

TEN-SYS 8

MEMORANDUM

To: Ten-Sys Group

From: D. Murphy

Subj: The Ten-Sys User Virtual Machine

Date: April 30, 1969

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A user program running under Ten-Sys operates on a virtual machine which looks something like a PDP-10 arithmetic processor with 256K of attached memory. The virtual APR does not make available to the user program the direct I/O instructions (CONO, DATAI, etc.), but has a large class of instructions (JSYS's and SYSPOP's) which provide access to monitor routines performing user-oriented I/O and other operations. The Ten-Sys monitor and paging hardware create an illusion of memory (call the the virtual memory) which can be treated as ordinary core. However, to make most effective use of the memory features of the Ten-Sys monitor, the user will need to understand the general nature of memory and files. This description follows:

The only "real", general purpose memory in Ten-Sys is the file system. It is "real" in the sense that it has relatively fixed names attached (memory is always referenced by logical user-selected names, never by hardware location such as disc address). Also, all information of any sort

(data, programs, etc.) resides in the file system when not being actively used.

Some of the characteristics of the file system have been discussed in earlier Ten-Sys memos. Generally, any piece of information in the file system is identified by:

1. File name (including user/directory)
within total file system
2. Page number within file (\emptyset -512 (2))
3. Word within page (\emptyset -512)

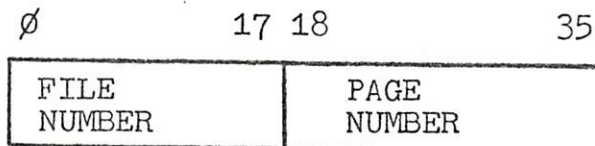
A concatenation of 2 and 3 (page number * 512 + word number; 9 bits of word number attached to the right end of up to 18 bits of page number) gives a logical identifier of any word within a file. A portion of the file system, called the random file logic, allows user programs to make single word random references into a file given the word address and the file number (the identifier of an open file).

Frequently, it is convenient to deal with information in the file system by treating a page as a basic unit. For this purpose page number and file number will be used. To reference information in a file, the file must be open. The file opening procedure takes a directory name and yields 18 bits of file number. Therefore, a page of any open file in

a job can be identified by a single 36-bit word containing:

Left Half: File Number

Right Half: Page Number



THE PDP-1Ø APR can not, in general, directly reference information in files. It does fetch instructions and instruction operands from what is called the virtual memory. To the APR, the virtual memory consists of 256K 36-bit word addresses. To the user, the virtual memory is 512 consecutively numbered page addresses, each consisting of 512 consecutively numbered word addresses. The pages of the virtual memory are effectively slots into which are placed indentifiers of pages in the file system. At any given time none, some, or all of the slots may be filled. In general, a user program may place any page of information from the file system into any page of virtual memory by:

1. Open the file (if not already open)
2. Execute a monitor call giving:
 - a. The file number and page number of the desired page of information in one word.
 - b. The number of the virtual memory page which is to receive the information in another

word.

Then any of the words in the page are available to the APR for instruction or operand fetches.

Processes and Forks

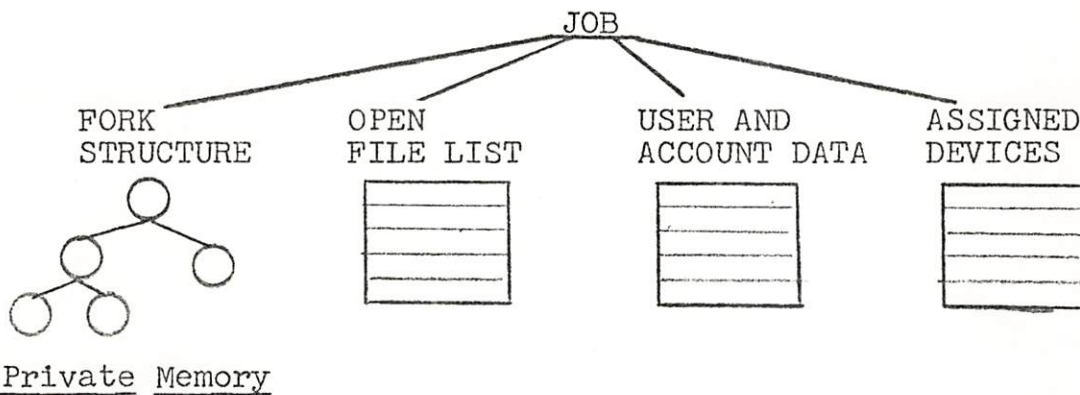
Precisely defined, a virtual memory is associated with a process (also called a fork). A process is a basic entity in Ten-Sys. It is a logical entity capable of performing computation. It is identified by its virtual memory map and the state of the APR, PC and all flags. A program may be thought of as a named entity capable of performing a set of user related functions, such as LISP or DDT. By this definition, a running program must be associated with at least one and possibly more processes.

Jobs

A job within Ten-Sys is a set of one or more related processes which can communicate with each other in defined ways. A job may contain several runnings or suspended programs. Each active process within Ten-Sys is a part of some job. A job has the following attributes:

1. Name of user who initiated the job
2. Account number to which is charged all costs associated with use of system resources by this job.
3. Some open files
4. A hierarchy of running and/or suspended processes

A job may also have one or more terminal or other devices assigned and attached.



Every job will have at least one open file, a file used as "private memory" by the job (analagous to the 940's PMT). This file will be created and opened by the monitor when the job is initiated. The first page to be assigned will be the primary TS block. Other pages will be assigned as needed, and deassigned in various explicit and implicit ways. Private memory is usually acquired by executing an instruction which attempts a store into an address in a page

which does not have memory assigned. When this occurs, the monitor will (except in some specific cases) assign a new page from the private memory file and place it into the process map. These files of private memory for the running job will exist in the system file directory.

A process will be able to place in its map any of the pages of its private memory file except those which are exec. An exec page is one which is acquired and used by the monitor (such as TS blocks) which the user program need not reference and must not modify.

4/18/69 DLM/EL