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LARS System Services User's Guide

Purdue University
Laboratory for Applications of Remote Sensing
West Lafayette, Indiana 47907
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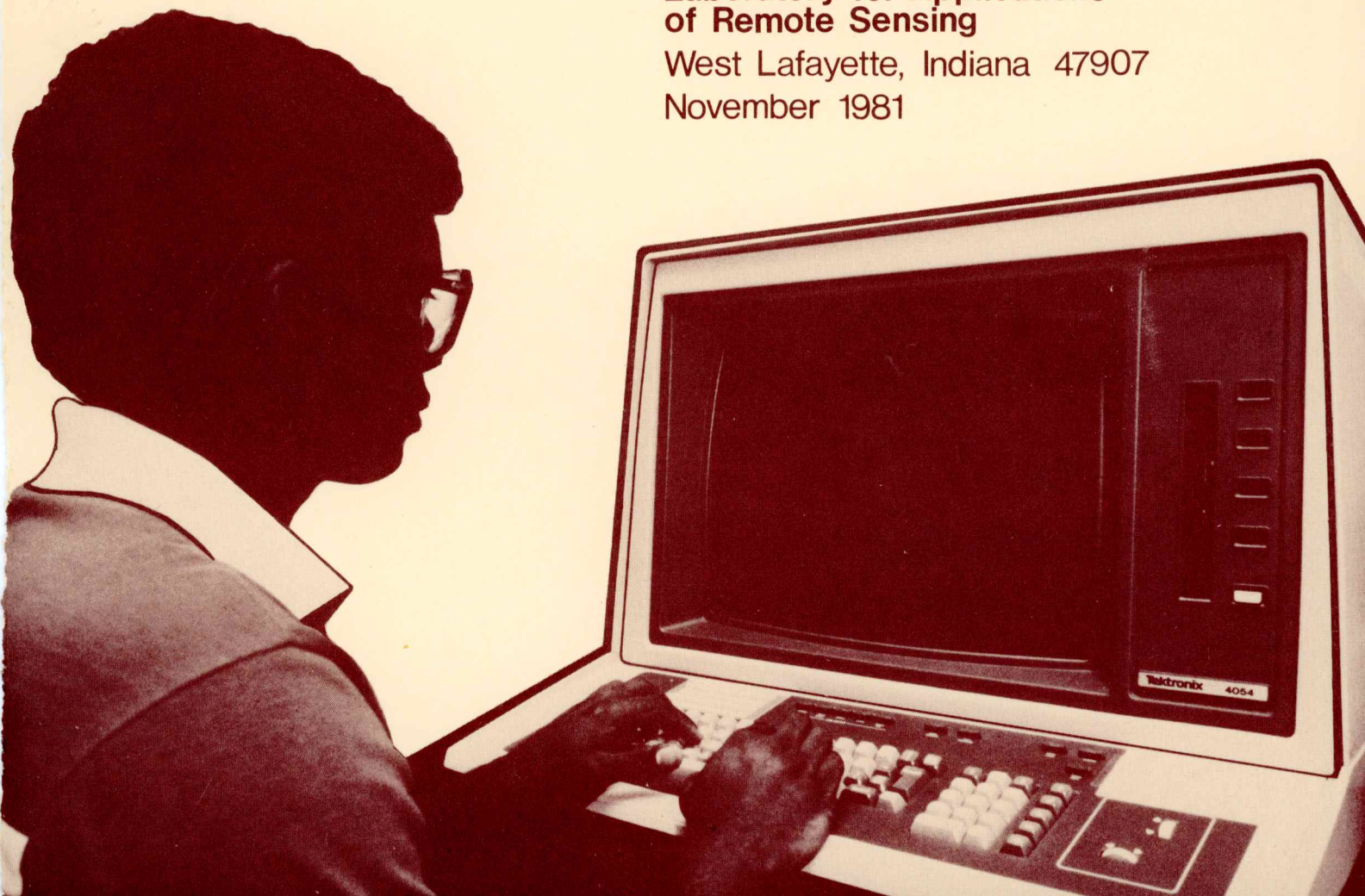

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PREFACE

The LARS System Services User's Guide is a reference manual for both beginning and experienced users of LARS System Services. The User's Guide describes general LARS policies and procedures and the computing services available on the LARS computer. Productivity as a computer user is in direct proportion to understanding the computer environment being used. This publication attempts to provide a framework for developing that understanding. A brief description of the User's Guide is given below.

Chapter 1 contains a summary of operational procedures, administrative procedures for opening and closing accounts, and System Services Staff.

Chapter 2 describes the LARS Hardware, Software, and the Data Library.

Chapter 3 contains a complete list of documentation available, system training and news facilities.

Chapter 4 explains the use and operation of LARS terminals.

Chapter 5 discusses CP, CMS, EDIT, EXEC and other software capabilities and utilities.

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Chapter 1

INTRODUCTION AND PROCEDURES

1.1 LARS SYSTEM SERVICES PURPOSE AND PHILOSOPHY OF USE

The primary purpose of LARS System Services has been to provide an excellent research computation facility to meet the needs of Purdue's remote sensing research community. LARS has elected to supply a highly interactive, multi-user, general purpose computing environment in order to maximize the accessibility of software tools and the speed and ease of program development.

The capability and flexibility provided by a general purpose machine has allowed LARS to supply data processing to Purdue researchers and simultaneously pursue the establishment of a remote terminal network. This network has been utilized to transfer and pool technologies developed by groups working at several levels of technology generation, from university to government to industry. The procedures, software, and data shared by the users of this network have provided tools to researchers at LARS that they would not otherwise have had.

Facilities are made available with as few restrictions as possible, consistent with maintaining efficient utilization of resources and fairness to all users. The few regulations necessary are detailed in this guide.

1.2 SYSTEM SERVICES STAFF ORGANIZATION

A LARS System Services Representative is assigned to each account to provide general assistance by answering questions, arranging for special services, helping with adminstrative tasks or referring other members of the staff when necessary or appropriate. Although the computer representative is the primary contact, users may contact other staff members on a specific subject. The following lists other full-time System Services personnel and their areas of responsibility:

Terry L. Phillips	LARS Deputy Director	Overall responsibility for the general administration of the the LARS System Services.

Jim Kast	Manager of User Services	Responsible for the administration of user services.
Ross Garmoe	Manager of Computer Systems	Responsible for Systems software and hardware configuration.
Kay Hunt	Manager of Software Products	Responsible for LARSYS, Statistical Services, LARSPEC, and Geographic Information Systems.
Luke Kraemer	Manager of Local Services	Responsible for Local Terminal Services.
Cathy Kozlowski	Manager of Reformatting Services	Responsible for all reformatting products, standard and custom-made as the need requires.
Ross Aiken	Operations Supervisor	Responsible for keeping the computer system running and for providing access to it.
Gary Brammer	System Engineer	Responsible for communications hardware maintenance and engineering.
Barbara Francis	Manager of Support Products	Responsible for Support Services including printed material, slides, educational packages, etc.
Pat Shoemaker	Account Clerk	Business Office representative in System Services.

Users at remote sites should contact their own site specialists with all questions and problems instead of contacting LARS personnel directly. The site specialists are then responsible for interfacing with their PURDUE/LARS counterparts.

1.3 ADMINISTRATIVE PROCEDURES

The first step in gaining access to LARS Systems Services is establishing a "Master Account". In order to establish a "Master Account", details about how much spending is authorized, the duration of the account, which people are authorized to spend money, who should receive accounting information, etc. must be specified. Users who have never established a Master Account at LARS should contact the Manager of User Services for assistance.

A LARS System Services Representative is assigned to each new Master Account. The System Services Representative provides general assistance to the users of the Master Account by answering questions, helping to secure needed documentation, helping to arrange for special services, and assisting with required paper work.

To access the computer, a user must have an ID established in the system directory. The directory identifies the resources which will be available for each ID at logon time (e.g. memory, disk space). A password is associated with each computer ID. Both the authorized computer ID and the password associated with it must be correctly entered for a user to successfully log on the system.

The accounting system provides information detailing the services used by each Master Account to the individual establishing the account, the System Services Representative and up to two additional "Account Managers". The quantity of each service consummed and the associated cost is provided on a monthly basis. In addition, more detailed information is provided on a "by-ID" basis for usage of computer service, priority service, terminal attached time, and special device attached time. Overall system usage figures are provided to assist in determining future resource needs and for analyzing usage patterns.

