

交大DEC-10計算機管理系統

The DEC-10 Administrative System of National Chiao-Tung University

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Abstract— The DEC-10 administrative system of National Chiao-Tung University is resulted by making an extension of the original system that is provided by the DEC-10 manufacture from the UFD basis into the SFD basis for meeting the special requirement of our computer center. This paper will present a detail description of this extension which consists of administrative control files, control file maintenance programs, administrative control programs, accounting process and failsaving programs. Some of them are resulted by making modification of the original system while the others by adding on.

I. Introduction

Today, facing the various users, a computer needs not only a powerful operating system which conducts and supervises the operation of the whole system, but also a complete administrative system that guarantees only the proper users may access the proper system resources. The administrative system identifies the users who will use the system, gives each individual user the privileges of accessing the sharable system resources that guides the operating system to conduct the proper usage of the system resources of the users, and makes the users' accounting. Usually, the administrative system is provided by the computer vendors since it is deeply dependent upon the operating system.

Associated with the TOPS-10 time-sharing operating system, we have an administrative system on the DEC-10 computer of our computer center [1,2]. In this administrative system, each user is given a Project-Programmer Number (PPN). It is this PPN that serves as the key of the all administrative control functions.

Since PPNs also serve as the key of access of the file system [3,4], the more PPNs the system has, the more overhead the file system will spend. Thus, a system can't offer too many PPNs for the consideration of efficiency. However, in our system, we must serve thousands of users which come from classes and projects. If we give every user a PPN, there will be too many PPNs in the system and also the classification of the users is restricted. But if we give every class a PPN, there will have many problems such as, too many interferences among the files of the users of the PPN, the credit for the PPN may be run out by only few of the users of the PPN, etc. So we need a special designed administrative control system for our DEC-10 system. This paper will present the design and implementation of this new administrative system which is resulted by adding one more type of control files onto the original system. Of course, some modifications of the original control programs and some add-on control programs are needed in this new system.

II. Preliminary, The DEC-10 File System [3, 4]

The file system manages the storage, retrieval, protection, and/or share of the data of the system and users. All data in the DEC-10 system are stored as named files in a uniform and consistent fashion. Usually, a system consists of one or more file structures. Each file structure is logically complete and is the smallest section of file memory that can be removed from the system without disturbing other units in other file structures. To a user, a file structure

is like a device.

A file structure consists of two types of files, the data files that physically contain the stored data and the directory files that contain pointers to the data files. Each user with access to the file structure has a user file directory (UFD) that contains the names of all his files on the file structure. The UFDs are identified by the project-programmer numbers (PPN), that is a pair of octal numbers separated by a comma. As a directory of individual UFDs, each file structure has one master file directory (MFD) that contains all the names of the UFDs on the file structure. As an entry of the UFD, the user can include another type of directory file, the sub-file directory (SFD). The SFD is similar to the other types of directory files in that it contains as entries all the names of files within the directory. This third level of directory allows groups of files belonging to the same user to be separated from each other. It is this SFD feature that makes our new administrative system realized.

A named file is uniquely identified in the system by a file structure name, a directory path, a file name and file extension. A directory path is an ordered list of directory names, enclosed within a pair of square brackets and starting with a UFD and followed by the SFDs which uniquely specifies a directory without regard to a file structure. The file extension, begins with a dot, is generally used to indicate the type of data in the file. The data of a file are stored in 128-word blocks and preceded by a retrieval information block (RIB) that contains the retrieval information of the file such as the file name, create and access data, protection code, file size, disk physical position of the file, etc. The access of a data file is done through its directory path. For reducing the file searching times, the sizes of the directory files must not be too large. Note that each entry of a directory file is 2 words.

By the DEC-10 administrative system, each PPN in each file structure is associated with two quota. When a user logs in, he starts using his login quota for competing with other users for the storage space. The logout quota is the amount of storage space that the user must be within in order to log off the system.

III. Administrative Control Files

1. DEC-10 Administrative Control Files

There are 4 administrative control files, ACCT.SYS, AUXACC.SYS, STRLST.SYS and QUOTA.SYS on the system library directory (1,4), which contain all the administrative control information of the DEC-10 system^[1].

The ACCT.SYS file consists of entries of all system users. Each entry is identified by a PPN and contains the name and password of the user, the time and where the user may log in, the environment to be set up if the user is logging in, the expiration date of the user and the privileges allowed to the user for some privileged system functions such as to engage the unspool devices, lock his job onto core, collect the performance statistics, check and/or modify monitor and/or other user's job, etc.

