

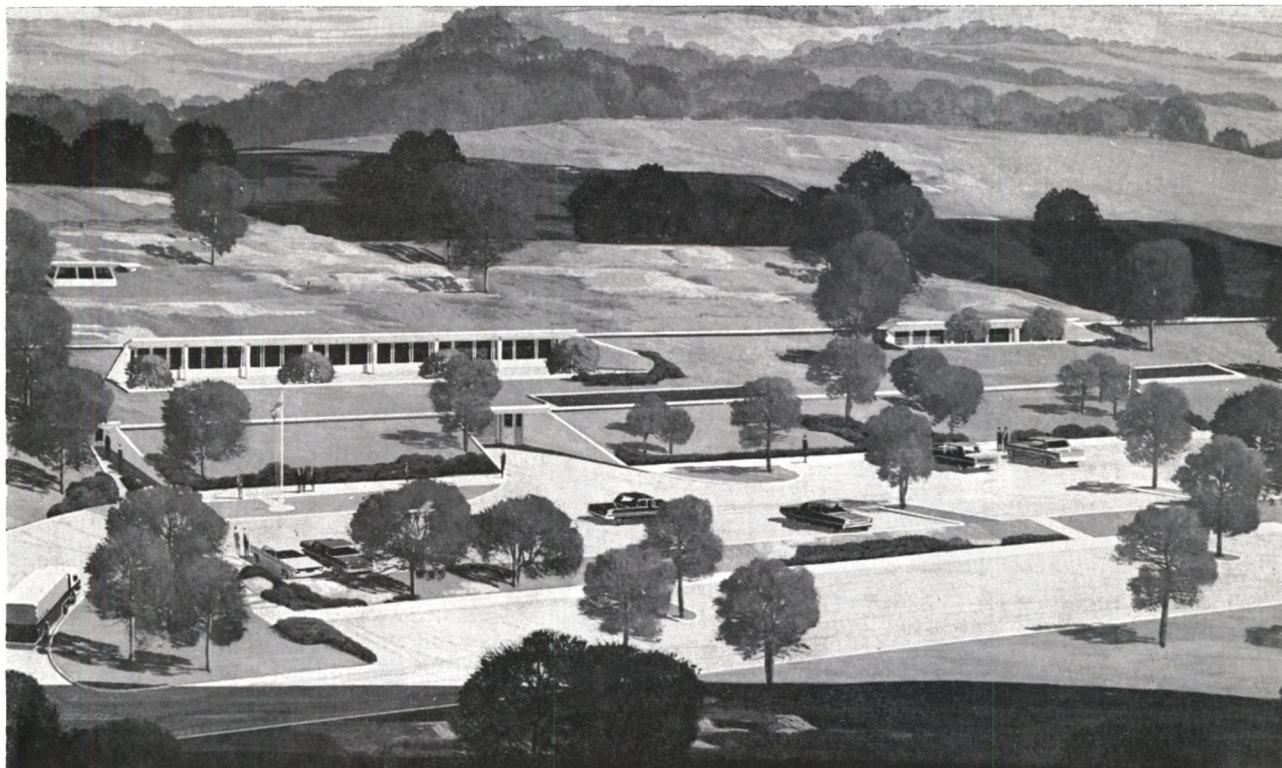
The Federal Reserve's Communications Center and the Payments System

Fortunately for the American payments system, the growth of knowledge in the field of information technology has kept pace with the growth of paper generated by the ever expanding volume of economic and financial transactions. While the paper jam has on numerous occasions impaired the orderly flow of economic activity, and probably will again, it is encouraging that steps are being taken which should practically rid the payments system of the future of this costly burden. One such step is that taken recently by the Federal Reserve System in opening its new Communications and Records Center at Culpeper, Virginia. The communications aspect of the center is now in the testing stage and is expected to be fully operational by July 1970. In view of the Federal Reserve's central role in the handling of economic and financial data—particularly banking statistics—the communications facility is expected to

have a significant bearing upon the speed and accuracy with which the payments system operates as well as upon the capacity of the system to handle the increased volume of information.

