meanwhile, at the Detroit originating office:

9. The passenger record is filed by flight and date (and perhaps alphabetically under flight and date).

The time that elapses between the customer's reservation request and the final filing of the passenger record, or records, is 30 minutes to three hours, or more – and parts of the passenger's over-all file are in two distant cities. If Mr. Emmons should call back to make a change in his reservation, or if his secretary should appear unexpectedly to pick up his ticket, his record might be anywhere en route from the agent's

desk to the flight-date files at both Detroit and San Francisco.

When the secretary does come to pick up the ticket, the sales agent calls the file department to retrieve Mr. Emmons's passenger record. This record may be in one of three areas:

1. Still in process.
2. In a "rough" file, waiting to be filed.
3. Actually filed; if filed, it is in a large room with many thousand records, staffed by clerks who become extremely busy during peak-load rushes.

The sales agent's call for Mr. Emmons's passenger record may be successful within a few minutes or it may be delayed for one or more reasons:

1. The file clerk may answer, "Please hold," and then, in a peak-load rush, go on to finish the job in process, coming back later to take the call for Mr. Emmons's record.
2. The file clerk may not be able to find the record in the flight-date files and may have to look in the rough file.
3. If the record is not in the rough file, someone may have to call processing departments to determine where the record is in the processing sequence.

As soon as the record is located, the sales agent reports that Mr. Emmons's ticket is being picked up, and this fact is entered on the record.

At flight time, a Detroit file section agent must find the files of all passengers for the 1:00 PM flight, summarize them for a flight manifest, make out meal orders, and arrange for special requests such as dietary restrictions and medical services.

After departure, the ticket lift agent must report the no-show's (ticket holders who failed to appear for the flight, leaving seats available), standby's (persons without reservations who are waiting to take unreserved seats on any flight to their destination), and no-rec's (persons with valid tickets, but for whom the airline has no record). This report must be transmitted to the control office and notice of extra available space relayed to the down-line station (Chicago, in this case) to allow notification of waitlisted customers.

Now let's follow Mr. Emmons's reservation as handled by an IBM TELE-PROCESSING* System.

Typical Transaction in a 9090 System

When Mr. Emmons's secretary telephones for information about a flight for the following afternoon, the sales agent picks from a file of air information cards the one marked "From Detroit to San Francisco" and places it in the Air Information Device (Figures 1 and 2).

* Trademark

Figure 1. Airlines Reservation Agent's Set

The agent then presses the origin button at the top of the column designating the point of departure for the one o'clock flight. On the Routine Action Pushbutton (Director) module (Figure 3), the agent presses the tomorrow button to establish the date, the 1-seat button to indicate the number of seats desired, and the availability button to request flight space availability information.

The agent's set transmits a message over the communication network to the data processing center so that the computer receives the identity of the air information card and flight numbers, the date, point of departure, and number of seats requested.

The computer checks that the request is valid. If it is, the computer causes the availability-reply indicators (Figure 2) to light, showing what flights have the requested space on the requested date. If the request is not valid, the response at the agent's set is a printed message notifying the agent that the date is not valid for the card used.

When the secretary informs the reservation agent that Mr. Emmons will take the one o'clock flight, the agent presses the line selector (flight) button (Figure 2) for the card line representing the one o'clock flight, first class, and presses the need button (Figure 3).

The computer decreases the inventory of seats by one, records the sale, and prepares a response to send