1.3.1 How to Establish a LARS System Services Master Account

Access to LARS System Services is initiated by completing a "REQUEST FOR SERVICES" form. Samples of this form are reproduced as Appendix B. Users who have never established a Master Account at LARS should contact the Manager of User Services for assistance in completing this form. Prospective users who are already familiar with the form may obtain a copy from the System Services Account Clerk or from the LARS Business Office. The appropriate REQUEST FOR SERVICES form must be completed by the project leader/ principal investigator, approved by the appropriate funding authority, and sent to the System Services Account Clerk for processing. The request will specify the amount of funding requested for System Services, the effective dates of service, and the Purdue University account to be charged. Also included are the name of the project or account, the name of the principal investigator (the person is responsible for all usage of the account), and (optionally) the names of up to two project managers who are delegated authority to request ID's and other services to be billed to the account.

There are two versions of the REQUEST FOR SERVICES form. The first version is to be completed by users of funds assigned a Purdue University account number. Such users are generally Purdue employees and are associated with departments on campus. Approval for establishing a Master Account funded through a University account number must be provided by a Purdue Department Head or Business Administrator.

All prospective users who do not have a Purdue University account number should fill out the "NON-UNIVERSITY ACCOUNT" version of the REQUEST FOR SERVICES form. This form includes a more complete billing address. Purdue University reserves the right to charge profit making enterprises a higher rate for services than it charges for University and non-profit institutions. At the time the REQUEST FOR SERVICES form is acquired the prospective user should indicate the profit making status of the organization, and should receive from LARS an indication of the overhead rate to be charged for the LARS System Services Usage.

After the Master Account has been established, a copy of the REQUEST FOR SERVICES form will be returned to the project leader (principal investigator). Two important pieces of information will have been added to this form by LARS: The Master Account number, which future resource requests must reference, and the name of the System Services Respresentative.

1.3.2 System Services Representative

LARS will assign to each Master Account a System Service Representative. This individual will be treated as a Manager for the project establishing the Master Account. The account representative is to establish an agency relationship between System Services and the project. This means that the System Services Representative is to serve as an advocate for the project within System Services and as a representative of System Services to the project managers.

As an advocate for the project, the representative will:

1. Know the project's objective, major milestones, current status, needs and problems.

2. Know the users of the Master Account and their general project responsibilities.

3. Know what the project budget is.

4. Know which System Service products the project is expected to consume.

5. Help make those who provide services to the project aware of its service needs and schedule.

6. See that the problems encountered with System Services are solved with minimal project impact.

7. Make System Services Managers aware of serious user criticism or concerns.

As a representative of System Services, the representative will:

1. Help project leaders and users become aware of products, procedures, resources and capabilities that may benefit their project.

2. Help prepare realistic System Service budgets for future use.

3. Stay in contact with the project manager.

4. Charge for time exceeding one hour per week spent helping a project.

5. Make sure the services budget is spent effectively and not grossly overspent.

6. Know and report plans for future projects.

7. Help identify other potential projects and investigators.

8. Seek help and advice in identifying needed new products.

1.3.3 How to Establish a LARS Computer ID

Once a Master Account has been approved and established, the principal investigator and the project managers will receive a completed copy of the REQUEST FOR SERVICES form together with the name of the Systems Services Representative for the Master Account. The principal investigator or a project manager may then, at any time, request that one or more ID's be established for the account. In order to initiate the creation of a new ID, a "REQUEST FOR A LARS COMPUTER ID" form must be completed. These forms may be obtained from the Operations Supervisor, System Services Account Clerk or from the LARS Business Office. The System Services Representative for the account can provide assistance in filling out the form. Once the form has been completed, it should be sent to the Operations Supervisor. Request for IDs will be filled within the period of one week from receipt, unless extenuating circumstances exist. A copy of the form will be returned to the applicant to indicate that the requested ID has been placed in the system directory. Appendix C is a sample "REQUEST FOR LARS COMPUTER ID" form.

Line (2) of the ID request form must be signed by the principal investigator or a project manager who is responsible for ID requests. The Master Account or project is identified line (3).

Each week the accounting system processes charges for all ID's, compares the total charges with the amount available in the Master

Account and checks the Master Account termination date. If a manager wishes to be notified if a particular ID has exceeded or nearly exceeded a specified dollar amount, that dollar amount should be written on line (4). Similarly, if a manager wishes to have an ID terminate before the Master Account termination date, the desired date should be written in on line (5). The manager will be notified about two weeks before the termination date.

The ID and password in lines (6 & 7) can be made up of any string of one to eight alphanumeric characters.

The Special Facilities to be associated with each ID are requested in item (8). The user's private disk space should be specified in megabytes (line A). It is strongly suggested that users specify read and write passwords for their private disk on lines B and C. Users desiring other than default memory size (line F), multiple write access for their private disk (line D), special disk links (line E) or PDP ID's (item 11) should contact the System Services Representative for assistance.

If any magnetic tapes are to be written on using this ID, they should be listed under item (12). The "owner's name" listed there should match either the name on line (2) or one of the names on line (10). If the project manager wishes to purchase tapes for this ID, the "owner's name column" of item (12) should be filled in one time for each tape wanted and a note written at the bottom of the form: "Please provide _(N)_ new tapes". The proper tape numbers will be entered into the corresponding blanks before a copy of the form is returned to the requesting manager.

1.3.4 How to Request Changes in an ID or Master Account

Any request for changes in a master account must come from the principal investigator and be directed to the Account Clerk. Examples of such changes might be to increase or decrease authorized funding, extend expiration dates, etc. Changes to a Master Account are initiated by completing a REQUEST FOR SERVICES form with the "Changes in Existing Account" box checked. This form must be signed by the project manager and a funding authority. The "Department", "Applicant", "Phone", "Date", and "Signature" lines must be completed. For changes in Existing Accounts, the Master Account Number should also be filled in at the bottom of the form. Other lines should be completed only if they represent changes from the information initially provided when the account was established.

Any request for modifications to a computer ID should be directed to Ross Aiken and should come from either the principal investigator or a project manager. Requests for changes should be made by sending an informal (signed) memo. Examples of changes include increasing or

decreasing the dollar amount authorized, changing the expiration date, deleting the ID, or adding to or deleting from the list of tapes authorized to be written on by an ID.

1.3.5 Accounting Procedures and Reports

Each week the system accounting data is run through an accounting program. A memo is generated and sent to the project manager if an ID will expire within the next two weeks or if it has overrun (or is about to overrun) the maximum dollar amount that was specified on the ID request form. A return form is attached to the memo which the project manager may fill out to increase the ID funding, delete the ID, or change the expiration date. If no response is received within the seven-day grace period, and the ID has overrun the dollars funded, the ID will automatically be deleted.

At the end of each month, three accounting reports are sent to the principal investigator and each manager. The first report gives the resources used by each ID under the master account, with totals for the master account appearing at the top of the page. Included in the information given are the number of terminal sessions, number of batch jobs run (see Section 5.3), total hours (clock time) attached to the system (broken down by terminal sessions and batch jobs), and total CPU hours used during the current month (also broken down by terminal sessions and batch jobs). At the far right of the page are summaries of the account status, including the number of CPU hours requested for the account and the total number of hours already used since the starting date of the project.

The second monthly report details LARSYS usage for the month. It is a one-page report for the project and contains the following items for each LARSYS function: number of times used, number of control card check-out runs, elapsed clock time, virtual CPU time, and total CPU time. Each of these three times is further subdivided into total, minimum, average, and maximum times. Totals are included.

The third monthly report is an itemized statement of charges. This report contains the rates and total charges for each of the System Services used during the month. It includes the information from the "REQUEST FOR SERVICES" form, the amount used and remaining prior to the current month, amount charged this month, amount used and remaining as of the end of this month, and an itemized list of charges.

Any questions concerning the first two reports should be directed to the Operations Supervisor. These reports are usually sent out on the second working day of each month. Questions concerning the third report, the itemized statement, should be referred to the Account Representative or the Operations Supervisor. This statement is sent out

separately from the first two reports, usually by the sixth working day of the month. Project managers can telephone the Operations Supervisor at any time during a month to obtain a copy of the current changes to an account. This special type of request may be particularly helpful for managers of small accounts that are close to being depleted. It should be noted, however, that although charges for Computer Products are processed every week, those for Reformatting, Support Services, and Statistical Services will usually not be processed until the end of the month.

1.4 OPERATIONAL PROCEDURES AND GOALS

The general policy is to have two computer operators on duty during the prime shift and one during the evening and night shift.