The AUXACC.SYS file consists of entries that contain the file structures and the associated quota of each individual or group of users that they have access. The STRLST.SYS contains the characteristic of the physical units of each file structures. While each mountable file structure maintains a QUOTA.SYS file which contains quota for all users who may write on the file structure.

To maintain the administrative control files, the system provides the administrative personnels the REACT program which may be used to create a file, add entries to a file, alter entries in a file, delete entries from a file, and list entries of a file^[2]. Anyone who logs in the privileged PPN (1,2) may run the REACT program. Usually, the PPN(1,2) is given to the administrative personnels and the system operators, with a universal privileges to access all system resources.

For accounting, the system generates entries onto transaction files^[5], if a user logs in^[6] or logs out^[7], when

a SPOOLer begins the service of a request^[8], and on a fixed time interval base^[9]. This time interval is set to 10 minutes now. There is the MONEY program that is provided for the listing and summary of the transaction files^[10]. In the DEC-10 system, the card reader, line printer and paper tape punch are serviced by SPOOLers^[8]. Moreover, a special designed input SPOOLer, the BATCON program, is provided to serviced users in batch under the time-sharing operating system^[11].

2. Add-On Administrative Control Files

To meet our requirement, we extend administrative control from the UFDs to the first level of the SFDs. That is, each course or project is given a UFD and each student or research worker is given a SFD within the UFD of his class or project. Also, the accounting is done on the log-out time of users rather than by MONEY program. Thus, we have a real-time accounting system now.

For the modification of the administrative system, we add one more group of control files onto the system. Each UFD is associated with a UIC file now. Each SFD within the UFD will have an entry in the associated UIC file which contains the following privilege informations as shown in fig. 1:

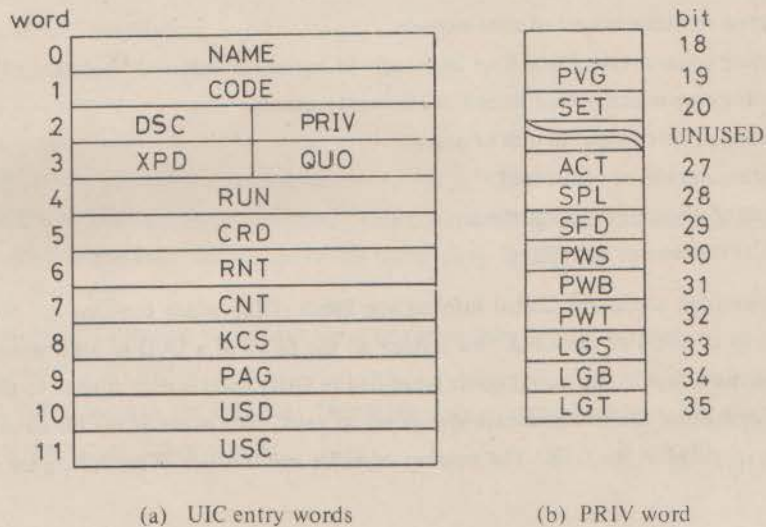


Fig. 1: UIC Entry of the Add-On Administrative Control File

NAME: NAME field contains the name of the user and his SFD. It is the identification of the user and his SFD.

CODE: CODE field contains the password of the user. In this add-on system, the user is given the privilege of changing his password. Note that in the original system, only the administrative personnels have the privilege of changing password (in ACCT.SYS file).

PRIV BITS: PRIV BITS give the privileges of the user. We have set up the following privileges, each privilege is indicated by setting a corresponding bit on in this field.

- LGT: The user may login from terminal.
- LGB: The user may login as batch job.
- LGS: The user may login from pseudo-TTY.
- PWT: Password is required if login from terminal.
- PWB: Password is required if login from batch.

- PWS: Password is required if login from pseudo-TTY.
- SFD: SFD path must be set up if login successes. Normally, the users have this bit on. Thus, he defaults the directory path to his own directory initially.
- SPL: Set SPOOL for spooling devices. Only some privileged users, who have the privilege of engaging spooled devices directly, need this bit specified.
- ACT: If this bit is set, accounting will not be done.
- SET: This user is an administrative personnel. He may maintain the privilege information of all UIC files except the UIC file of the privileged UFD (1,2).
- PVG: This user is the manager of the system software. He has the universal privileges.
- XPD: XPD field is halfword that gives the expiration date of the SFD.
- QUO: QUO field is a halfword that gives the logout quota of the user.
- RUN: RUN field specifies the program name which will be run automatically if the user logs in.
- CRD: This field contains the credit of the user. If the field is non-positive, the user can't log in except his ACT bit is on. On log-out time, the amount of accounting of this run will be subtracted from the contains of this field.
- RNT: Accumulating run-time in unit of mini-seconds.
- CNT: Accumulating connect-time (total time from login to logout) in unit of 2^{18} days.
- KCS: Accumulating core memory used in unit of kiloword-seconds.
- PAG: Accumulating printer output in unit of pages.
- USD: Accumulating amount of credit used.
- DSC: The amount of discount for accounting.
- USC: The credit at the time of last billing.