Officially dedicated in December 1969, the Communications and Records Center, built largely underground, serves several roles. It provides vault space for storage of money and duplicate records for use in the event of a national emergency. Also, it will house a computer to serve the data processing needs of the Federal Reserve Board, and to supplement the Board's existing computer located in Washington.

Of most significance to the payments mechanism, however, is the fact that the Culpeper facility contains the Federal Reserve System's new communications center, consisting of four large, high-speed, special-purpose, communications switching computers. The Culpeper facility, including the com-



The Federal Reserve Bank of Richmond's Culpeper facility. The facility houses the Federal Reserve System's new communications center, and provides vault space for the storage of money and duplicate records.

munications center, is operated by the staff of the Federal Reserve Bank of Richmond for the entire Federal Reserve System. When it goes into full operation in about July of this year, the new communications system will replace the existing Telegraph and Switching Center, which has been in operation at the Richmond Bank's head office since 1953. The Federal Reserve System has operated a wire transfer system since 1922, but the Board of Governors decided to move the center which handled this operation from Washington to Richmond in 1953, to make it less vulnerable to nuclear attack. The decision to move to Culpeper was predicated partially on the same motive, but of equal importance was the desire to establish a modern facility with a capability for growth commensurate with that expected in the Federal Reserve System's communications needs.

Technical Features of the Communications Center Under a \$2¾ million contract, Marshall Communications, Inc., now a division of Control Data Corporation, has installed a M-1000 Quad Communications Switching System at Culpeper. This system is actually four M-1000 computers which are designed to handle in very rapid fashion the receiving and relaying of messages among the 12 Federal Reserve Banks, their 24 branches, the Federal Reserve Board, and the U. S. Treasury. The system operates as a message exchange or switch, and it communicates with the 38 locations, each of which has one or more terminal units, by means of telephone lines capable of high speed data transmission. Any type of message, whether quantitative or narrative, can be transmitted by the system.

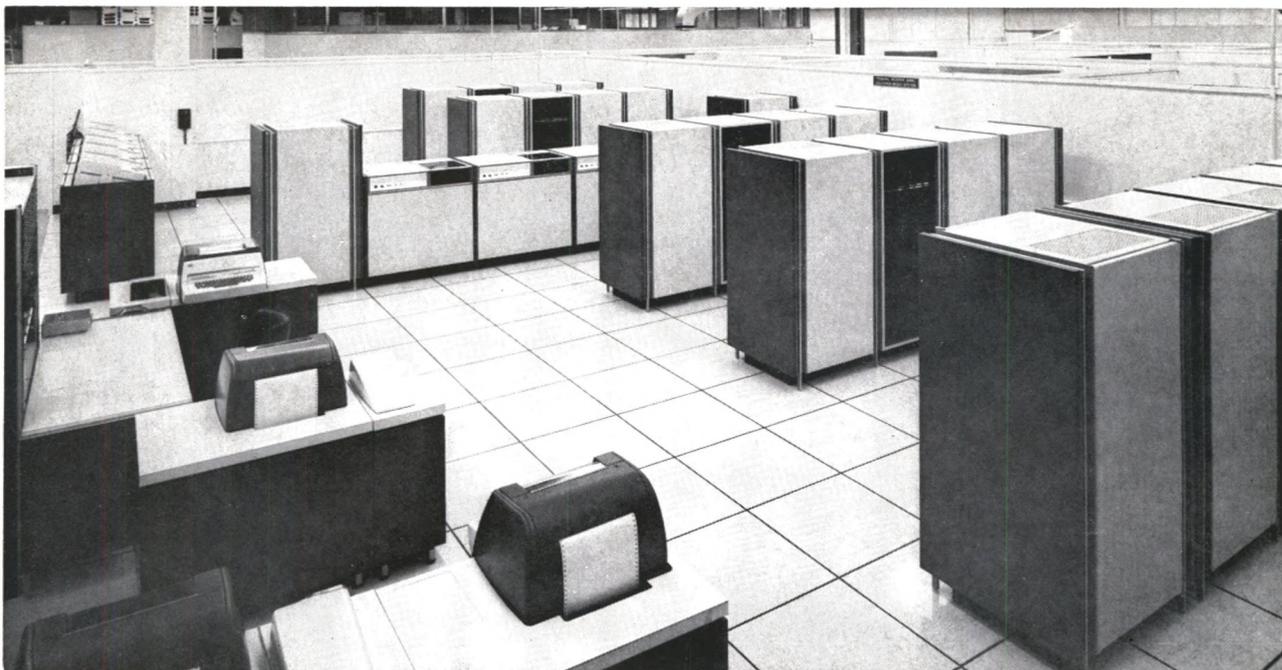
An important feature of the system is that the kinds of terminal units located at each of the Federal Reserve offices can vary considerably. Standardization is achieved through the use of a universally adopted code in which all messages are phrased and transmitted. This code, which can be handled by several types of terminal gear, is ASCII, American Standard Code for Information Interchange, known as "asky." The code is a communications language which, in addition to actually transmitting information, executes its own internal check on the accuracy of the information transmitted.