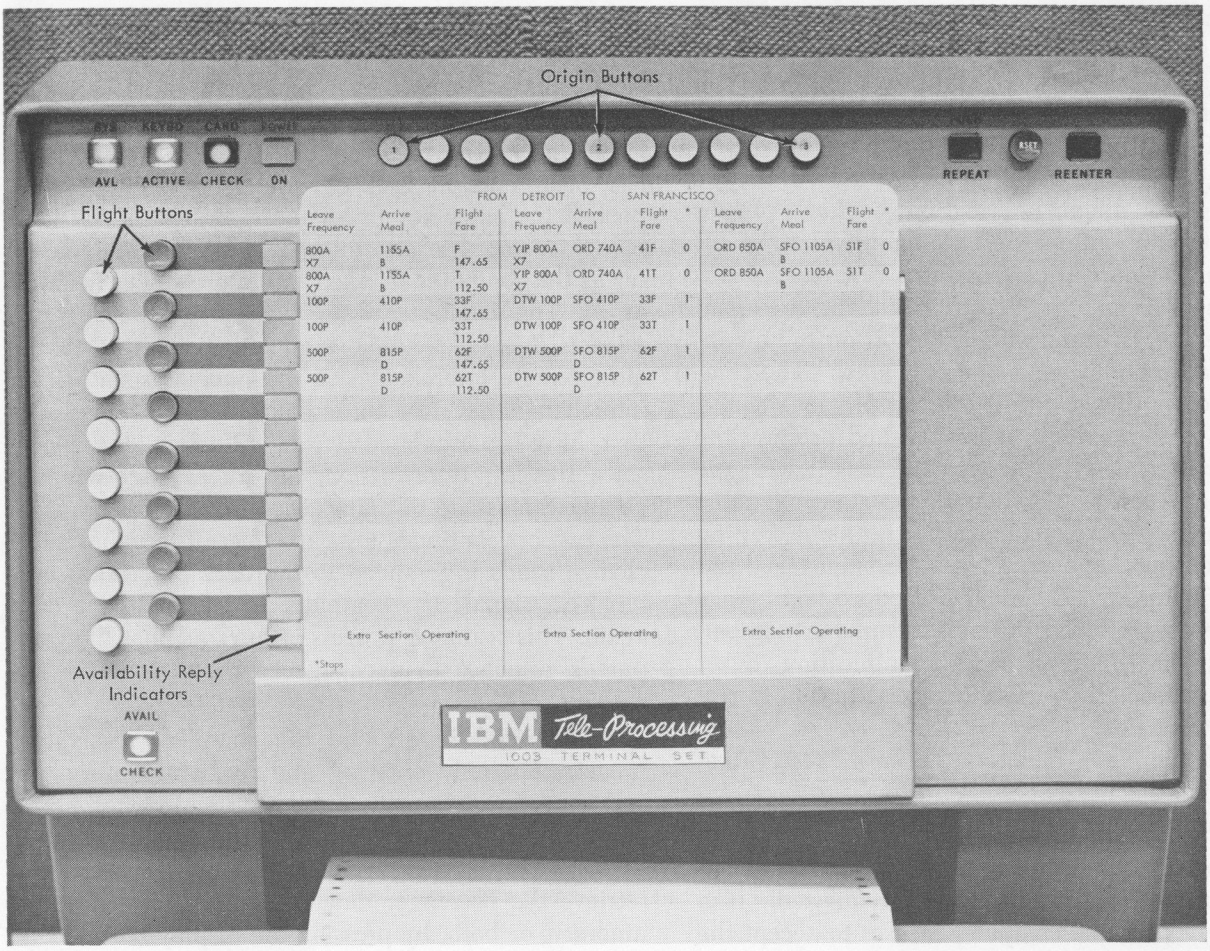


Figure 2. Air Information Device

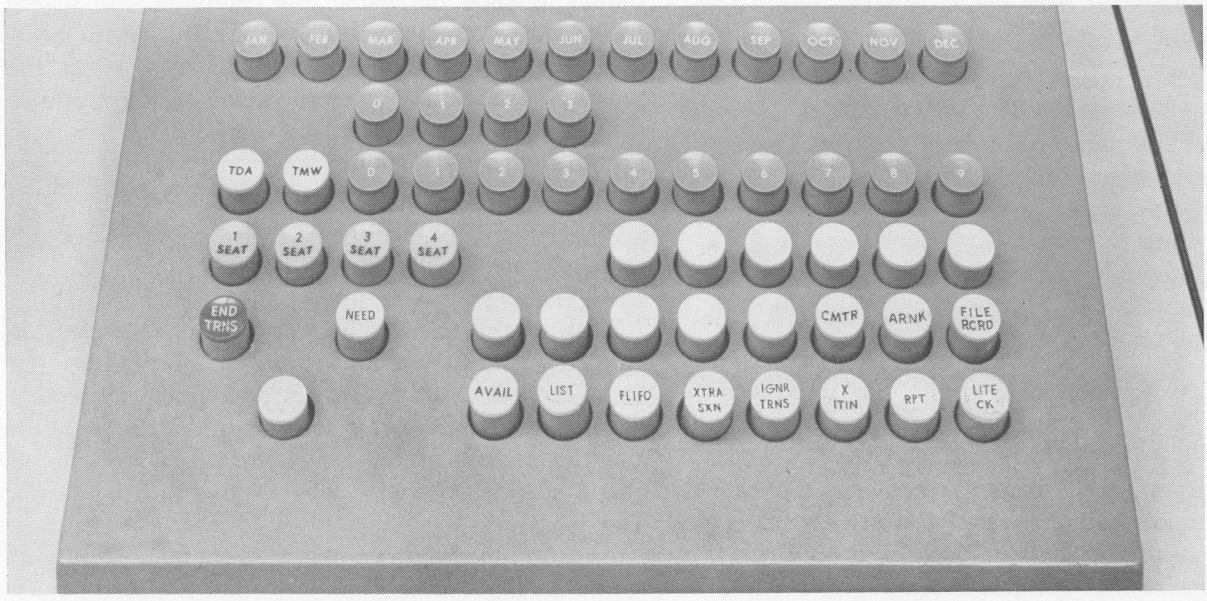


Figure 3. Routine Action Pushbutton (Director) Set

to the agent. This response (determined by programming) consists of a description of the sale by segment number, action code (status of the reservation, such as sold or listed), flight number, class of service, date, number of passengers in the party, boarding point, "off" point, departure time, and arrival time. Now, the agent turns over the air information sheet and presses the correct date buttons and availability button for Mr. Emmons's return trip. When Mr. Emmons's secretary says he will take the two o'clock flight, the agent presses the corresponding flight button on the air information device and again presses "need." The computer processes this sale as it did the previous one.

As soon as the agent's set has finished printing the sale information and the agent compares it with the customer's request, he enters the customer's name through the keyboard. He pushes the name key on the input-output keyboard, types "Emmons/F," and pushes the enter key. A similar procedure takes place as the agent enters the business telephone number, home telephone number, caller identification, ticket time limit and, finally, pushes a special button to signify end-transaction.

The computer then monitors the entire reservation to make sure that all necessary items have been entered. It performs several tests, such as:

1. Comparing the number of passenger names entered against the number of seats requested. If a discrepancy exists, the computer refuses to accept the reservation and sends back a printed response asking the agent to correct the entry.

2. Checking for flight segment continuity, (that the "off" point for one segment of the itinerary is the boarding point for the next segment). If a discrepancy exists, the computer does not accept the reservation and notifies the agent to complete or correct the order of the itinerary.

If the reservation is in order, the computer:

1. Indexes all passenger names (of the reserving party) for each segment of the flight.

2. Starts any special processing called for by the transaction, such as a request for special food or medical care.

3. If necessary, initiates a message to another airline, a hotel, or a car rental agency for forwarding via private or message service telecommunication facilities.

4. Files the entire reservation record.

This back-and-forth exchange between the agent and the computer appears continuous but is actually a series of separate groups of input and output messages for the computer. These messages are interspersed with similar exchanges with many other terminal sets, as well as with simultaneous processing of other types of information within the computer.

The printed copy of a typical transaction between the agent and the computer is shown in Figure 4. Each line of the print-out represents a message that has been entered into the system when the agent pushed the enter key or an action button. Each message was stored in a terminal interchange until called for as the computer scanned the interchanges for messages. The computer scans each high-speed transmission line by sending a go-ahead message to the most remote interchange on the line. As soon as that interchange has transmitted all the input messages that have accumulated (from all of its terminals) since the last transmission, the interchange sends a go-ahead message to the next-less-remote interchange. The process continues until the nearest terminal interchange sends a go-ahead to the data processing center. This signals the computer to start the line scan again. This scanning process is so rapid that the computer's response to each agent's message seems immediate.