In a UIC file, there is an additional Global Information Block (GIB) which contains the privilege informations that are contributed to all SFDs of the UFD. We restrict all the SFDs of a UFD to have non-zero logout quota in only a single file structure, that is, the logout quota (specified in QUO field) is only applied to this file structure and the logout quota of any other file structures are always set to zero. The name of the file structure they have non-zero logout quota is specified in the GIB. The number of SFDs and the date of last billing are also recorded in the GIB.

For simplifying the modification of the administrative control programs, we change the meanings of two bits in the ACCT.SYS file. There are two bits in the ACCT.SYS file that indicate whether the name is required if the user (PPN) is logging in from terminal and batch respectively. Now, we use them to indicate this is a UFD with UIC file.

3. Maintenance of the ADD-On UIC Files

There are two programs, SETCOD and SETUIC, designed for the maintenance of the add-on UIC files.

The SETCOD provides all users the facility to list his own UIC entry and/or accept the request of changing his password. Usually, users are prohibited to access the UIC files directly for security. Thus, when a user logs in, a temporary file is created to contains his entry of the UIC entry. This file is named with his job number and UIF as extension. If user requests changing his password, SETCOD program records the new password on the UIF file. The update of the actual UIC file is done when he logs off..

The SETUIC program is designed for the privileged personnels who are logging in the PPN (1,2). We further classify the privileged users into 3 classes, the operators, the administrative personnels and the managers of system software, each with different privileges to maintain the UIC files.

The operators, the SET and PVG bits of his UIC entry are off, have the privilege to list the UIC entry of any user only. So they can response those users who can't log in.

The administrative personnels, whose SET bit is on but PVG bit is off, have the privileges to maintain all UIC files except the UIC file of the privileged UFD (1,2). Moreover, all the accounting informations are unchangable to them.

The system software managers have the universal privileges to do anythings to all the UIC files and all informations of them. Only the users of this class have their SET and PVG bits on.

The SETUIC is an interactive program. It accepts commands from terminal and executes the requests under restriction on the privileges of the user. Now, it provides the users the following function commands

- A command: Adjusting accounting informations. Usually, it is used to complement the effect of testing.
- B command: Billing.
- C command: Changing entries.
- D command: Deleting entries.
- E command: Exiting.
- F command: Listing all UIC directories.
- I command: Inserting entry.
- K command: Killing UIC file.
- L command: Listing expired entries.
- M command: Printing (to line printer) expired entries.
- N command: Selecting new UIC file for maintening. This command will read the selected UIC file into buffer. All the other commands take actions to the buffer only.
- P command: Printing all entries.
- R command: Running REACT program to mainten the origin administrative control files.
- T command: Typing entry or all entries.
- W command: Writing buffer back to the UIC file. This is the only command that will change the actual UIC file.
- Z command: Deleting the entries if they expired.

IV. Administrative Control Programs

As shown in Fig. 2, there are 4 administrative control programs, LOGIN, KJOB, LOGOUT and SPRINT, that have been modified by us for meeting our new add-on administrative control system.

1. LOGIN Program^[6]

The LOGIN program is designed for determining whether or not the user is currently authorized to use the time-sharing system and if so, to establish the user's initial profile. It is the first program to be run for anyone who wants to use the time-sharing system.