Most Federal Reserve offices have been equipped with Model 37 terminal units—slightly modernized versions of conventional teletype equipment. Each

office has the capability to send and receive messages, although specialized equipment to receive or send only is provided additionally at some locations. These units handle the frequent and important low-content messages involving transfers of funds and administrative transmissions, but usually not those messages transmitting large quantities of data.

At present, the system is equipped to handle messages to or from the Model 37 terminals at the speed of 150 words per minute. The transmission speed is constrained by the lines rather than by the message exchange at Culpeper. The lines presently available for use with the Model 37 terminals are 150 "baud," where "baud" is defined as a unit of signalling speed. The term is, for practical purposes, almost synonymous with "bits per second." With the ASCII code, there are eight bits per character, and six characters per word. Allowing for additional characters that are transmitted in order to check the internal accuracy of the message, the term "baud" becomes approximately synonymous with words per minute. To compare present with potential speed in this respect, it should be noted that the message exchange computers at Culpeper are capable of transmitting messages to distant points at speeds of 9,600 bits per second. At present, therefore, constraints are imposed by the lines as well as by the types of terminals in use at the various end locations. Present needs, however, do not require the maximum utilization of the capacity available at the Culpeper message exchange.

The lines used with the Model 37 terminals are "full-duplex," which means that messages can be received and sent simultaneously between any given points, each at the designated speed. The fact that a terminal is in the process of sending a message does not preclude its receiving another message at the same time. Whether this is done is determined by the message exchange computers at Culpeper. The Culpeper computers continuously poll all terminals to determine whether a message is waiting to be transmitted. The complete polling cycle takes about 45 seconds. If a positive signal is indicated by a waiting terminal, the Culpeper exchange receives the message and notifies the terminal of the message's arrival. In a similar fashion, if a message has been received by the Culpeper exchange for delivery elsewhere, the Culpeper exchange notifies the terminal at the destination (or destinations) that a message is to be delivered. Upon receipt of the proper signal, the message is sent to its destination, and the



M-1000 communications switching computers and related equipment at the Federal Reserve's Communications and Records Center in Culpeper, Virginia. Equipment in this room links all offices of the Federal Reserve, and will play a central role in facilitating the nation's payments system.

Culpeper computer awaits a signal from the terminal that the message was received. All messages are then stored at the Culpeper center on disks or tapes for a predetermined period of time.

In addition to the Model 37 terminals, the 12 Federal Reserve head offices and the Federal Reserve Board are being equipped with I.B.M. Model 2968 tape units for transmitting and receiving large quantities of data through the Culpeper exchange. These units utilize magnetic tape which is readable by the data processing computers at each of the locations. Thus, tapes of economic information generated by the Banks' computers can be immediately transmitted to other Reserve Banks or to the Board through the Culpeper exchange, or conversely, can be received by a given Reserve Bank for immediate processing on its own computer. Lines available for transmission by this method are 2400 "baud," i.e., approximately 2400 words per minute. These lines are "half-duplex," however, which means that a terminal can either receive or send at a given time, but not both.