Expected typical levels of system availability and reliability are described below:

1. There should not be more than an average of 3 unscheduled shutdowns (system crashes) experienced in one week. Any system failure should be repaired within one hour.

2. LARS local terminals should be operational during the same hours as the system with less than an average of one failure per week per terminal lasting not more than one working day.

3. Users with priority service requests (such as tape mounting and device attachment) should be responded to within two minutes. Card input or printer output at the central computer site should be available within five minutes of production and card output within 8 hours. In order to conserve paper, it is our policy to occasionally delay removing output from the printers for up to half an hour; however, if you want your output sooner, you may request the operator to get it for you at any time. There should be sufficient tape units available so that users can obtain one tape unit within 10 minutes of a request, or two tape units within 1 hour of a request, and three or more drives within fifteen hours.

1.4.1 Magnetic Tape Usage Policy and Practice

The LARS Computational Facility currently manages about 8000 reels of magnetic tape. Many of these reels comprise a data base of remote sensing multispectral image data. In addition, individual users may have tapes assigned to them for use in storing their own data or results.

Each magnetic tape has a tape number assigned and is kept in its own numbered slot in the tape racks. The computer facility staff will ensure that each assigned reel bears a "tape identification label" containing the following information:

1. Tape Number

2. General use for which the tape is intended

3. Name of person responsible for the tape

4. List of ID's authorized to write on the tape

Any master account may purchase any number of tapes. Users needing quantity of 40 tapes or more should give a 60 day notice because of the long lead time required for ordering tapes. This can be arranged by the project manager together with the Operations Supervisor. As part of this procedure an "owner" will be designated for each tape. This "owner" may make changes (e.g. add or delete items from list of ID's authorized to write on the tape).

Although each tape is assigned to a specific person (the "owner") who is responsible for its contents, the computer operators and Operations Supervisor are responsible for the physical handling of the reels. Reels of tape can be removed from the computer room only by the owner (or the representative who has an authorization request signed by the owner). The owner or the representative must request the tape from the senior computer operator on duty. Although any tape may be requested and read by any user, only ID's authorized by the tape "owner" and listed on the "tape identification label" will be able to request that a tape be mounted so that it can be written on.

In addition, users are strongly urged to request that a "tape contents label" describing current contents and date last written be made for each tape each time it is written. This can be done as suggested by the following examples:

EXAMPLE 1 - To create a new contents label.

```
M OP TAPE 999 NEWLABEL = "CLASSN RESULTS - RUN 660006000"
```

In this case the computer operator will write out a label with the current date and the requested information and use it to replace all old labels on the tape.

EXAMPLE: 2 - To add to a label.

```
M OP TAPE 999 ADDLABEL = "FILE 3 - RUN 66000601"
```

In this case all old labels on the tape will remain and a new one with the current date and the requested information will be added.

1.4.2 System Back-up Goals

On a weekly basis all data on disk storage devices is transferred to a backup tape library. The primary intent of this backup is to guarantee the restoration of the data if a severe disk failure were to occur. The backup library generated in this process is kept for a two week period. After this two week period the library is re-used for the current backup run. In the event of a severe disk failure all user files would be restored from the most current set of backup tapes.

In general the restoration of lost disk files occurs only in the event of a severe systems failure. In special cases, individual users may request restoration of their files. However, in these cases no guarantee can be made for a successful restoration.

In addition to the current disk storage backup procedure, the systems staff will backup critical data for off-site storage on a monthly basis. The tape library used for this backup is stored in a fire proof vault off the premises of Flexlab 1 and Flexlab 2.

1.4.3 Computer Schedule

The LARS computer is in operation 24 hours a day except from 5 PM Saturday to 6 AM Monday and Purdue holidays. If a Purdue holiday falls on Friday then the system will not be in operation the following Saturday. In addition, scheduled preventive maintenance (currently between 7AM and 9 AM on Friday mornings) may preclude availability to users. Bulletin boards, log messages and the news service of the LARS system (see section 3.2) will announce permanent and temporary changes in the availability schedule. Advance notice of temporary downtime for maintenance including scheduled maintenance periods will be given in the log message, if possible.

The Computational Facility is closed during Purdue holidays which are:

New Years Day	Memorial Day
July 4th	Labor Day
Thanksgiving and the day after	Christmas
and	

Two special days during Christmas-New Years week (designated by the Purdue president).

1.4.4 Terminal Availability Policy and Practice

Local Terminal service provides the terminal facilities enabling FLEXLAB1 and FLEXLAB2 users access to the LARS computers. This access includes interactive editing, job submission, and graphics. Local Terminal Service also investigates new terminal capabilities and attempts to improve existing access methods.

Local Terminal Service provides access to the LARS computers through a variety of devices. The primary user terminal is the INFOTON GTX which is an uppercase, ASCII CRT. This terminal is planned to be completely phased out of usage and will be replaced by upper/lowercase, semi-intelligent ASCII devices. Full screen, 327x display terminals are also being made available for word processing, systems support, and general usage. These terminals enable advanced editing capabilities and assist in systems maintenance. Three DECwriter LA36 terminals provide hard copy output and one of these also has line-drawing capabilities.

Local Terminal also maintains a Tektronix 4054 graphics terminal with a hard copy unit. This device can be used as a high resolution, line-drawing device, an interactive terminal, or a stand-alone processor. In addition, this terminal is accessible from both the IBM and the PDP system. Six portable terminals are available on a signout basis. These terminals can be used to access the IBM computer through the telephone system. Any LARS user (at LARS or elsewhere) may check out the portable terminals. Portable terminals are available for four hour periods during weekdays from 8 to 5 and may also be checked out for weekends and overnight.

Availability of this service is the same as the hours of operation of the computer. It will normally be available from Monday at 6 am to Saturday at 5 pm, except for two hours of scheduled computer maintenance and unscheduled shutdowns.

Any user with an active IBM computer ID will be able to log in and gain access to the IBM computer system. Any user with an active PDP ID/UIC will be able to log into and gain access to the PDP 11/34A system. This service accompanies any local usage of computer service during the time logged into the system.

Two full screen editing terminals have been designated for word processing use in both Flexlab 1 and 2 with priority for secretarial word processing needs. Those in Flexlab 1 are located in the area of 108A and room 170. Those in Flexlab 2 are in area C100 and in the reception area in Unit B.

Two Diablo printers are to be used for the printing of draft and final word processing output. In order to facilitate this purpose, the Diablo should not be used as a terminal for creating or editing files. They are located next to the full screen terminal in 108A (Flexlab 1) and next to the terminal in C100 (Flexlab 2).

The secretaries for the Crop Inventory and Data Processing and Analysis (Flexlab 1) and for the Computer Facility (Flexlab 2) will be responsible for the maintenance, storage and availability of print wheels, ribbons and paper supplies for the Diablos. These people will also be responsible for the setup of the Diablos with special print wheels or ribbons upon request from users.

Users may initiate the printing of files on the Diablo by accessing the printer themselves or sending the print file to the Diablo through RSCS (see section 4.2)

From 8:00 a.m. to 5:00 p.m., Monday through Friday, users may contact the appropriate secretary to request a ribbon or print wheel change. Carbon ribbons will be provided for final copy output only. The user should notify the secretary when the job is completed so that the standard Diablo set-up (12-pitch elite print wheel and cloth ribbon) can be restored.

Users wishing to access the Diablo after 5:00 p.m. should notify the secretary of the Computer Facility in advance if a special print wheel will be needed. The Diablo print wheel will be changed as requested at 5:00 p.m. and then restored to the 12-pitch standard wheel at 8:00 a.m. the following morning. From 5:00 p.m. on Friday to 8:00 a.m. on Saturday only the standard Diablo set-up will be available for use. Carbon ribbons for final output will not be available after 5:00 p.m.

Users may obtain final copy output or 10-pitch output on Saturdays by notifying the computer operator on duty. The operator should also be notified when the job is completed so that the standard set-up can be restored.

The TI Silent 700's are portable terminals which enable remote access to the LARS computer. The TI's are available on a sign-up basis. During the 8:00 a.m. to 5:00 p.m. shift these terminals can be reserved for up to four hours; however, they cannot leave the facility. These terminals are also available for remote usage between the hours of 5:00 p.m. to 8:00 a.m. Prompt return of these terminals is expected. Before using one of these devices verify that enough paper is remaining. If the amount of paper remaining on the spool is inadequate then take another full spool. Return all unused paper. Report all malfunctions to the Manager of Local Services.