The printed report and the complete reservation process, not only entering and updating reservation and seat inventories but also storing for instant retrieval the full passenger data record, *has taken only a few seconds.* Any agent in the 9090 system may retrieve the passenger data record or the passenger's itinerary, or both, by pressing the display-record code key on the printer keyboard, entering identifying information (usually name, flight, and date), and finally pushing the enter key. The computer immediately causes the printer at the agent's set to print out the desired record. If the agent asking for record retrieval should misspell the name, the computer will search the complete reservation index and print out the nearest matching name and record. If this is not the record desired, the agent can signal the computer to display the next-nearest match. Thus, even with slightly inadequate identifying information, the agent is able to supply the customer with a desired record almost immediately. Passenger data records may include waitlisted prospective passengers as well as passengers with reservations.

With all of this information instantly retrievable and automatically printed by the 9090 system, the flight section agent can easily and quickly assemble the files of all passengers at flight time. His manifest and the records of the ticket lift agent are entered into the 9090 system as soon as they are made up. The 9090 system automatically transmits necessary information to the down-line station (the next city at which the flight lands) and any other required points. This transmission is accomplished within seconds, or

```
1.      33F/20 S1  DTW SFO  100P   410P
2.      45F/21 S1  SFO DTW  200P  1040P
-. EMMONS/F*
9. YU9-7732     X 492B*
9. PL4-7321H*
8. 6P/19*
6. SECY*
OK..
```

AGENT'S TRANSACTION COPY

EXPLANATION

1. 33F/20 S1 DTW SFO 100P 410P
   1. means segment 1.
   33 is the flight number.
   F means first class.
   20 is the day of the month printed as a result of pushing the tomorrow button.
   S is the action code indicating confirmation of the agent's request.
   1 designates the number of seats requested.
   DTW is the code for the airport of departure.
   SFO is the code for the airport of arrival.
   100P is the departure time.
   410P is the arrival time.

2. 45F/21 S1 SFO DTW 200P 1040P
   2. means segment 2 (in this case, the return trip). The remaining information follows the same pattern as that on line 1.

-. EMMONS/F*
   -. is the code for a name entry.
   EMMONS/F appears as the agent typed it.
   * and the type-head carrier return occur automatically as the computer's response that this entry is in order and has been accepted.

9. YU9-7732 X 492B*
   9. is the code for telephone number.
   YU9-7732 X 492B appears as the agent typed it; B designates business telephone number.
   * and the carrier return are automatic, occurring as the computer's acceptance of the entry.

9. PL4-7321H*
   9. is the code for telephone number.
   PL4-7321H appears as the agent typed it; H designates home telephone number.
   * and the carrier return are automatic, occurring as the computer's acceptance of the entry.

8. 6P/19*
   8. is the code for time-limit information.
   6P/ means 6:00 PM (the time of ticket pick-up, typed by the agent).
   19 is day-of-the-month time limit for ticket pick-up, typed by the agent.
   * and the carrier return are automatic, occurring as the computer's acceptance of the entry.

6. SECY*
   6. is the code for the caller's identification.
   SECY is the identification of the caller, as typed by the agent.
   * and carrier return are automatic, as in the other entries.

O.K..
   After the agent presses the end-transaction key and the computer has reviewed and found the whole transaction correct, the keyboard automatically types O.K., and returns the type-head carrier for the next entry.

Note: Transaction copies vary with the programmed operation procedures of different airlines. This is a typical example.

Figure 4. Agent's Copy of a Typical Transaction

possibly a very few minutes, whenever the nature of the information requires speedy processing. Programs permit the computer to determine transmission priorities for reports.

Over-all Capabilities of the IBM 9090

The extent of the 9090 system is limited only by the existence of reliable transmission media. A system may be regional, nationwide, or international. The American Airlines system will span some 32,000 miles of network connecting the data processing center and agents' sets through a system of major trunk lines and short lines. It takes the 9090 system only a few seconds to process a query and response in a network of this size.

The on-line IBM 7090 Data Processing System, the center of the 9090 system, can execute 210,000 operations per second; it holds 32,768 six-character words in a magnetic core storage alone; disk files and drums provide a much larger volume of random-access storage; magnetic tapes store an almost unlimited number of batch records. For more detail on component capacities, see the Configurations section and Figure 11.

System Reliability

Safeguards are present in every part of the system to insure continuous, reliable operation. The 9090 is constructed of solid-state components with the highest degree of dependability that years of IBM research, testing, and manufacturing can produce.

At the Data Processing Center, the presence of two identical 7090 computers means that one is always available to take over on-line operations at a signal from the duplex console. File records are maintained in duplicate. Both 7090 systems have access to disk and drum storage. These protective factors virtually eliminate the possibility of lost records or messages. The control programs (described later) contain many check points to determine that data flow and system operations are functioning properly. A malfunction would cause an instantaneous alarm signal with the proper indication to guide the operator's course of action. Programming safeguards also include the use of diagnostic programs and standby programs.

In the Transmission Network, communication channels are supplied by and are the responsibility of the common carrier. If some terminal interchange fails to respond to a go-ahead signal from the preceding interchange, the computer sends to the last-responding interchange a new address for its go-ahead message – the address of the next interchange after the nonresponding one. This process can be repeated until the computer receives an interchange response. In this way, local high-speed line problems do not interrupt the operation of the 9090 system; the operators at the data processing center are instantly informed of nonresponding interchanges.

At the Remote Installations, an agent's possible forgetfulness about entering all information required for a reservation elicits a reminder from the computer and a rejection of the reservation until the completed record has been entered. To prevent accidental entering of information that cannot be accepted, the design of the terminal sets includes automatic keyboard locks. For example, the keyboard locks while the computer is processing a previous query from that terminal.

A terminal set is replaceable merely by disconnecting it (from the standard electric outlet and interchange connection) and connecting another. Whether a set will be on reserve at a terminal installation will depend upon the size of the installation. This ease of replacement and IBM Customer Engineers, either standing by or on call, are further safeguards for the continuous and reliable input and output of data for the 9090 system.