Since the Culpeper message exchange is capable of communicating with a wide variety of terminal equipment, the use of the Model 37 terminals, and to a lesser extent even the use of the Model 2968 tape

terminals, is regarded as temporary at several of the Federal Reserve offices. A number of Reserve Banks and branches are in the process of upgrading their data processing and research computer equipment. In doing this, they have taken into consideration the coming potential of the Culpeper center. Thus, some of them intend to use large third-generation computers as terminals to communicate with the Culpeper exchange in addition to performing other data processing or research functions for the Reserve Banks. The Federal Reserve Bank of New York has planned from the outset to do this, and will therefore begin its communication with the Culpeper exchange via a computer. The Federal Reserve Banks of Chicago and San Francisco have plans to follow a similar approach in the near future, and will probably replace or at least supplement their existing terminal gear with computer-to-computer communications. Other Reserve Banks, including the Federal Reserve Bank of Richmond, have similar plans under consideration. The advantages of this approach are considerable in that all messages flowing to or from the Culpeper exchange at a given Reserve Bank can be examined by that Bank's computer for informational content relevant to other computer related functions—accounting, reserve account-

ing, research and statistics, fiscal agency operations, discount and credit, etc. The terminal computer can thus automatically update files or perform necessary processing of the data it receives from the message flows.

Several Reserve Banks have further plans to establish computer-to-computer communications with member commercial banks in their districts. Such arrangements will make possible direct electronic communication via the Culpeper exchange of commercial banks throughout the nation. Messages involving funds transfers, for example, will be completed almost instantaneously. Human intervention in the transaction will be minimized thus reducing the possibility of error, and automatic updating of all relevant reserve accounts will be achieved as a by-product of the communication.

The technical capability exists for still other communications linkages, of a bank or non-bank nature, either directly to the Culpeper exchange or to it via a computer-type terminal at a Reserve Bank or branch. The existence of the Culpeper facility makes feasible, for example, the sharing among Federal Reserve offices of a large centralized data bank of national economic information.

Implications for the Payments System To obtain *maximum* efficiency in the operation of any payments system would require the instantaneous communication of transactions data. Realistically, however, constraints are imposed by the complexity of the economy and its institutions, as well as by the distances which separate individuals and organizations—not to mention many other natural barriers. There is presumably some maximum speed at which it is physically possible to sort checks, to move pieces of paper from one location to another, or to ship currency and coin. While numerous advances have been made in all these areas, progress to date is still considered far short of adequate. Modern technology does not seem to promise an ultimate solution whereby maximum efficiency of the payments system can be achieved. Since all economic units are not electronically interfaced with one another, it is not feasible to consider this kind of efficiency—nor would such a system necessarily be desirable. Nevertheless, the limits of feasibility have been greatly expanded. The establishment of the Culpeper exchange is a reminder of the technological possibility of alternative payments systems, which might feasibly include an economy without checks.

Banks play an obviously critical role in the American payments system as it presently exists. They provide the mechanism through which the overwhelming preponderance of payments are made. Thus, the efficiency of communications among banks largely determines the efficiency with which the payments system operates. The Federal Reserve, as the central bank, in turn plays a critical role in the settling of payments among banks, both member and nonmember. Therefore, the Federal Reserve's communications center at Culpeper, the nerve center of the central banking system, will unquestionably become a core element in the nation's payments mechanism.

The significance of the Culpeper center is yet to be seen, since its contribution to the Federal Reserve and to the payments system does not begin until mid-year. Its potential impact, however, is more clearly revealed by its technical characteristics than by the nature of the jobs that it will be required to perform in its initial stages. Most of the work that will be put through the Culpeper exchange at the outset are conventional tasks that will be transferred from the existing Telegraph and Switching Center—e.g., funds transfers among banks, administrative messages, transmissions of economic information among Reserve Banks, etc. However, as the Federal Reserve Banks and branches begin to install more sophisticated terminal equipment, as communications via computers are established with commercial banks, and as rapid data transmission among Reserve Banks gets underway, the impact of the center upon the operations of these institutions should be striking. Significant departures from existing customs of communication will be quick to follow. Technological progress in the communications field has exceeded present levels of ability and readiness to take maximum advantage of its potential. However, there is little doubt that the Culpeper center represents one of the early steps leading invariably to an electronic payments system.

The Culpeper facility was a necessary development because improvement in the timeliness of economic information is necessary. But, even so, the development is impressive. Its impressiveness lies not in any immediate revamping of existing methods of communication, but in the opportunity which it offers for significant future accomplishments in the communications field.

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