ABSTRACT

This project demonstrated the application of large microcomputers in successfully fulfilling business needs previously assigned to minicomputers or mainframes. The programs and procedures developed for this project were used to facilitate and increase the operating efficiency of a medium sized organization.

Teleservice Corporation of America owns, operates or manages 40 cable television systems located primarily in Texas, Louisiana and Arkansas. There are approximately 220,000 subscribers served by these systems. Prior to the development of this project, initial data entry was all carried on in the company's home office in Tyler, Texas. The aim of this project was to develop computer programs and procedures to:

1. Transfer data collection procedures for all transactions affecting accounts receivables to the 39 field offices.

2. Allow each field office to retrieve data regarding the customers in their local system.

3. Facilitate efficient and economical transfer of this data between field offices and the home office.
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Teleservice Corporation of America owns, operates or manages 40 cable television systems located primarily in Texas, Louisiana and Arkansas. There are approximately 220,000 subscribers served by these systems. Prior to this project, initial data entry was all carried on in the company's home office in Tyler, Texas. The aim of this project was to develop computer programs and procedures to:

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In 1971, when the first microprocessor was introduced, no one could have foreseen the impact this device would have upon the entire world of electronic data processing. It is now possible (using the most advanced and largest microcomputers) to fulfill projects previously requiring much larger machines. The newest generation of large micros has such features as Direct Memory Access (using one microprocessor strictly for Input/Output control), inexpensive availability of mass storage devices, and the ability to use high-level compiled languages such as COBOL to allow smooth development of programs and rapid execution times.

While commercially available programs for business applications have become increasingly available, there is still a considerable need for custom programming for particular applications. For example, there are many good and efficient accounts receivable programs available. None of them, however, met the needs of the particular organization for which this project was designed. In the same manner many general data base management
programs are available. These programs could not, however, be used with the newest of microcomputers; the organizational requirements of this company can be met only by the newest and largest of microcomputers.

The main computer used in developing this system was the Radio Shack TRS-80 Model 16. This machine uses some of the most modern technology presently available in a commercially available microcomputer. The main processor of the computer is a MC68000 microprocessor with a data-path width of 16 bits and addressing capabilities of 24 bits. Translated into practical terms, this computer is exceedingly fast for a microcomputer at "number-crunching" tasks and is designed to include 512 Kilobytes of Random Access Memory. Disk storage space for a minimum unit is 1.2 M Bytes of storage using a dual-sided double density 8" floppy disk unit. One to three additional floppy disks and/or hard-disk units may be added, giving the unit a total capacity of over 48 M Bytes of online Mass Storage. A Z80A microprocessor handles all of the Input and Output functions of this computer, allowing Direct Memory Access. The computer is also capable of having up to three independent users at one time. The multi-user software, which is the XENIX system (a commercial derivative of the UNIX operating system) was used in the final stages of developing this project.

As the project developed, it was clear that two distinct systems, both using the Model 16, would be needed. In the smaller towns served by this company, a single user Model 16 using two floppy disk drives was the system chosen for use. TRSDOS 16 was the operating system used in these smaller systems. In larger systems needing more than one user, it was necessary to use a hard-disk system. The use of a hard disk system was made necessary by the larger amount of data in a larger system as well as the requirements of the XENIX operating system for 5 M Bytes of disk storage.

COBOL is the only language presently available for the Model 16 in which source code portability between the single user and multi-user mode exists. The vast majority of the application programs used in this project were written in COBOL.

In the single user mode, some small "DO" files and supervisor calls were written and executed using the TRSDOS 16 operating system and the 68000 Editor, Assembler, and Linker.
In the multi-user system, a XENIX "shell" was used to automatically load and begin the programs.

One of the main purposes of this project was the transfer of information between this computer and the home office. This was done via shipment of Floppy diskettes. The home office uses an IBM System 34; in the single user mode, the translation of data between the Radio Shack format and the IBM format was made possible by using the commercially available "REFORMATTER" program.

In the multi-user mode, a "hardwired" communication link using a "black-box" protocol converter between the System 34 and the Model 16 was used for data transfer.

Throughout the design and implementation of this project, many principles of sound information processing were continually used. One of the basic principles of any effective design is the data structures chosen to represent the information stored in the system. The book *Data Structures for Computer Information Systems*¹ was constantly used as a guide to appropriate data structures.

Several different file types were used in this project. An introduction to the various types of file structures available in COBOL was found in the text, *File Techniques For Data Base Organization In Cobol*².

Although most of the accounting procedures used in this project had been developed by the home office of TCA, some knowledge of basic accounting practices was helpful in various stages of the project's development. These practices may be found in *Introduction To Financial Accounting*³.

The Organizational Requirements of TCA

There were two primary goals defined by TCA management at the beginning of this project. Since the company's main computer is an IBM system 34, the microcomputer chosen for this project was required to have the ability to transfer data files to and from this mini-computer in the home office.
The second goal was to have all of the programs at field locations easily usable by field personnel with little or no computer literacy or training. As with any new system, management was aware that some training of personnel would be required; they wished, however, to have the new system as "user-friendly" as possible.