Validity Checking of Information

Not only does the 9090 incorporate every possible safeguard to keep its equipment operating smoothly and reliably, but also it makes automatic validity checks as the data pass through several parts of the system. An error discovered at any stage of data transfer within the system causes a signal that indicates where the error is located. Through program control, the data are rechecked, cleared, or displayed for operator handling.

At the Data Processing Center, the Real Time Channel (RTC) receives, in addition to data, control information from the transmission input channels. The RTC performs error checking and recognizes and acts upon several control codes. It performs similar functions for outgoing data from computer storage.

At the Other End of the Transmission Lines, the output characters are checked after they come off the lines, and the input characters are checked just before they go on the lines. At the extreme periphery of the system; the agent's set itself checks each character that is printed out or entered into the keyboard; the components handling data transfer between the 9090 system and telegraph systems also perform character checks.

Control Programs

A set of control programs frees the customer programmer from: routine real-time allocations in storage for normal types of data input, input-output considerations (except the necessity for using macroinstructions), and priority and interrupt considerations. These 9090 programs are developed by IBM as a working complement to the physical equipment contained in the 9090 system. They are discussed in greater detail in the Programming section.

Flexibility of Operational Programs

Customer management determines how much of the 9090 system is to be devoted to reservations, operation applications, and other types of 9090 system applications, such as planning and administrative message traffic. With the control program handling the basic listing of operations of the 9090 system, the operational program can be flexible. It harnesses the 9090 to executive planning for the particular needs of the installation.

Extra Services

To aid in planning for, installing, programming, and maintaining the 9090 system, IBM offers many extra services. These include education facilities (equipment and space) for the customer's use in training personnel. In addition, IBM itself offers training in some areas such as programming. IBM also provides programmer specialists to work with customer operational programmers and analysis specialists to work with customer systems analysts.

The installation of the 9090 takes place under the combined efforts of an IBM-customer installation group. The installation follows a tested pattern of orderly changeover from preceding systems, with no break in continuity of operation.

One of the most important of the extra services associated with the 9090 system is the use of simulation programs. These programs permit analysis of the expected operational characteristics of a proposed system before it is manufactured. Equally important is their ability to analyze the influence of varying business conditions on the behavior of the system. In addition to helping plan the initial installation of a 9090 system, present and future simulated programs will project the effect of: (1) contemplated changes in an already existent 9090 system, or (2) expected operational changes such as traffic growth.

Configuration

The IBM 9090 is an integrated system of equipment comprising the data processing center, the communication network, and the remote input-output stations. Figure 15 (at the back of the manual) is a schematic outline of a 9090 configuration; this figure is a fold-out sheet so that you can relate each component to the over-all 9090 system.

Configurations are flexible, as are programs. While the data processing center of any 9090 system includes two 7090 Data Processing Systems, the extent and type of storage, the size of the transmission network, and the number and nature of terminal sets are tailored to each customer's current and projected needs.

IBM computers other than the 7090 can be used in similar systems. For instance, an IBM 7080 Data Processing System combined with a telecommunications reservation system is a 9080 system; an IBM 7074, a 9074; still other computers such as an IBM 1410 can be the center of a TELE-PROCESSING system of this type.

Remote Input-Output Equipment

In the 9090 system, most reservation transactions are handled by direct agent query and system response through the agent's set. Three sections of the agent's set have already been mentioned but are described in more detail here.

The Air Information Device is the receptacle for an air information sheet. This sheet is placed in its holder and sensed for identity as soon as a message is entered. The computer replies to space availability inquiries by lighting indicators to the left of the air-information-sheet flight lines. The use of origin and flight buttons in entering a message from the air information device is discussed under Typical Transaction in a 9090 System.

To speed the entry of repetitive data such as the date and number of seats requested, the agent's set has a special *Routine Action Pushbutton (Director) Set* (Figure 3) designed for maximum convenience and efficiency. It contains pushbuttons such as "tomorrow" to enable the agent to request tomorrow's flights without having to enter the full month and date. The 9090 system converts the request to the proper date. When the agent requests information about flights on a particular day, certain of the buttons on this special keyboard remain depressed until another button in the same group is depressed. In this way, the agent enters routine information only once to both inquire for and sell the reservation.

The Input-Output Device (Printer) is the instrument of both the agent and the computer (Figure 5). All information entered into this keyboard by the