Chapter 2

DESCRIPTION OF HARDWARE, SOFTWARE, AND DATA LIBRARY

2.1 THE COMPUTER AND ASSOCIATED HARDWARE

An IBM 4341 central processing unit (CPU) and associated hardware form the computer system at LARS. The current configuration includes four million bytes of memory. Unit record equipment (card reader, card punch and line printer) are connected to the CPU via a byte multiplexor channel. Nine-track magnetic tape units are connected to the CPU via one block multiplexor channel. The operating system and user files are stored on two spindles of CDC 3330-11 disk storage and four spindles of CDC 33502 disk storage connected via a block multiplexor channel. Communication with terminals and remote job entry sites is through a Comten 3670 Communication Processor. The computer configuration is shown in Figure 2-1. The communication configuration is shown in Figure 2-2.

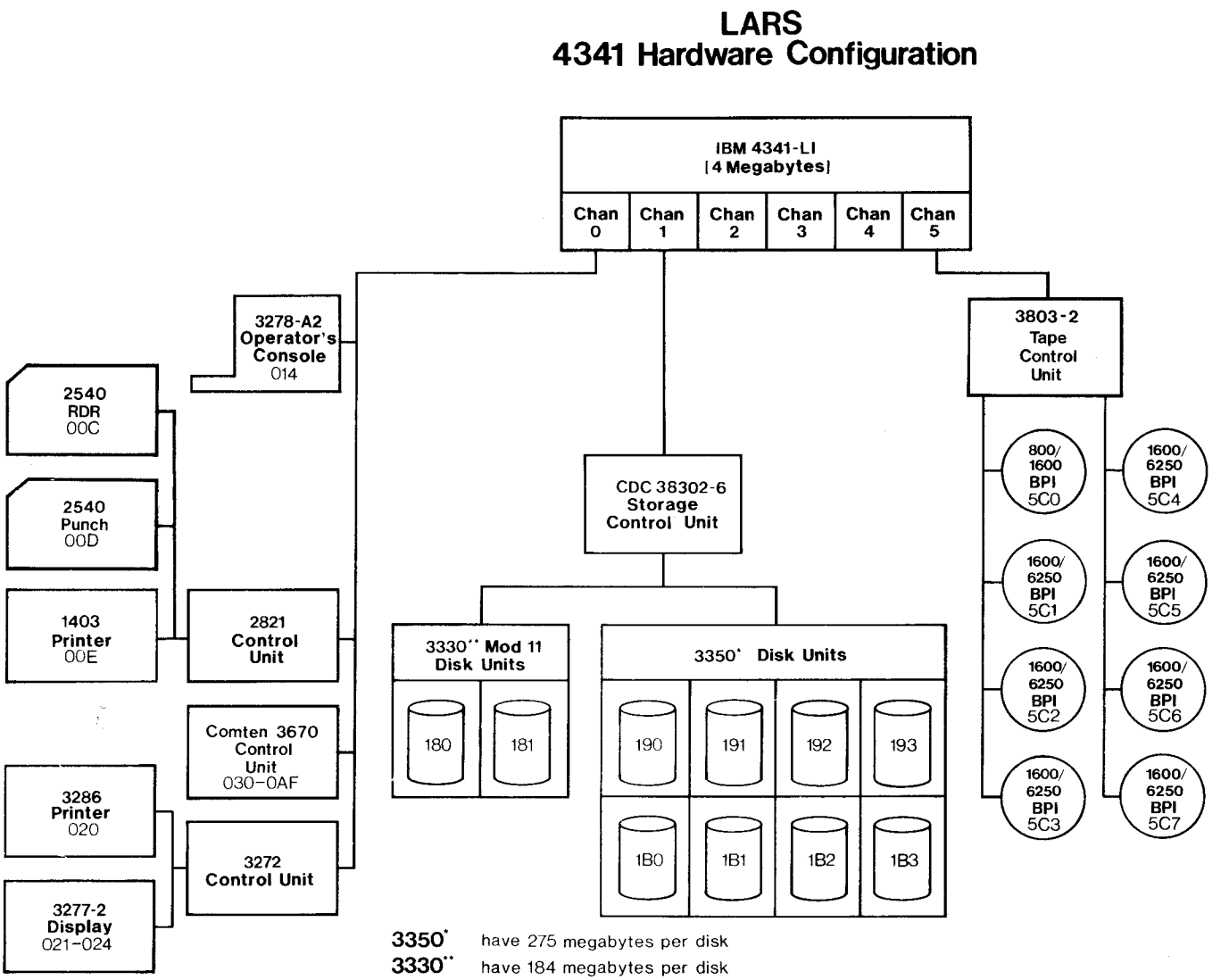

Figure 2-1. LARS Computer Configuration

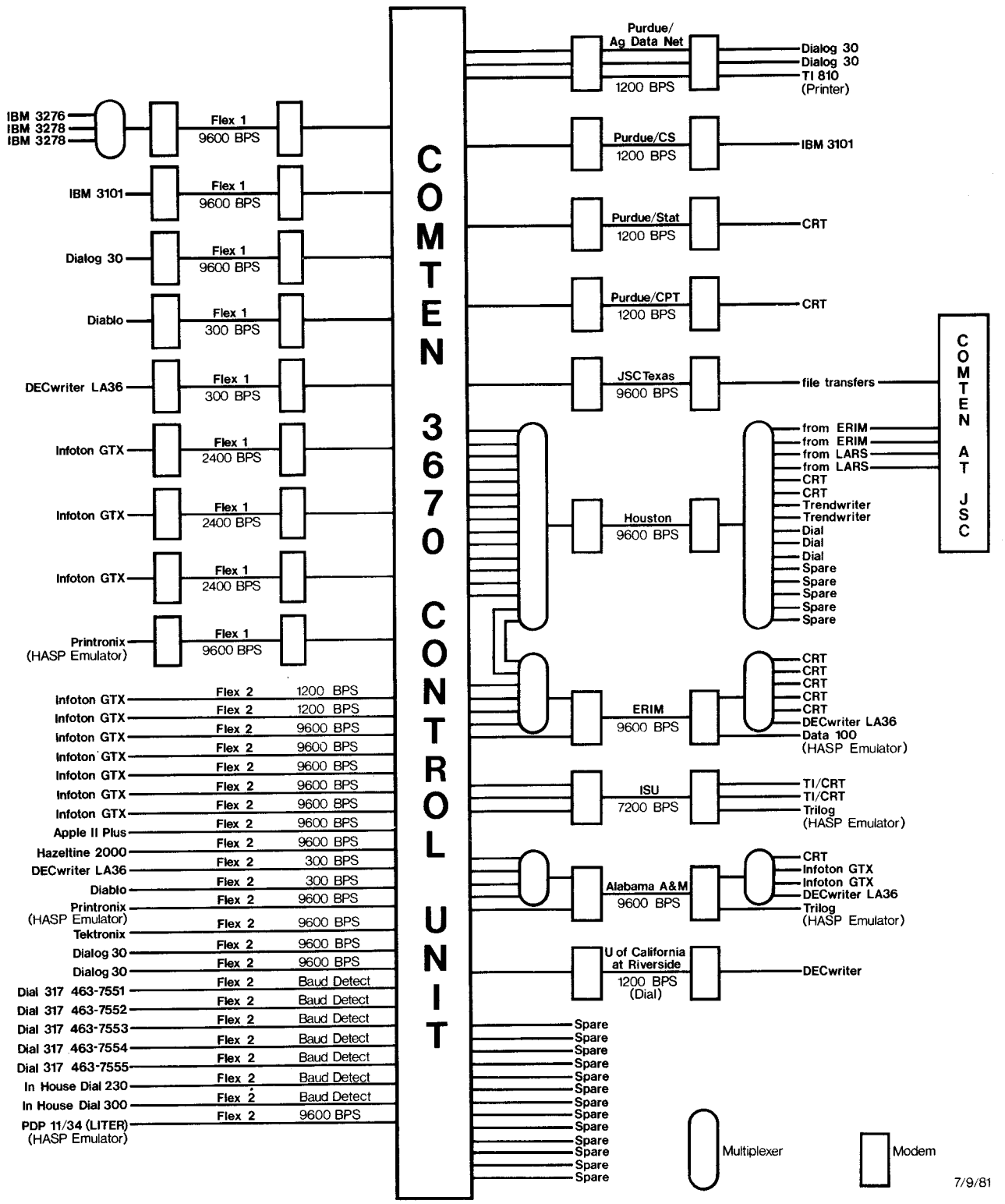

Figure 2-2. LARS Communication Configuration

PDP Hardware

A PDP 11/34-A supports several major peripherals at LARS. The 11/34-A CPU has floating point hardware and 256K bytes of main memory. The PDP supports an electrostatic printer/plotter, a card reader, a Tektronix 4054 graphics terminal, a Talos table digitizer and a COMTAL Vision One-20 color display. Four storage media are available:

1. One 800/1600 bpi 9 track tape drive (TU10)
2. Two single/double density 8 in. floppy drives (RX02)
3. Two 80 mb CDC 9762 disk drives (RP04)
4. Two 2 1/2 mb front loading disks (RK05)

The PDP currently runs RSX-11M V3.2 as its operating system. Communication to the IBM is provided via HASP+ software and DU11. The PDP currently supports five terminals, with two spare terminal lines.