Implied within this definition of user-friendliness were certain automatic data verification sequences. The most interesting verification requirements are described in detail in Chapter Two.

Procedures Used Prior To This System

The main desire of management was to eliminate time consuming and inefficient entry of data. Before this project began, all bills for TV cable service would be sent from the home office to each customer. A portion of each bill would be detached and returned, along with payment, to each individual local office.

There, local personnel would verify the amount of each customer's payment and then deposit the sum of each day's transactions in a local bank account. The detached "stubs" would be mailed, along with an adding machine tape of all transactions, to the home office.

At the home office, data entry personnel would transfer the amount and category of each customer's transaction into the main computer. If a batch did not balance, correcting entries would be made at the home office. In some cases, non-balancing batches would require several phone calls between the home office and field office personnel to determine the cause of the problem.

After a batch was entered, a preliminary report, known as the "edit report", would be prepared. In essence, this report was nothing more than a printout of the customer tickets as they were entered. An example of an edit report may be found in Appendix Six.

After this edit report was checked for correct entries and was found to be in balance, the customer entries were then "posted" to their respective accounts. At this time, a second five-column summary report was prepared. See Appendix Six for an example of the
five-column summary. A copy of this second report, along with the original customers' "stubs" were mailed back to the field office.

In each field office, the process of completing the accounts receivable cycle was completed. Field office personnel would manually "post" the amount of each transaction to a printout of closing balances of each customer from the previous month.

There were many problems with this procedure. First of all, one can see the inherent inefficiency, as several tasks were repeated many times by field office personnel as well as data entry operators and auditors in the home office.

If a batch were lost in the mail, there was no "backup" of individual customer stubs. While the bank deposit ticket from a batch would have some information, data would invariably be lost.

In addition to these constraints, there was always a time lag involved between the receipt of a customer's payment and the final "posting" to the temporary ledger in a field office. Thus, if a customer called a field office before the field office had received confirmation of a payment batch, a customer's balance would be incorrect.

If it became necessary for a field office bookkeeper to determine the payment history of a particular customer, a long and involved manual search would be required. While this type of involved research was not necessary on a regular basis, on those occasions when a billing problem required a local bookkeeper to "research" an account, massive amounts of time would be spent locating the records of a particular customer.

The one concern which TCA management did not have was the speed with which they received the data from a field office. They were completely satisfied if they received the complete records of deposit batches within two or three working days after the deposit itself was made.

The Development Of The Microcomputer System

The first phase of development was the creation of a program for entering and
balancing deposit batches. This program is described in detail in Chapter Two; the entire program listing may be found in Appendix One.

After the program for deposit batch data entry was developed, it was tested in the home office for a month. During this time, personnel in the home office used the microcomputer as if it were the primary vehicle for entering data for one of the thirty-nine systems. In this way, home-office personnel became familiar with the system. This experience proved invaluable when the first system was moved to a field office.

Also, as would be expected during this stage of developing a new system, several minor modifications were made. In most cases, these changes were made to facilitate data entry. A few minor bugs were found in the program during this test stage; these were quickly corrected.

The next stage of project development was the creation of programs by which the essential data items of the master file of one entire field office were transferred to the microcomputer. In addition, programs to transfer six months of past billing history to the microcomputer system were also developed. These programs are described in detail in Chapter Three; complete program listings are found in Appendix Two.

As these file transfer programs were developed, a program was also developed to query this local master file for information about local customers. This program is described completely in Chapter Four; the complete program listing is found in Appendix Three. Soon after this program was completed, the program for deposit data entry was updated to include posting to customers' accounts.

Finally, a program by which a local "working master" file could be updated on a monthly basis by the master files of the home office was developed. The description of this program is found in Chapter Five with a complete listing in Appendix Four. This final program was necessary to purge customers who had been eliminated from the home office's master files, eliminate billing history more than six months old (and re-assign the resulting free space to a free space list), and update customers' master records.

At this stage of development, an additional microcomputer was purchased and the
complete system of entry and customer inquiry was transferred to one of the smaller field offices of the company.

The next step of program development was to implement all of the above programs and procedures in a multi-user setting. By the completion of this project, a prototype system will be in use in one of the larger offices of the cable system.

Along with the entire series of programs, automatic loading and backup procedures were implemented on both the single and multi user systems. Descriptions of the auto loading and executing techniques, the necessary supervisor calls, and the menus are given in Chapter Six; the complete listings of all menu programs, "DO" files, and XENIX shells are found in Appendix Five.

All program listings are from the multi-user system. The programs for the single-user version of the system are extremely similar to the multi-user system with the exception of external file names. In the one case (mutual exclusion) where a particular structure was necessary for the multi-user system, this feature is clearly identified.

A User's Manual was also developed for the system; a complete copy of this manual for the single user system is to be found in Appendix Seven.