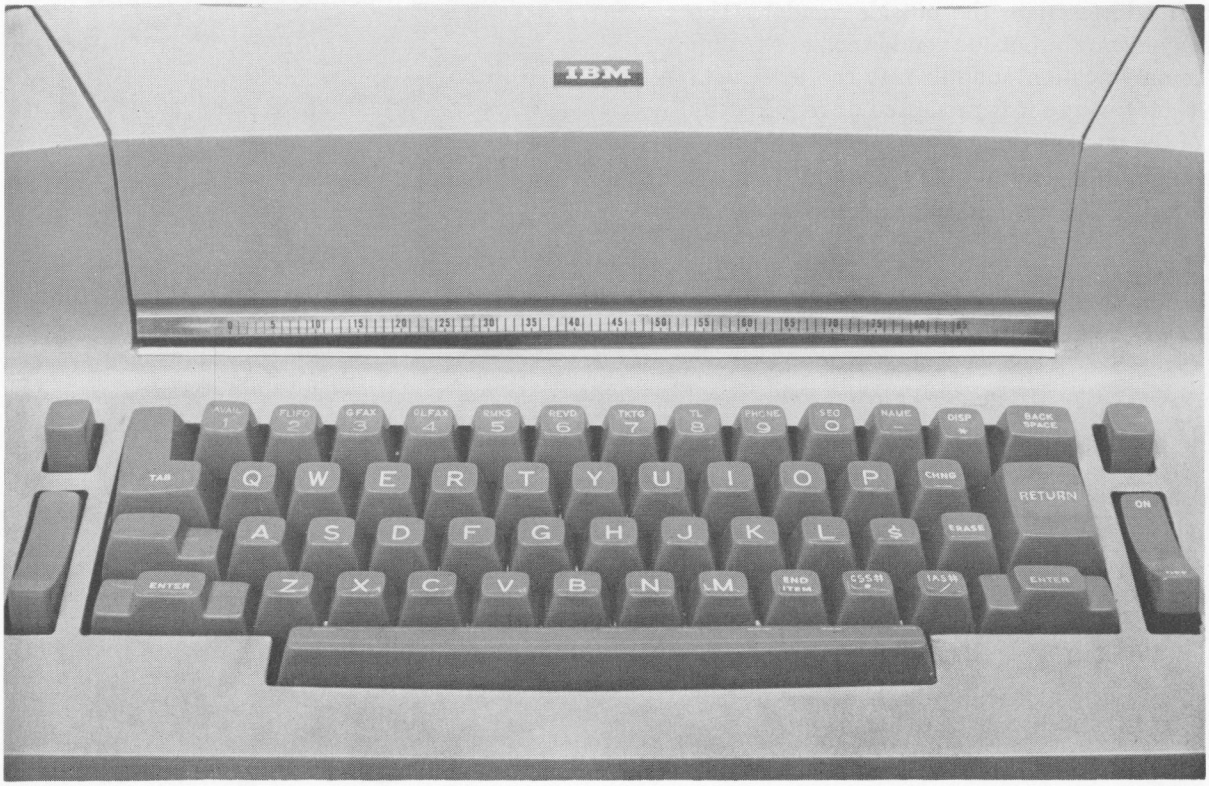


Figure 5. Input-Output Device (Printer) Keyboard

agent is printed simultaneously for visual verification. Most computer replies resulting from agent entries result in a print-out by the printer. This device also prints other messages from the data processing center.

The Terminal Control is a module containing the controls for the entire terminal set.

The Supervisor's Terminal Set and the Dispatcher's Terminal Set differ from the agent's set only in their use; this difference is achieved by programming.

Two other types of terminal sets differ from the agent's set in both function and design.

The Input Communication Adapter and the Output Communication Adapter perform the translation and editing necessary to keep telegraph data compatible with 9090 system data formats. See Figure 6. In addition, they act as speed changers between 9090 terminal-to-interchange speed of 207 bits per second and telegraph speeds as high as 200 words per minute.

If an airline customer needs a reservation from an outside source, such as another airline or hotel, the agent includes this fact in his transaction entries to the 9090 system. The computer then initiates and transmits the message just as it would transmit to an agent's set except that, in addition to including the desired destination in the body of the message, it addresses the message to an output communication adapter which automatically changes BCD code into five-channel telegraph code and enters it into a telegraph system addressed to the outside vendor. The return message from the outside vendor comes through the input communication adapter into the 9090 data processing center where it is processed as required by the nature of the message.

The Terminal Interchange (Figure 7) acts as a hold-and-forward communications processor and speed changer between all types of 9090 terminal sets and a high-speed transmission line. As many as 30 of these units can connect with one high-speed duplex set of transmission lines; each interchange can handle up to 30 low-speed lines.

On output (information coming *from* the data processing center), all terminal interchanges on the line listen to all traffic. When an interchange detects its own address preceding a message, it accepts a complete message or message segment and relays it to the appropriate output line while checking for correct data transmission. On input, each terminal interchange in its turn transmits any messages accumulated since the last transmission, prefixing each message with the terminal interchange address. (The terminal address is also affixed by the interchange and included in the message.)

Communication Network

The communication network of the 9090 system consists, first of all, of common carrier high-speed transmission lines. At the computer end of each line and at the terminal-interchange connection points are

Figure 6. Input or Output Communication Adapter

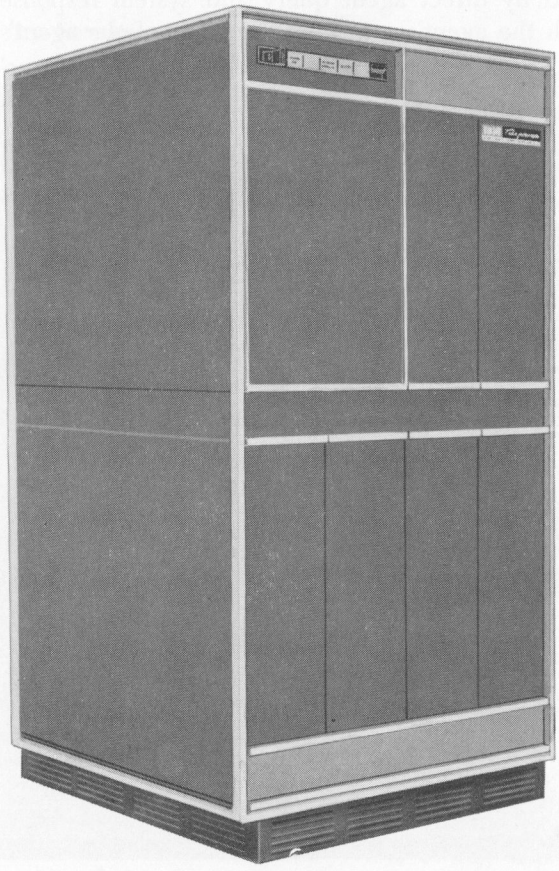


Figure 7. Terminal Interchange

2000-bits-per-second data sets to convert data processing signals into modulated pulses suitable for transmission and vice versa. (Data set is a general term for the connection between data processing equipment and common-carrier communication systems. In this manual, the term data set includes equipment known as subsets and modems, as well as demarcation strips and special connection devices used in telegraph service.)

Depending upon the needs of the service at the remote installation, its high-speed data set may be:

1. A modulation-demodulation unit (assigned to the most remote interchange on any line).

2. One modulation and two demodulation units assigned to one interchange.

3. One modulation and two demodulation units to be shared by two interchanges. As shown in Figure 15, up to 15 pairs of duplex lines may be used to carry data to and from the data processing center. The desired transmission speed of these duplex lines is guaranteed by the common carrier before the 9090 system is installed.