Comtal Hardware Color Display

The COMTAL Vision One-20 is a complete image processing system providing the user with built-in interactive processing and control capabilities. The system produces a high spatial resolution video image over a full range of brightness levels in shades of gray, pseudo-color or full color.

The Vision One/20 system consists of a fully intergrated LSI-11 processor, image processing electronics, refresh memory using 64K bytes of RAM and application firmware. Complete control is accomplished via the system alphanumeric keyboard or remotely over the standard interface.

After receiving data from the PDP host computer, a user may manipulate image data with the Comtal's stand-alone minicomputer. The present configuration contains four image planes (512 x 512 8-bit pixels each) and four graphics planes (512 x 512 1 bit pixels each). A combination of specific hardware and software operations create an ideal processing environment for image enhancement band manipulation. The CPU is an LSI-11/23 with 64K bytes of memory. A computer controller provides the interface circuitry between the PDP 11/34 and the system standard interface.

Tektronix Graphics Terminal

The Tektronix 4054 is a high resolution graphics display. It is capable of operating connected to a host (IBM/PDP) or as a stand alone system running BASIC. This is a good device for interactive display of results. It is presently interfaced to user programs through GCS, IGL,

SAS and PLOT50. A Tektronix 4612 electrostatic hardcopy unit is attached to the 4054.

Talos Table Digitizer

The Talos model 660 Graphic Digitizer converts positional information of a cursor into digital output that can be used to input data from maps or other graphic data for analysis. The active digitizing area is 44 x 60 inches with a resolution of 0.001 inches. Individual points can be input by the operator, or contour lines can be traced with the cursor to automatically input a series of points that describe the line.

2.2 COMPUTER SYSTEM SOFTWARE

2.2.1 VM370 and the Virtual Machine Concept

"VM" is an acronym for the Virtual Machine Facility. VM has two major components, the CP control program and the CMS interactive operating system.

Control Program (CP)

CP is the program that is in control of the real machine (the computer). It manages the resources of the real machine -- main storage, the central processing unit (CPU), disks, tape drives, card readers, line printers, card punches, and communications lines to terminals. It does this in a fashion that enables a multitude of operating systems to co-exist on the real machine as "virtual" machines, each of which has "virtual" resources. Each virtual machines is identified by its VM "userid". This "virtual machines" environment is illustrated in Figure 2-3. CP maps the virtual resources of each virtual machine into the real resources of the real machine. For example, it manages the main-storage requirements of each virtual machine by moving 4K "pages" of main storage between real memory and peripheral "paging" devices -- therefore, the entire program does not need to be in main storage at the same time, just the "pages" of instructions and data that are currently being processed.

CP also manages a "spool file" system. It queues all of the files printed or punched by the virtual machines and prints or punches them on its real printers and punches. CP also queues card decks that come in

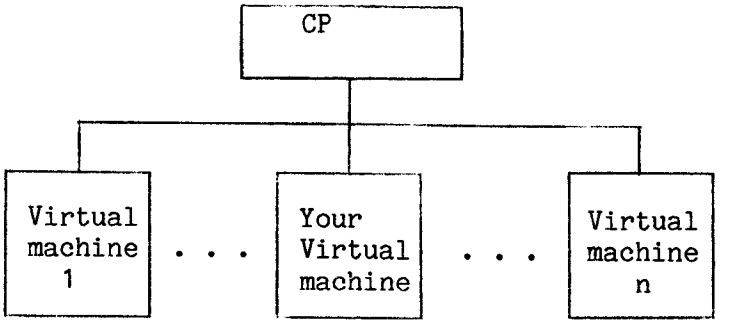

Figure 2-3. The "Virtual Machines" Environment

through real card readers for the virtual reader of the specified virtual machine.

Conversational Monitor System (CMS)

CMS is an interactive single-user operating system designed specifically to function as a virtual machine under CP. Under CMS each user has a separate virtual machine with its own virtual resources (CPU, storage, disk, card reader, line printer, card punch, and operator's console or "terminal"). CMS can be used to create "files" of information, and to invoke programs that process those files as "input" and produce other files as "output". The creation and modification of files is accomplished by using a program known as an "editor". The editor intended specifically for CMS is a program called EDIT.

A Conceptual Approach

It is most important that you have a good understanding of the environment in which you are going to be working. Therefore consider the following attempt to establish a convenient way of conceptualizing that environment.

> Imagine that you have just been hired as an employee of some company. First, you go through an administrative process that registers you as a member of the company; among other things, the process results in your being assigned an office and being given a key to that office.
>
> Each time you come to work, you must check in with the security guard at the entrance to the building. The guard checks your name against the company list to ensure that you do indeed work there, and writes your name in a "log" book as you go in (the company, being somewhat security-conscious, keeps a log of every person who enters and leaves the building). You then proceed to your office, insert the key in the lock, open the door, and go in.

In your office, you have a collection of "standard office equipment" that you use in carrying out your work -- pens, pencils, paper, a desk, an "in" basket, an "out" basket, a file cabinet, a telephone, a typewriter, a calculator, and a set of reference books. In carrying out your work, you perform a variety of tasks. Fundamentally, you prepare, process, and produce information. Sometimes, these tasks involve information seen only by you -- you create it, you process it, and you use the results in carrying out other tasks. Sometimes, you work from information provided by others, perform additional processing on it and forward the results to those who need it to carry out tasks of their own. Other times, your work involves some combination of these approaches.

The working environment of this mythical company can easily be mapped into the working environment of the computing system you are going to be using:

the building	. . . the computer
the building administrator	. . . CP
the security guard	. . . the CP "LOGON" command
your name	. . . your VM userid
your key	. . . the password for your userid
your office	. . . CMS
your desk	. . . your disk
your current work items	. . . the files on your disk
your "in" basket	. . . your virtual reader
your "out" basket	. . . your virtual printer and punch
your file cabinet	. . . the BACKUP command
your telephone	. . . your computer terminal
your calculator	. . . various commands (programs)
your reference books	. . . the CMS "HELP" command

While this conceptual view of the VM environment as an electronic office is not yet complete, it's a good start. You use CMS to do electronically what you would otherwise have to do manually with that collection of "standard office equipment": preparing documents and other reports, communicating with others, analyzing data and a wide variety of other tasks. Among the major features of the LARS computing environment are:

* Software: including the SCRIPT text formatter, the FORTRAN and PASCAL compilers, SAS, SPSS, LARSYS and numerous other language processors and applications packages that are commonly used at computing installations around the world.

* Background Processing: various "batch" virtual machines for longer-running non-interactive work. When you aren't in a hurry for the results, you can compute at less than the cost of interactive procesing.

* Virtual Main Storage: because the CP control program maps "pages" of main storage into the real main storage of the computer, the CMS user

can have a virtual machine with more main storage than exists on the real machine -- up to 1 megabyte by default, and up to 16 megabytes by administrative arrangement.

* Availability: 24 hours a day from 6:00 a.m. Monday through 5:00 p.m. Saturday (except for hardware maintenance from 7:00 a.m. to 9:00 a.m. Friday, and University Holidays)

* Out-of-town access: via dial-up facilities at speeds to 1200 characters per second.