When a user types the system command LOGIN followed by his PPN from a terminal, LOGIN program is initialized by the command decoder of the operating system. It fetches the associated entries of the PPN from the ACCT.SYS and AUXACC.SYS files. If the user is currently authorized to log in the time-sharing system, it further asks the user to identify himself by typing his password and/or name according to the indication shown in the ACCT entry. If anything goes wrong, the user is rejected, otherwise, the LOGIN program will establish a job to the operating system for the user, set the spooling devices and watching status (for tracing the execution of command, etc.), set up the active file structure and default directory path, etc. Of course, all of these are done according to the speci-

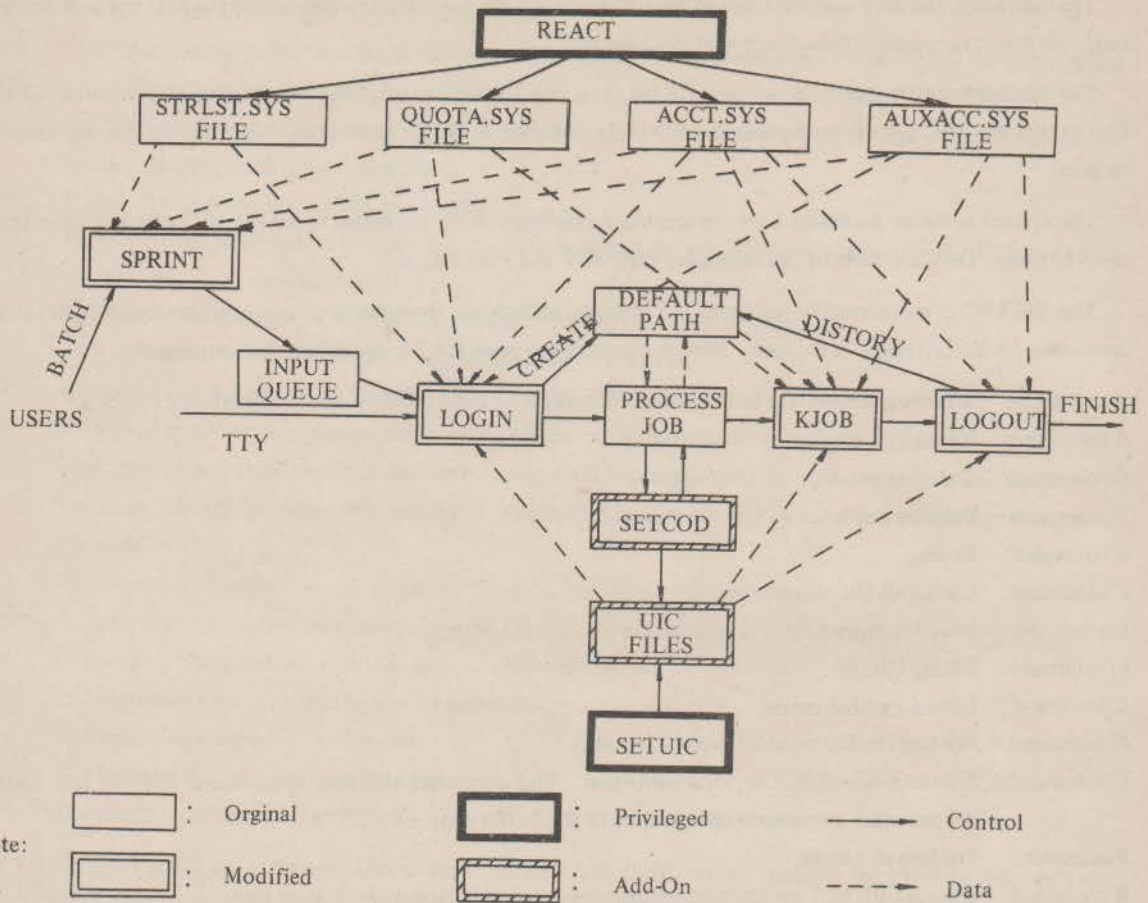


Fig. 2: The Administrative System of the DEC-10 System of the N. C. T. U.

fication of the ACCT and AUXACC entries. All his disk files are then checked if they have errors. An accounting transation entry is appended to the accounting file. Finally, LOGIN informs the user if any message of the day and errors detected. Now, the user is a legal user of the system, he may use the system resources by other system commands.

In our modified LOGIN program, if the entry of ACCT.SYS specifies that name is required for logging in from time-sharing it will ask the user the name and open the associated UIC file to get the entry of the given name. Then the checking and initialization are done according to the specification of the UIC entry. The words "CODE", "PASSWORD" and "NAME" are used to request the user to type his password, the password of the PPN and the user name respectively. Moreover, the time of logging in and the structure name specified in the GIB of the UIC file are appended to the UIC entry. Then they are written to a temporary file named by his job number and with the extension UIF. This UIF file provides the SETCOD and KJOB programs the necessary information for their functions. A simplified flowchart of the modified LOGIN is shown in fig. 3.