Linking the periphery of the 9090 system to the high-speed transmission network is a flexible low-speed system. The possible input-output lines of the terminal interchange, with their respective low-speed rates are shown in Figure 15. If an agent's set is located on a direct cable (less than 1500 feet from the interchange,) no low-speed data set is required. For remote terminals connected by transmission lines of more than 1500 feet, a low-speed data set is required at each end of the lines.

Data Processing Center

This center contains two IBM 7090 Data Processing Systems with their respective data channels and multiplexors, a duplex console, and two real time channels. The center also contains drum and disk storage systems that are shared by the two 7090 systems. All external information flow is under control of the duplex console.

As many as eight channels may operate concurrently in one 7090 system: the real time channel uses two; each data channel, disk channel, and drum channel uses one. Only one drum channel may be used in each 7090 system.

The Duplex Console (Figure 8) controls the routing of input-output messages between the transmis-

Figure 8. Duplex Console

sion-line data sets and the two real time channels. It also houses many special-function indicators and alarms for use within the data processing center.

The Real Time Channel (Figure 9) assembles message characters arriving via communication lines into groups, checks for errors, and then moves the groups as words into core storage. Output messages follow a reverse path. A magnetic core storage array (buffer storage) in the real time channel accommodates the data-handling requirements of the 32 lines (16 input and 16 output). One input line and one output line connect only the two real time channels, through the duplex console, for intercommunication between the 7090 systems. Besides handling and policing the simultaneous transmission of data over the communication lines, the real time channel performs other functions, including character recognition, error detection, and character synchronization. Incoming data from all lines are treated as though they are of the same type and priority. Outgoing messages are queued for transmission through the real time channel according to programmed priority.

The Data Channel, under the control program, regulates the flow of data between core storage and a group of input, output, and storage devices. It links magnetic tape units, card equipment, and printers to core storage. One data channel (Figure 10) can control the following input-output equipment: one IBM 711 Model 2 Card Reader, one IBM 721 Card Punch, one IBM 716 Printer and as many as ten IBM 729 II or IV Magnetic Tape Units. The transfer of commands or data words between the data channel and core storage occurs as a 36-bit parallel operation. Once started, the data channel operates autonomously. As with other components of the 9090 system, however, the main program exercises a large degree of supervisory control through instructions that test the status of the data channels.

The Multiplexor (similar in external appearance to the data channel) controls the flow of information into and out of core storage. All data to be stored or retrieved must pass through it. Under control-program direction, the multiplexor develops its own priority system for deciding which unit receives or sends information to the core storage.

Figure 9. Real Time Channel

The Central Processing Unit controls and supervises the entire on-line 7090 computer and performs the actual arithmetic and logic operations on data. The control portion of this component directs and coordinates all operations called for by over 200 programming instructions. The arithmetic portion calculates (using binary arithmetic and 36-bit fixed-length words), shifts numbers, sets the algebraic sign of results, rounds, and compares. The logic portion carries out decision-making operations to change the sequence of instruction execution. Three index registers provide indexing facilities and make possible automatic address modification and loop control within programs.

The Console of each 7090 system contains indicators, switches, keys, and register displays for the operator's use. It can display data from any requested storage location. When the system is in manual mode, the operator can change data in any storage location by using the entry keys and switches.

The 9090 system provides three types of random-access storage—magnetic cores, magnetic disks, and magnetic drums. Figure 11 shows the make-up, capacities, and access time for each type of storage.

Core Storage contains the instructions controlling the computer operation, frequently used reference tables, and transactions that are actually in process.

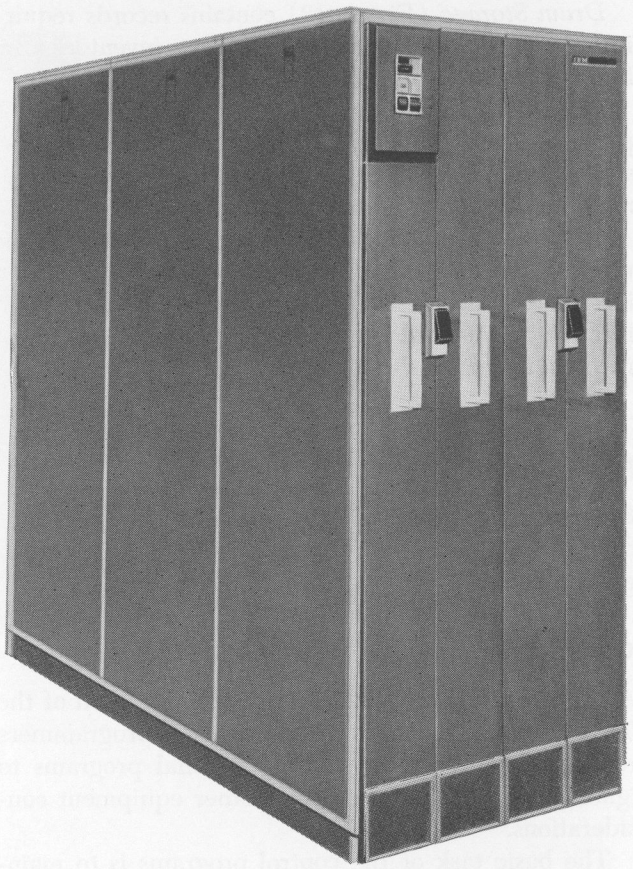


Figure 10. Data Channel

DISK SYSTEM (Shared by Both 7090's)	DRUM SYSTEM (Shared by Both 7090's)	CORE STORAGE (Each 7090)*
36 bits per word (6 characters per word)	36 bits per word (6 characters per word)	36 bits per word (6 characters per word)
37 words per record	32 words per record	variable no. of words per record
10 records per track	32 records per group	
250 tracks per surface	8 interleaved groups per drum field	
40 surfaces per module	25 drum fields per drum	
2 modules per file		
7,400,000 words per file	204,800 words per drum	32,768 words per 7302 Core Storage
16 — maximum number of files per pair of disk channels	8 — maximum number of drums	
118,400,000 words — maximum capacity	1,638,400 words — maximum capacity	32,768 words — maximum capacity
50-180 milliseconds — track access time	11.25 milliseconds — average access time	2.18 microseconds — access time
17 milliseconds — average rotational access time		
Words are written and read in *serial* fashion	Words are written and read in parallel fashion	Words are written and read in parallel fashion

SUMMARY

A maximum of 120,071,168 words (36 bits or 6 characters) can be stored for random access in a 9090 System with one pair of disk channels.
98.61% of this maximum storage capacity is in disk storage.
1.36% of this maximum storage capacity is in drum storage.
0.03% of this maximum storage capacity is in core storage.