As a CMS user, your virtual machine has real and virtual resources. The relationship between the real and virtual resources is shown in

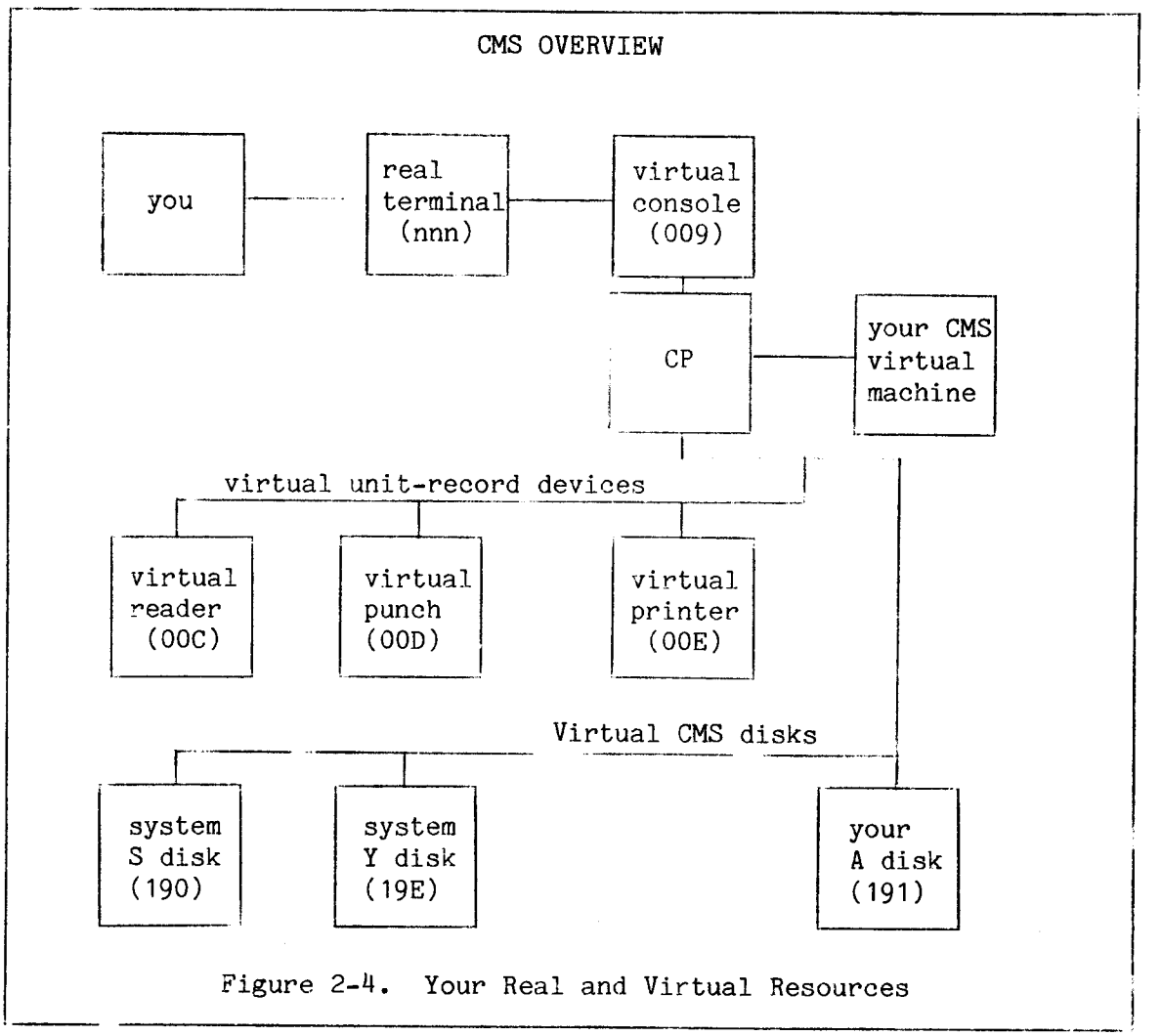

Figure 2-4. Your Real and Virtual Resources

Figure 2-4. The only real device is the terminal you are using. The virtual resources consist of main storage, a disk, a card reader, a card

punch, a line printer, and an operator's console. CP is responsible for mapping all of these virtual resources into the resources of the real machine.

The CMS File System

The Virtual Disk

A virtual machine has a certain amount of file space, permanently allocated in the form of a virtual disk (often called a "mini-disk"). This virtual disk will contain one or more cylinders. A virtual disk is totally private to your virtual machine. No other user can get at it without logging on using the userid and password. (There is a method by which you can enable other users to access your disk by establishing a disk password -- this will be discussed later). Your permanent disk will be defined to CP at virtual address "191" and will be accessed for you by CMS as disk "A" each time you log on. Your permanent disk is actually only a part of a real disk. The "address" (location) of the real disk is known to the CP control program, but not to you. The location of your part of that real disk is also known to CP but not to you. Your virtual machine refers to your part of the real disk via a "virtual" address, 191, and CP maps that into the proper location on the real disk.

Files on CMS Disks

Almost everything done in CMS will involve the processing of the files on mini-disks. Each disk file has a 3-component "file identifier", of the form

filename filetype filemode

The "file identifier" is usually documented as "fileid" or as "fn ft fm" for brevity. The filename and filetype may each consist of from one to eight characters containing any combination of letters, digits, and the "national" characters "$", "@", and "#". Many of the language processors and applications packages available in CMS demand that the information to be processed reside in a file of a specific filetype. For example, a file to be used as input to the SCRIPT document-composition program must have a filetype of SCRIPT. Table 2-1 lists the filetypes required or produced by various commonly- used programs.

The "filemode" is a 2-character letter-and-number designation. The filemode letter is the same as the "access mode" by which CMS has accessed the disk ("A" for the A disk). The filemode number will be one of the numbers from 0 to 5, as shown in Table 2-2. System Disks

During logon, CP automatically gives you access to the CMS system disks, as well as to your own disk. The system disks, S(190) and

Table 2-1 Filetypes For Various Processors

ASSEMBLE	the assembler
EXEC	the EXEC processor
FORTRAN	the H EXTENDED compilers
LISTING	output files produced by most processors
MODULE	machine-executable program
SAS	the SAS program
SCRIPT	SCRIPT
SPSS	the SPSS program

Table 2-2 Filemode Numbers

0 -- The number for "private" files; even if someone else knows how to link to the disk in read mode, they can't access filemode 0 files.

1 -- The normal filemode number for most files on the disk.

2 -- Sometimes useful when accessing another user's disk.

3 -- For temporary files; CMS will erase such a file as soon as any command or program uses it in a read-only manner.

4 -- For files created in simulated OS-access internal form.

5 -- Produced by certain CMS "utility" commands, such as LOAD.

Y(19E), contain common files accessed by every CMS user. For example, most of the CMS commands discussed here are actually MODULE or EXEC files on the system disks. (We will discuss how to create commands as MODULEs or EXECs later in this document).

File Directories, File Blocks, and File Compression

The following information is included just for the sake of completeness; you don't have to do anything about it because it happens automatically.

File Directory

Each CMS disk contains a directory of all of the files on that disk. This file directory is copied into virtual storage when the disk is accessed. Whenever a command is executed that indirectly alters the information contained in this "in-core" directory, CMS writes the directory back onto the disk.

File Blocks: No matter what attributes are specified for a disk file, files on CMS disks are always written in 800, 1024, 2048, or 4096 byte. Attributes such as RECFM (record format) and LRECL (record length) are actually present, but the CMS file system handles the mapping of these attributes into the block structure.

Command Language, On-Line Assistance and Security

The command language consists of several parts. There are CP commands which control the configuration of the virtual machine and CMS commands, which are used to direct CMS. The CMS command language may be extended by creating load modules and command files (called EXEC's).

CMS provides on-line assistance in the form of the HELP command. HELP is available for CP and CMS commands, EDIT and DEBUG subcommands, and for CP and CMS error messages. HELP files have been written for LARS extensions to VM and for LARS developed application systems.

CMS provides extensive protection and security mechanisms. Because each CMS user runs in a separate virtual machine, users are isolatd from mistakes made by other users. Because each user has private disk space, files can be read by other users only if they have been given the password to the disk space. (If the mini-disk does not have a password, then only the owner can read the files.) To share files selectively, send a copy of the files to the users desiring a copy of the file. The section on Inter-User communications in Chapter Five will explain this.

Before attempting to use CMS, read chapters four and five of this user's guide to obtain more information about using CMS and about the terminals on the LARS system.

2.2.2 Programming Languages

The LARS computer has several programming languages available. This section gives only a brief description of them; section 3.3 lists the IBM manuals that document the languages, and section 5.5 tells how to run programs written in these languages.

1. FORTRAN. The FORTRAN language is especially useful in writing programs for applications that involve mathematical computations and other manipulation of numerical data.