2. KJOB and LOGOUT Program^[7,12]

KJOB and LOGOUT programs are used to perform those operations necessary to log the user off the system in

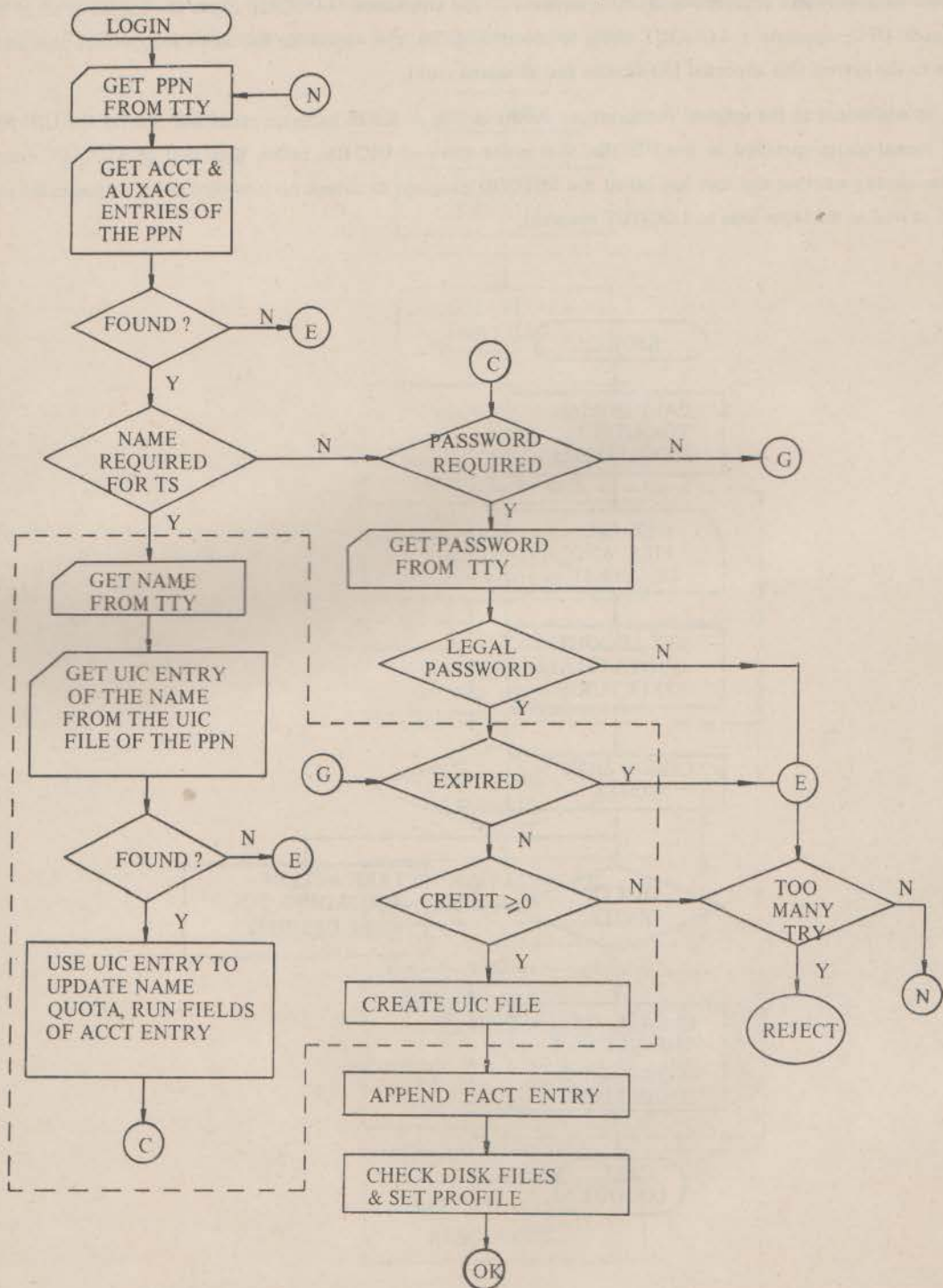


Fig. 3: Simplified Flowchart of Modified LOGIN

a reasonable way. KJOB provides the user the facility to queue spooled output not yet queued, leave his disk files in the state he desires and enforce logout-out quota on all file structures. LOGOUT clears the logged-in bit in the RIB of each UFD, appends a LOGOUT entry to accounting file, and cancelling the user's job, returns the user's resources to the system (his allocated I/O devices and allocated core).

Now, in addition to the original functions, as shown in Fig. 4, KJOB program reads and deletes the UIF file, uses the logout-quota specified in the UIF file, that is the entry of UIC file, rather than that of AUXACC entry. KJOB also checks whether the user has called the SETCOD program to change his password and if so, passes the new password as well as the login time to LOGOUT program.