* Because of the off-line status of one 7090 at all times, only one core storage is considered. A second IBM 7302 Core Storage is available for each 7090 system as a special feature.

Figure 11. Characteristics of Random-Access Storage in IBM 9090 System

Drum Storage (Figure 12) contains records requiring the most accesses (such as seat inventories of flights that will take place within eight days).

Disk Storage (Figure 13) holds a large quantity of programs, the less-active flight inventories and passenger reservation records, flight and schedule information, and other operational information.

Magnetic Tape contains records not requiring immediate access. These records would include such information as messages that can be held for deferred transmission, journals of transactions, historical records, and some duplicate records.

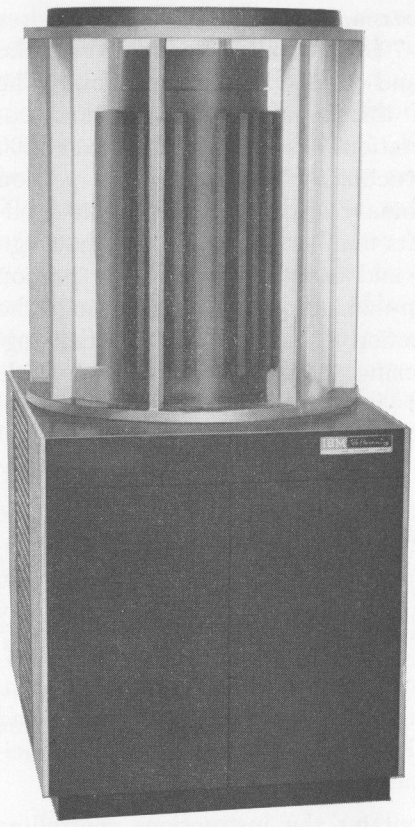


Figure 12. Drum Storage

Programming

Programming for the 9090 system falls into two major categories: control programming and operational programming.

Control Programs

A set of control programs directs the operation of the 9090 system. These programs allow the programmers responsible for creating the operational programs to ignore input-output timing and other equipment considerations.

The basic task of the control programs is to maintain lists of jobs (usually, data transfers) to be performed by various programs and components. Items are added to lists of work for input-output components on demand by the operational program. Items are deleted from these lists on completion of the data transfer. Items are added to the central processing unit lists on arrival from an external source and also at any time that a deferred job becomes ready for processing. The control programs also can cause these lists to be serviced with a preassigned priority, giving some jobs precedence over others.

Operational Programs

The operational programs are the result of planning and programming for a particular customer's application. Basic airline reservation operational programs being developed include programs for agent's set entries, origination of reservation records, and maintenance of these records.

Typical of this sort of program would be the routine for handling this situation:

1. A customer cancels a long-distance-flight reservation, leaving a seat available.
2. The computer consults the records of persons on the waiting list.
3. It processes these records to determine who should be notified of the available seat.

Figure 14 is a listing for such a program, showing the logical steps taken by the 9090 in carrying out this aspect of the reservation process.