LARS currently provides the IBM FORTRAN H Extended compiler, which supports ANS FORTRAN X3.9-1966 with extensions. The FORTRAN language has recently been updated to include character string variables and structured programming facilities (ANSI FORTRAN-77). At this time, IBM's FORTRAN-77 is not available; however, LARS will provide FORTRAN-77 soon after it is released by IBM. Contact your account representative for availability information.

2. PASCAL. Originally designed as a high level programming language by N. Wirth, PASCAL has emerged as an influential and well accepted user language in today's data processing environment. PASCAL provides the user with the ability to produce very reliable code by performing many error detection checks automatically.

   The compiler adheres to the currently proposed ISO standard and includes many important extensions. The language extensions include: separate compilation, dynamic character strings and extended I/O capabilities. The implementation features include: fast compilation, optimization and a symbolic terminal oriented debugger that allows the user to debug a program quickly and efficiently.

3. Assembler. Assembler language provides a symbolic representation of machine instructions, on a one-to-one basis. Macro instructions are available to facilitate I/O operations and communications with CMS. Use of assembler language programming in applications programs is usually saved for optimizing frequently-used routines in production programs, and for tasks that are difficult or impossible in other languages.

4. EXEC. Properly speaking, EXEC is a command language, rather than a programming language. EXEC allows the creation of a file of CP and CMS commands. All the commands in the file are then executed by invoking the EXEC as a CMS command. EXEC contains programming constructs such as variables, assignment statements, loops, branches, go to statements, labels, and limited I/O capabilities. If a task requires a sequence of CP and CMS commands, it can be automated by putting the commands in an EXEC file.

2.3 APPLICATIONS SOFTWARE

2.3.1 Statistical Capabilities

Two large statistical systems, SAS and SPSS, are available on the LARS VM/CMS system.

SAS stands for the Statistical Analysis System, a set of computer programs created in the Statistics Department at North Carolina State University. The programs are now developed and marketed by an independent firm, SAS Institute Inc. in Cary, North Carolina.

SAS provides a wide range of statistical procedures including linear and nonlinear regression, ANOVA, various descriptive statistics, clustering, classification, factor analysis, and a very powerful univariate and multivariate general linear model procedure.

SAS contains powerful and flexible data manipulation and management tools. It can read hierarchical files, variable length records, and multiple record types. It can sort, merge, and concatenate data sets. It reads blocked tapes easily.

SAS also has plot and chart routines for line printers and a set of procedures, called SAS/GRAPH, for high-resolution graphics terminals, pen plotters and graphics matrix printers. SAS/GRAPH routines create two- and three-dimensional bar charts, pie charts, line plots, contour plots, and three-dimensional response surface plots. SAS/GRAPH also draws continent, country, state and county maps and elegant title pages.

In addition to SAS, Statistical Services supports SPSS (Statistical Package for the Social Sciences). SPSS is less versatile than SAS, but it contains easy-to-use nonparametic tests.

SPSS is available on a wide range of computers, but SAS runs only under an IBM operating system, and is therefore not available on any other Purdue University computer.

A basic knowledge of the VM/CMS operating system is needed to use SAS or SPSS at LARS. This material is presented in a series of tape/slide minicourses, which are available at both Flexlab1 and Flexlab2. A unit called 'Introduction to SAS' is part of this series. For further information see Section 3.1.1.

User consulting for SAS and SPSS is available from the Statistical Consultant. See Section 3.4.1 for information about documentation.

2.3.2 Graphics Capabilities

2.3.2.1 GCS

The United States Military Academy Graphics Compatibility System (GCS) is a FORTRAN-based computer graphics system designed for use on a wide variety of computer graphics terminals. Due to its comprehensive and modular design, GCS provides a simplified easy-to-learn and easy-to-use approach to computer graphics, while simultaneously providing a powerful tool which the sophisticated programmer may use for demanding highly interactive applications.

The graphics displays supported by the GCS systems implemented at Purdue /LARS are:

1. Line Printers
2. Alphanumeric Terminals
3. Varian Electrostatic Printer/Plotter
4. Decwriter II Terminals with Graphics Board
5. Tektronix 4054 graphics terminal
6. Printronix Dot Matrix Printer

GCS is a non-supported system of routines at LARS. Software support and programming advice that are supplied will be charged to the appropriate project.

GCS is available in two versions, a two-dimensional version, and a three-dimensional version. The three dimensional version is a sophisticated, highly capable package having such features as graphical data structures, text processing, and of course, three-dimensional graphics. The two-dimensional version is the older, less sophisticated version. While possessing fewer capabilities, it is still supported since it offers the benefits of a smaller memory requirement, and a higher execution speed, while still fulfilling most of the normal graphics requirements. In general, the two-dimensional version is a proper subset of the three-dimension version meaning that all elements of two-dimension GCS are contained within the three-dimensional version.

To access and use GCS type:

```
GETDSK PLTDSK
GCS dev Filename Options.
```

WHERE:

dev = PRT for line printer
TER for Terminals
VAR for Varian Printer/Plotter
DEC for Decwriter terminal
T54 for Tektronix 4054
TRX for Printronix Dot Matrix Printer

Filename = TEXT file containing call to GCS subroutines

Options = 3D and various options as described in the GCS User's Manual.

Contact Jerry Majkowski for further information regarding GCS.

2.3.2.2 IGL

The Tektronix 4010C01 PLOT 10 Interactive Graphics Library (IGL) provides a collection of ANSI standard FORTRAN routines to be used in generating output on a graphics terminal or digital plotter. Programs can be written in FORTRAN, MORTRAN, or any language which allows FORTRAN library routines, such as SAIL on a DECSystem 10 and PL/I on a IBM 370.

The system provides the capability to set and save various graphics and system environmentals including absolute and relative displacement, several clipping and line type options and various physical units specifications. A set of low level graphics and text input and output routines provide the basis for writing interactive programs which can build, save and replay all or part of a graphic display. Numerous host file communication and ultility transformation and conversion routines are also supplied.

Currently the LARS/IGL system includes the TEKTRONIX 4014 family of graphics terminals.

To access and use IGL type:

```
GETDISK PLTDSK
IGL 'Filename'
```

Where 'Filename' is in a TEXT file containing calls to IGL routines.

For further information contact Jerry Majkowski.

2.3.2.3 SAS/GRAPH

The Statistical Analysis System (SAS) offers graphics capabilities on various devices. Refer to the description of SAS in Section 2.3.1 for more information.

2.3.3 Mathematical Libraries

LARS maintains two libraries of FORTRAN mathematical subroutines, IMSL and SSP.

IMSL, the International Mathematical and Statistical Library, is a proprietary product. Its routines may be used by any programmer at LARS, but they should not be copied to another computer system. (Both the Johnson Space Center's EODL computer and Purdue University Computing Center maintain the IMSL library, so programs which use IMSL routines may be transferred between LARS, JSC, and PUCC).

IMSL contains hundreds of subroutines for solution of problems requiring differential equations, quadrature, random number generation, linear equations, interpolation and smoothing, special functions, and linear programming. The routines are thoroughly tested and updated whenever new or improved algorithms become available. They are generally held in high regard by numerical analysts. To access the IMSL routine use the "GETDISK IMSL" command.

SSP, the Scientific Subroutine Package, is a set of subroutines distributed by IBM in 1970 and is available on the system Y-disk. They are not proprietary, and so may be copied and used anywhere. In many cases these routines are less efficient or accurate than the corresponding IMSL routines. They should be used with caution.

2.3.4 LARSYS

Over the years, several software facilities have been implemented to support remote sensing research. LARS has developed LARSYS and LARSYSDV, multispectral data processing systems. LARSYS Version 3.1 is a fully-documented software system which is a widely recognized standard in the remote sensing community. LARSYS is distributed nationally and internationally through the Federal Government's Computer Software Management and Information Center (COSMIC).

LARSYS is a system of programs designed to support the user software requirements for the analysis of data collected by various multispectral scanner systems. A large quantity of Landsat satellite data exists, and there are also aircraft and Skylab data. The system is divided into two parts; standard LARSYS and developmental LARSYS or LARSYSDV. Standard LARSYS consists of 18 processors and some additional routines which have proven to be useful utilities for users (tape copy and dump routines). Routines for the maintenance and test of the LARSYS processors and their hardware interfaces are also included. LARSYSDV came into existence during 1975 and includes new processors and modifications to the standard LARSYS processors. LARSYS programming standards have been, to a great extent, maintained in the LARSYSDV processors, but program abstracts and user documentation may or may not exist. There is in every case, though, a control card description for the processors on the LARSYS disk.

