ETOS - A MULTI-LINGUAL TIME SHARING SYSTEM FOR THE PDP8

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ABSTRACT

EDUCOMP's Time-shared Operating System (ETOS) is an integrated package of hardware and software designed for maximum utility of a computer. ETOS supports up to 16 users, with each user able to use the system as if he were operating on a stand-alone PDP8 with 64K bytes of memory.

This paper will contrast the various modes of computer operation and illustrate how the combination of batch, real-time, and interactive usage results in the optimum fulfillment of the all-important criterion of price/performance.

ETOS requires a 16K omnibus PDP8, clock, an RK8e controller with an RK05 drive, a backup peripheral for the RK05 drive, and a Time Share Control Module.

INTRODUCTION

The PDP8 was introduced in 1964. Since that time, over 20,000 PDP8s have been installed throughout the world. They have been used for every conceivable type of application from ~~CAI to POS~~ computer assisted instruction (CAI) to point of sales data entry (P.O.S.). A complete array of peripherals have been interfaced to this versatile computer.

The inherent problem in this versatility has been non-standardization of hardware and software components. The large install-base

has resulted in a proliferation of tailored software. One outcome of this situation is the fact that users usually can find other users who are performing similiar operations. Due to the flexibility of the machine, combining groups for greater efficiency and lower costs has often been impossible. A group of lab technicians running analog to digital conversion applications monopolize the machine so that data entry personnel spend their time and their employer's money waiting for the completion of the real-time tasks.

EDUCOMP decided that the variety of uses for the computer did not have to be mutually exclusive. ETOS was conceived with this objective.

GOALS

Before evaluating the effectiveness of a system, one must first define the goals of a computer utility[1].

1. Convenient remote terminal access as the normal mode of system usage.
2. Continuous operation with a minimum of interruptions.
3. A wide range of capacity to allow growth or contraction without either system or user reorganization.
4. An internal file system so reliable that users trust their only copy of programs and data to be stored in it.
5. Sufficient control of access to allow selective sharing

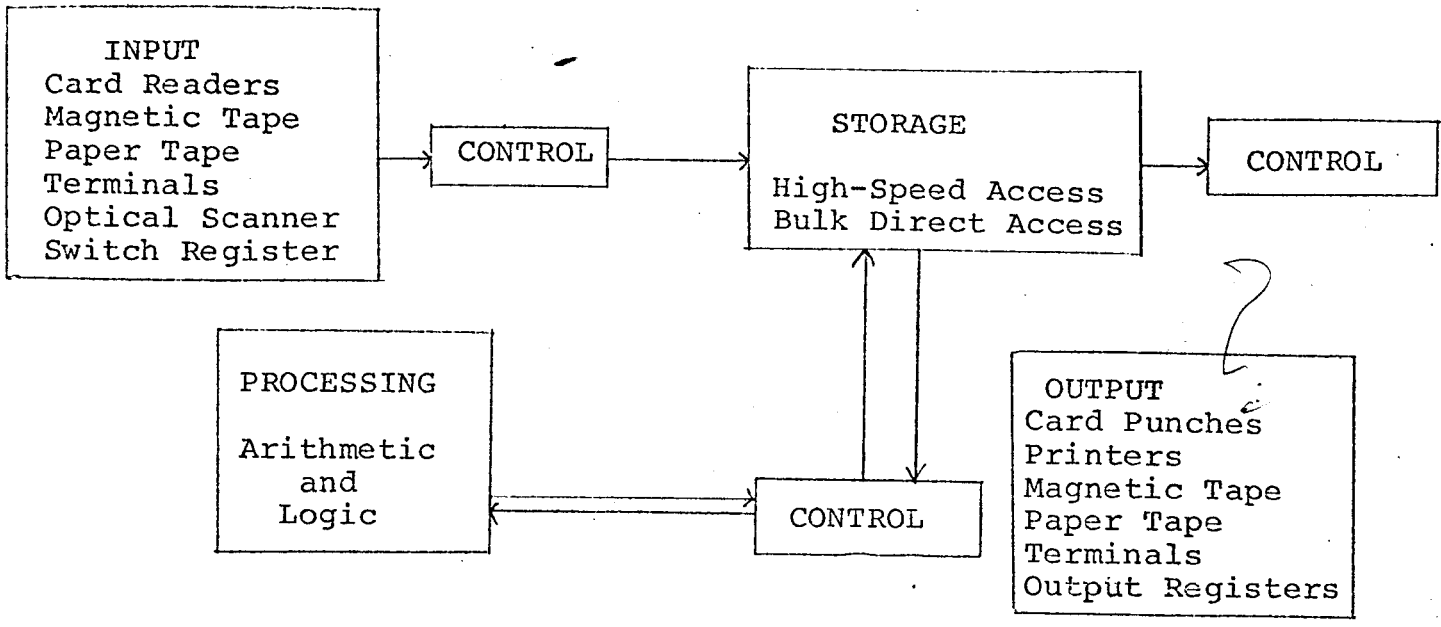
of information.

6. The ability to structure hierarchically both the logical storage of information and the administration of the system.
7. The capability of serving users with often conflicting objectives, such as educational, industrial, and administrative users.
8. The ability to support differing programming environments and human interfaces within a single system.
9. The flexibility and generality of system organization required for evolution through successive waves of technological improvements and the inevitable growth of user expectations.
10. An elevated degree of sophistication for the advanced user; yet, at the same time, ease of operation for the novice.

To determine if ETOS satisfies these requirements, it is necessary to examine the evolution of computers in general and, as an important subset, the PDP8.

HISTORY

The five basic functions ~~fo~~ of a digital computer are input, storage, control, processing, and output. These functions can be illustrated with the following flowchart[2]:



One of the earliest forms of computer I/O was paper tape. These systems were very slow for program development, and the file structures (boxes and racks of paper tape) were bulky and unreliable. On the PDP8, versions of BASIC, FOCAL, and Assembler used this method.

To achieve a more efficient programming system, the capability was developed to store programs and files on a mass storage medium. On the PDP8, the 4K disk/DECtape monitor fulfilled this responsibility. It provided users file and program storage and a keyboard monitor so that users could retrieve and run programs off the disk or tape with a few simple keyboard commands. Throughput of the system, especially editing, assembling, and debugging, was substantially improved. A batch mode was added to this monitor so that users could write programs on cards and increase throughput and the utility of the computer.

Up to this point, the use of the computer was restricted to single-user. In the interactive mode, program development for the one

user is fast, but no one else can use the computer. File security is maintained, but the sacrifice in throughput is unacceptable. In the batch mode, the central processing unit is used efficiently, but peripherals will often remain inactive if a proportion of the users do not access them. Under these constraints, the peripherals are not available for a user who could be accessing them. With the variety of unsupervised jobs on the system, many batch environments are not suitable for file protection.

Another mode for utilizing the computer is real-time. This mode functions interactively or in a batch environment. Real-time may be defined as processing in which the input, computing, and output of the information must meet a deadline established by external conditions. An example is the application of the computer to perform analog to digital data conversion. An external device must be sampled every *x* seconds, or data would be lost permanently. The controlling job must be sure that no processing or other forms of I/O are occurring when the device necessitates data acquisition. The above characteristics restrict real-time to single-user mode in most systems.

The time sharing system was developed to remedy these problems. The first time-shared systems, however, supported only one language. Another important restriction was the requirement for enough memory on the system capable of maintaining all user jobs resident in memory. The ramifications of this was that an operating system requiring 4K words, at maximum, left 28K for users. If each task were only 4K, a maximum of 7 users could be