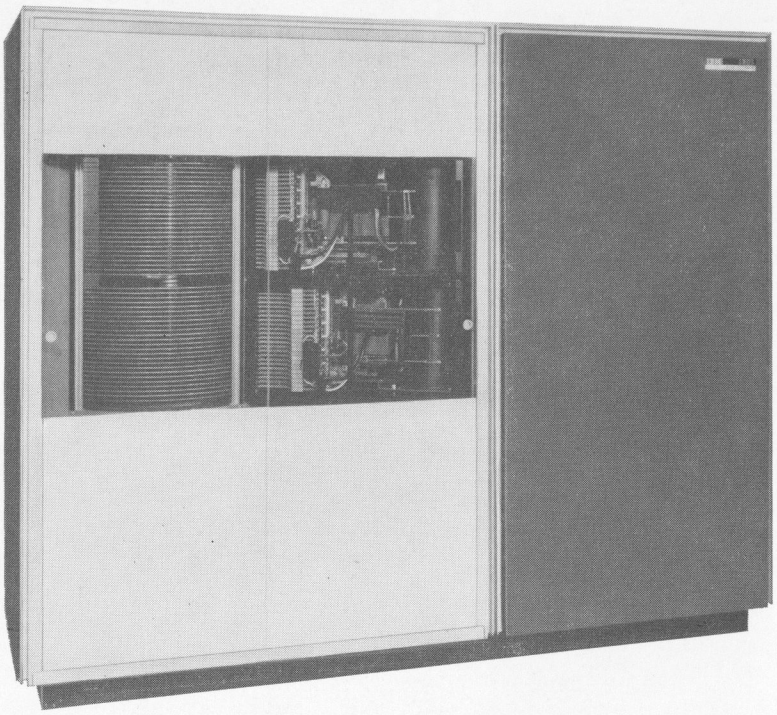
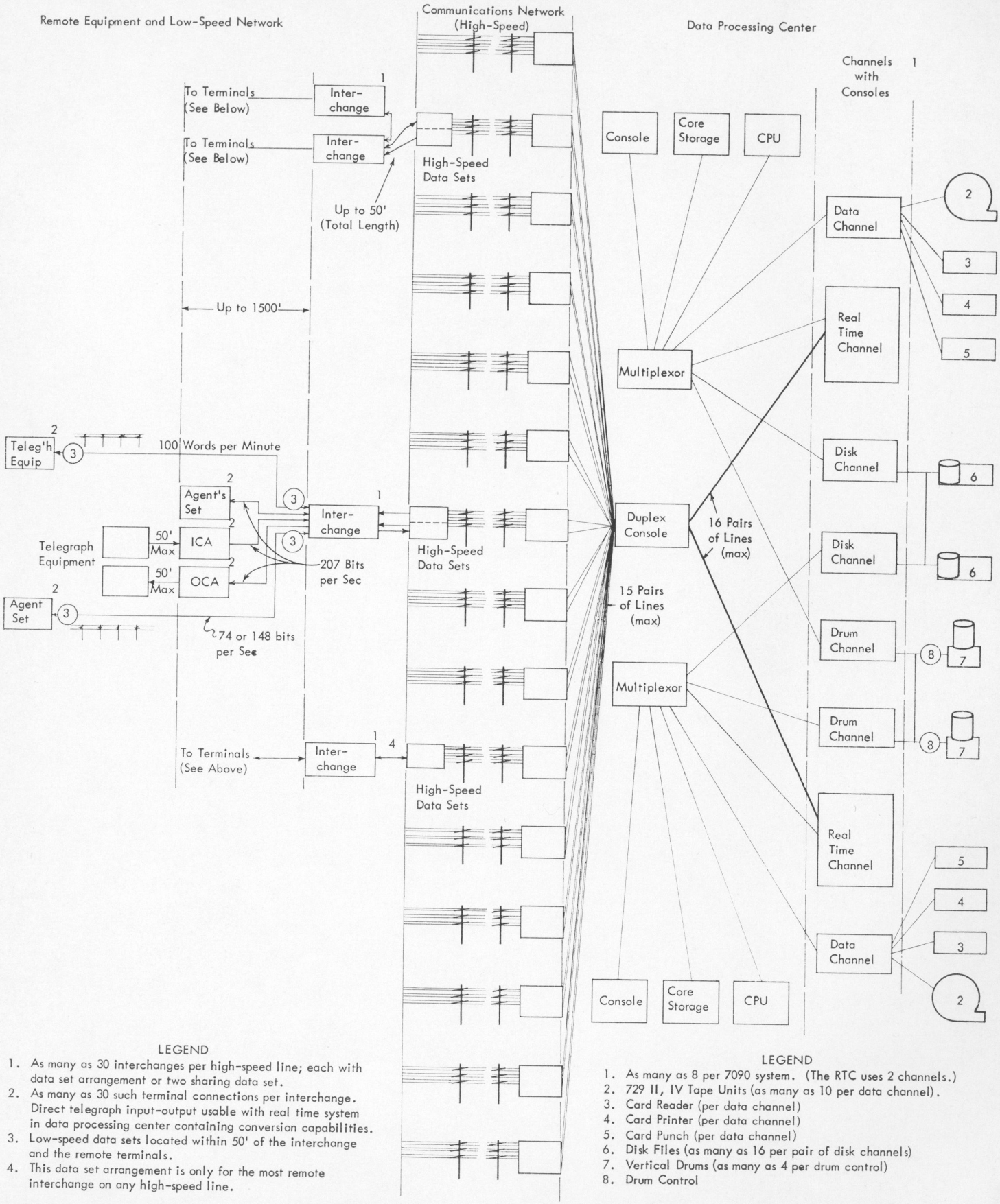


Figure 13. Disk Storage

PROCESS PATH — WAITLIST REVIEW AND PROCESSING

Step	Operation	Next step if: Yes	No	Unconditional
START	Note: At start of program, inventory record has been retrieved (by cancel program). It contains counts of seats available for each leg and the number of passengers waitlisted for each segment.			1
1.	Are there any available seats that may be used to confirm waitlisted passengers?	2	28	
2.	Remove any seats from inventory that may be used to confirm waitlisted passengers.			3
3.	File inventory record. (To permit other real-time messages to be processed.)			4
4.	Is there a priority waitlist? (The waitlist is divided into two sections; Priority — death, emergency, etc. — and Regular.)	5	14	
5.	Get priority waitlist from files.			6
6.	Search the priority waitlist for highest priority, earliest party, that can be confirmed.			7
7.	Get passenger record.			8
8.	Change record to reflect confirmation.			9
9.	Route record to local office for passenger notification.			10
10.	Record segment and number in party (to adjust waitlist counts in inventory record).			11
11.	Have seats withheld from inventory been exhausted?	22	12	
12.	Has priority waitlist been completely processed?	13	6	
13.	File priority waitlist.			14
14.	Is there a regular waitlist?	15	24	
15.	Get regular waitlist.			16
16.	Search regular waitlist for earliest party which can be confirmed.			17
17.	Get passenger record.			18
18.	Change record to reflect confirmation.			19
19.	Route record to local office for passenger notification.			20
20.	Record segment and number in party (to adjust waitlist counts in inventory record).			21
21.	Have seats withheld from inventory been exhausted?	23	16	
22.	File priority waitlist.			24
23.	File regular waitlist.			24
24.	Get inventory record.			25
25.	Reduce segment counts of waitlist passengers to reflect confirmed parties.			26
26.	Restore any seats not used in clearing waitlist to inventory.			27
27.	Have additional seats been cancelled while waitlist processing was in progress?	1	28	
28.	File inventory record.			29
29.	Exit to control program.			End

Figure 14. Listing of Typical Operational Program



LEGEND

1. As many as 30 interchanges per high-speed line; each with data set arrangement or two sharing data set.
2. As many as 30 such terminal connections per interchange. Direct telegraph input-output usable with real time system in data processing center containing conversion capabilities.
3. Low-speed data sets located within 50' of the interchange and the remote terminals.
4. This data set arrangement is only for the most remote interchange on any high-speed line.

LEGEND

1. As many as 8 per 7090 system. (The RTC uses 2 channels.)
2. 729 II, IV Tape Units (as many as 10 per data channel).
3. Card Reader (per data channel)
4. Card Printer (per data channel)
5. Card Punch (per data channel)
6. Disk Files (as many as 16 per pair of disk channels)
7. Vertical Drums (as many as 4 per drum control)
8. Drum Control

Figure 15. IBM 9090 System Schematic

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