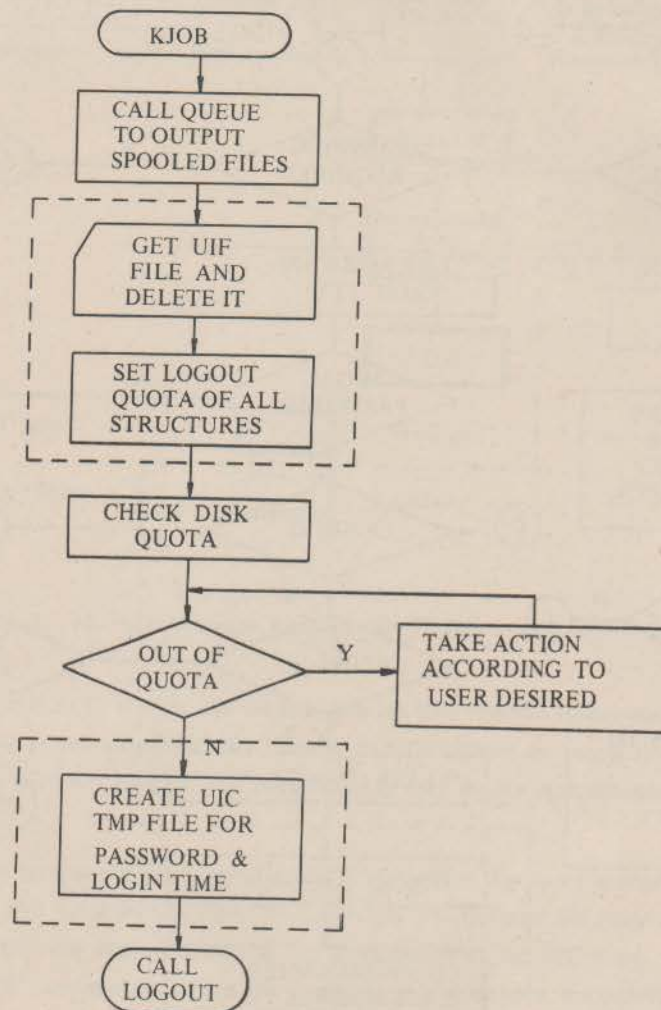


Fig. 4: Simplified Flowchart of Modified KJOB

The additional functions of LOGOUT program, as shown in Fig. 5, making the accounting and changing the password if required to the UIC file. It must open the UIC file, get the entry of the user, update it and write it back to the file. The login time is used to calculate the connect time of the user.

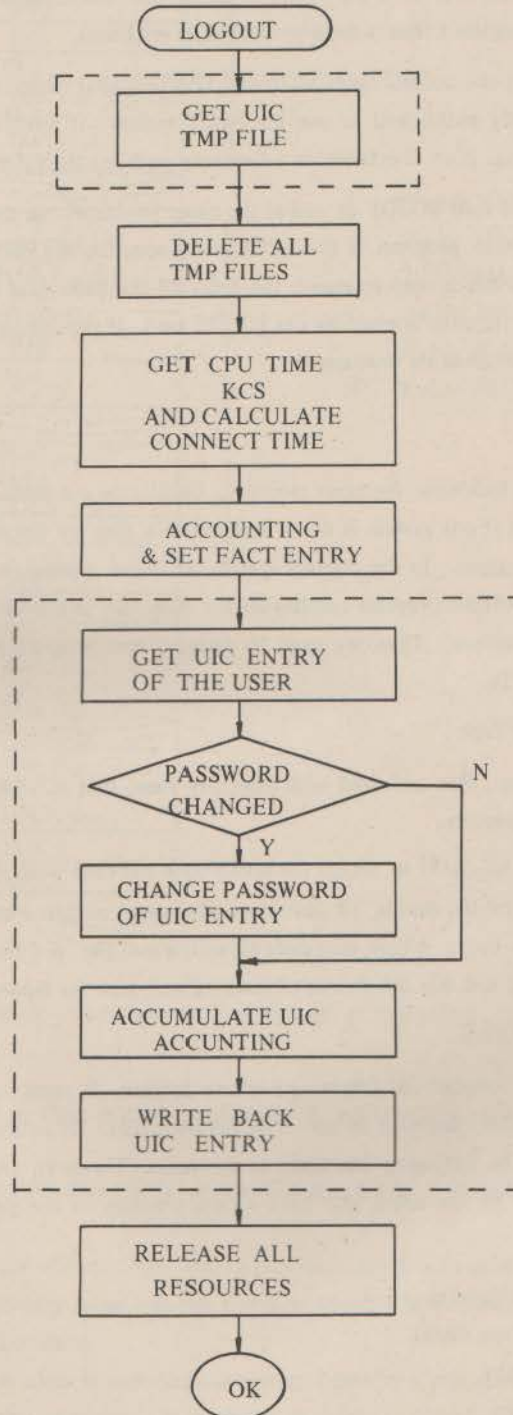


Fig. 5: Simplified Flowchart of Modified LOGOUT

3. SPRINT Program^[11]

SPRINT is designed for input spooling processing. It reads a sequential input stream and separates them into appropriate files according to the control cards imbedded in the stream that are supplied by the users. If the job requires, SPRINT also prepares the user's input, enters the job into batch input queue for further processing, but it does not initiate any processing itself (this is done by BATCON program).

The SPRINT program uses the control cards \$JOB and \$PASSWORD to determine with the user who he is and whether or not he is currently authorized to use the batch system. It fetches the entries from the ACCT and AUXACC files for the checking. If so, it establishes a directory path for the following spooling.

Now, an additional control card \$CODE as well as the name switch within the \$JOB card, is used to identify the UIC users. That is, as in LOGIN program, if the ACCT entry specifies the name is required for logging in from batch, the corresponding UIC file is used to search the entry of the name that is given by the name switch in the \$JOB card. The password if required is given by the \$CODE card. If anything goes OK, the directory path is set to the user's SFD. Any other functions are unchanged.

V. Failsaving

Failsaving is an important technique for error recovery. Usually, in our center, we save all disk files onto magnetic tapes every week. So that if our system is down and the disk files are destroyed, we can back up them by restoring those in the magnetic tapes. In the original system, we have a program FAILSA that is designed for failsaving^[13]. However, this FAILSA program handles all the files only in the UFD level. All files in any SFDs can't be saved by this FAILSA program. Thus, we need to design a new program for failsaving our new system since now most users' files are in SFDs.

1. Format of the Magnetic Tape

In our new failsaving system, files are saved with directory base, that is, all files of a directory are saved sequentially and preceded by their directory.

A file begins with his RIB block^[4] to which the saving date and time were appended. Then the data blocks are saved with a blocking factor of 10, that is, 10 disk blocks are saved within a magnetic tape block. However, the directory files have RIB block only. A save area ends up with a null file. A directory without any file in it will not be saved to magnetic tape. Fig. 6 shows the format of the magnetic tape for failsaving.

2. Failsaving Program, DSKSAV

The program DSKSAV is designed for failsaving our new system. It saves not only the SFD files but also the UFD files. It can also be used by any user to save only his own files. Of course, it can restore any files that were saved by itself. It provides the following functions to the users. However, saving or restoring the files of other directories can be taken only by the users who have access privilege or the privileged users who log in the PPN (1,2).

- /A: Advancing magnetic tape file(s).
- /B: Backspacing magnetic tape file(s).
- /J: Skipping to next save area.
- /W: Rewinding magnetic tape.
- /L: Listing all file names in magnetic tape to terminal or printer.
- /D: Selecting whether the access date will be checked while restoring. That is, if a file is requested to be restored, and there is a file with the same name in the disk, then restoring is taken only when the access date of

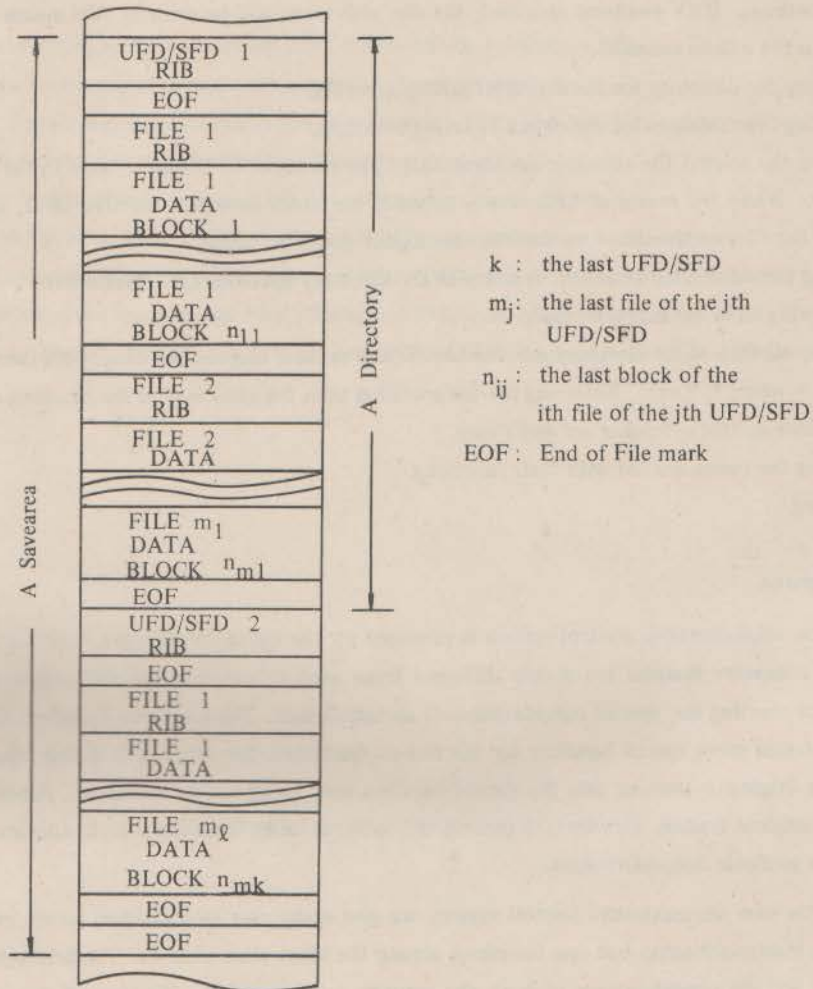


Fig. 6: The Magnetic Tape Format of Failsaving

the magnetic tape file is later than that of the disk file if checking is specified (by /D). If /DN is specified, restoring is always taken.

- /F: Selecting whether only the UFD files (/FU), or the SFD files (/FS) or both of them (/FB) will be saved or restored.
- /I: Specify whether the operator will intervene when a new directory will be saved or restored. If /I is specified, DSKSAV will type the directory name and ask operator whether this directory will be saved/restored. /IN indicates all directories will be done.
- /Q: Specifying the action to be taken if restoring unexisting directory is requested. /Q means this restoring will be aborted. /QR means this restoring will be taken by creating its directory first. /QD means operator intervention is required.
- /T: Listing all the name of files being saved/restored. /TT means list to terminal, /TL means list to line printer and /T cancels the request.

- /V*: Specifying the action to be taken while error occurs and then continued by operator. If error occurs, DSKSAV messages to operator, and accepts the next command from operator. The operator can use the */C* command to continue. If */V* has been specified, the file with error will be retried. */VN* means the saving or restoring of this file will be canceled.
- /G*: Selecting the directory for the source of saving/restoring.
- /O*: Selecting the directory for the object of saving/restoring.
- /S*: Saving the selected file structure (as argument). The saving of UFD files is taken in the order of entries in the MFD. While the saving of SFD files is taken in the order shown in the UIC UFD, that is the PPN [1,3]. Only the files on the structure that user has logout quota are saved.
- /Y*: Saving the selected file structure begins with the directory specified (as arguments).
- /R*: Restoring all in the magnetic tape.
- /U*: Saving all files of the directory specified by */G* and rename them as the files of the directory specified by */O*. File name, **,**, name**,*.ext*: Restoring the file specified with the same way as the handling of */U*. Where *** means the name and/or extension are don't care.
- /H*: Typing the command list with their functions.
- /E*: Exiting.

VI. Conclusions

Usually, the administrative control system is provided by the computer vendors. But since the management of the users of computer systems are deeply different from each others, some modifications of the original system are needed for meeting the special consideration of an installation. There are two problems for such modifications. One is to redesign some special handlers for the add-on functions, the other is to decide where and how to make change of the original system so that the special handlers may be smoothly added on. All of them require a detail study of the original system. However, in general, this study is taken from the source program listings of the system with only few available documentations.

Now, by the new administrative control system, we give every user an individual access of the system resources with a strong interrelationship but few interferes among the same class of users. The privileged users are restrained hierarchically for the considerations of both the security and operation efficiency of the system. The real time accounting system realizes the students the sense of the computer cost. The only thing changed to users for accessing system is that his name is necessary for identifying himself while name is optional in the original system.

However, since the SFD isn't a full tested standard feature of the DEC-10 file system [14], some monitor errors have occurred during the past one year implementation of the new system. It needs a further study, testing and improvement.

Acknowledgement

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