The 18 standard LARSYS processors are:

a. PICTUREPRINT. Histograms and displays image data in picture form on the line printer for each channel.

b. IMAGEDISPLAY. Histograms and displays selected channels of image data on the digital display.

c. CLUSTER. Using reflectance values from all channels, groups the data into classes and displays the results on the line printer.

d. STATISTICS. Calculates statistics on fields of data which the user has divided into classes.

e. SEPARABILITY. Calculates transformed divergence between all class pairs, for every set of channels requested by the user.

f. CLASSIFYPOINTS. Assigns each pixel in a user selected region using the maximum likelihood algorithm. The results are written onto tape or disk.

g. SAMPLECLASSIFY. Assigns each user identified field to a class using first and second order statistics and displays the results on the line printer.

h. PRINTRESULTS. Prints a map and tabulates the number of pixels classified into each class using the classification results located on tape or disk.

i. IDPRINT. Displays the information contained in the LARSYS identification records.

j. DUPLICATERUN. Moves a data run from tape to tape, adjusting entries in the identification record.

k. TRANSFERDATA. Prints the actual data values on the tape for any number of channels.

l. COPYRESULTS. Copies classification results from disk or tape to another tape.

m. LISTRESULTS. Prints selected information located in the header records of the classification results stored on tape.

n. PUNCHSTATISTICS. Punches a copy of the statistics deck located on a classification results tape.

o. LINEGRAPH. Graphs a line of MSS data on the line printer.

p. COLUMNGRAPH. Graphs a column of MSS data on the line printer.

q. HISTOGRAM. Histograms data and may punch a deck of the histogram information.

r. GRAPHHISTOGRAM. On the line printer, displays the histogram produced by PICTUREPRINT, IMAGEDISPLAY or HISTOGRAM processors.

At this time, the LARSYSDV system contains 7 processors developed since LARSYS Version 3.1 and some modified versions of LARSYS processors which will be completely supported. These processors are completely documented in the LARSFRIS documentation. Modified LARSYS Processors are located on the LARSYSDV system disk. The 7 supported LARSYSDV processors are:

a. SECHO Classifier. Groups the data into homogeneous areas, and classifies each homogeneous area using first and second order statistics.

b. MERGESTATISTICS. Combines more than one statistics deck into one deck.

c. RATIO. Using the mean vectors of classes in a statistics deck, calculates and prints the ratio of the values for the specified channels and the sum for each class.

d. COMPARERESULTS. Compares two separate results files, pixel for pixel, and produces an output results file.

e. BIPLOT. Plots in 2-dimensional feature space: means, ellipses of concentration, classifications.

f. CHANNELTRANSFORMATION. Copies MSS data runs and creates new algebraic combinations of existing channels.

g. SMOOTHRESULTS. Processes blocks of classified data and produces a smoothed results file.

To access and use LARSYS and LARSYSDV, users can enter the special environment by typing in CMS or CP:

```
IPL LARSYS
   or
IPL LARSYSDV
```

Software maintenance support is provided and user consulting is available. Contact Kay Hunt for further information.

2.3.5 LARSPEC

LARSPEC is a system of Fortran and assembler computer programs used to access and analyze data obtained by spectrometer or multiband radiometer systems that have been used for laboratory or field research.

The data used for input to LARSPEC include spectral information either in 'continuous' wavelength formats collected by spectrometers in discrete wavelength bands collected by multiband radiometers. The data also include identification information such as crop species that are stored with the spectral information.

Instruments that have been used to collect spectral data for laboratory or field research that are included in the LARSPEC system are:

1. Purdue/LARS Exotech 20C field spectroradiometer system
2. NASA/JSC Field Spectrometer System (FSS)
3. NASA/JSC Field Signature Acquisition System (FSAS)
4. NASA/ERL Exotech 20D field spectroradiometer system
5. Purdue/LARS Exotech 100 Landsat band radiometer field system
6. Purdue/LARS Clevenger spectrometer system

One can refer to NASA/JSC Field Research Project Plans for more information describing the spectrometer or multiband radiometer systems. The LARSPEC data format is general so that the data from most spectrometer or radiometer systems may be included in the LARSPEC data base. LARSPEC has three overall capabilities:

- Printing and punching statistics of wavelength bands (DSEL)
- Printing and punching identification record information (IDLIST)
- Data verification and assessment (GSPEC)

The following paragraphs briefly discuss the capabilities of the three processors.

The DSEL processor can select observations according to user specified ID parameters and calculate averages of data values over user specified wavelength bands. The averaged band means can be printed along with other descriptive statistics which include standard deviation, range variance, and percent deviation. A matrix of interband correlations can also be requested. The band mean information can be punched on computer cards along with, optionally, the agronomic and/or geometric parameters (the same set as IDLIST punches). This deck can be used as input to statistical analysis packages.

A clustering algorithm is also available in the DSEL processor to separate the specified observations into spectral subclasses. The printed output using the cluster option includes a grouping table based on a separability measure called transformed divergence, cluster means and variances, and number of data points per cluster class. A LARSYS-formattted statistics deck can be punched for use with the LARSYS software system.

The GSPEC processor is used for data verification, exploratory analysis of spectral characteristics, and qualitative assessments of relationships between reflectance and wavelength and/or agronomic or soil characteristics.

This processor can select either all observations in a data set or a subset of the data depending on the user specified ID parameters. GSPEC provides graphical output of the data for the observation. The graph or plot may be of the values of one individual spectra or an average of the values of several spectra depending on user specified parameters.

The graph output can be sent to either the line printer, user terminal, DECwriter II terminal with graphics board, Tektronix 4054 graphics terminal, Printronix dot matrix printer or the Varian (an electro-static printer). The plotting options available include polar coordinates, logarithmic scales, curvefitting, and general scaling and plot specifications. The graph values can be printed in tables or punched in binary format on computer cards for use with other computer programs.

The IDLIST processor is used to select certain observations and print the identification (ID) information associated with those observations. The observations are selected according to user specified ID parameters such as all observations with a scene type 'CORN' or all observations collected on a particular date in the crop year. After either the entire data set or a subset of the data is selected, the user is able to specify which of the ID parameters is to be printed. This listing of selected observations is printed on the line printer. An additional feature of IDLIST is the ability to output subsets of the ID information - agronomic and/or geometric - in a card format or disk file that is usable in subsequent data analyses using other software such as SPSS or SAS.

To access and use LARSPEC, users can enter the LARSPEC environment by typing in:

```
IPL LARSPEC
```

At this point users may enter LARSPEC, CMS or CP commands. Refer to the LARSPEC User's Manual for further information about the LARSPEC environment or type REFERENCE with one of the following parameters:

```
REFERENCE  ALL
           COMMANDS
           DSEL
           GSPEC
           IDLIST
           INITIALIZATION
```

for a printout of command and control card documentation.

Software maintainance support is provided and user consulting is available. Contact Jerry Majkowski for further information.

2.3.6 Word Processing - SCRIPT

Word Processing is available on the LARS computer using a text processor, SCRIPT, distributed by the University of Waterloo. SCRIPT is useful for the preparation of large documents such as manuals, theses, and other research, technical, and instructional publications that contain tables, figures, indexes, and table of contents. By using the macro-writing features of SCRIPT, it is possible to automate the preparation and maintenance of documents, and to standardize their layout. This quide was prepared using SCRIPT and the SYSPUB macro file. Word Processing is invoked through the use of the "SCRIPT" command.

2.4 DATA LIBRARIES

2.4.1 Spectral

The LARS computer facility has available the LARS RUNTABLE, an index to LARSYS data set runs stored in the tape library. Over 3,000 data sets are currently available.

A single entry in the RUNTABLE references of the following information: Run number, tape, file, scan lines, channels, samples, flightline ID, date and time the data was collected, aircraft altitude and ground heading (when applicable), and date generated. The run number is an 8 digit identifier uniquely assigned to each data set in the RUNTABLE. The number is made up of the year the data was collected (2 digits), an accession number (4 digits), and a set number (2 digits). For example, all data sets generated from the same Landsat frame would have run numbers unique only in the last two digits.

The RUNTABLE serves two functions. The primary function is that it supplies LARSYS and LARSYSDV processors with the appropriate run information (run number, file, tape), thus eliminating the user's need to create private runtables. The other use relates to the LARSYS function, 'IDPRINT' which acquires all LARSYS header information directly from the RUNTABLE file.

The RUNTABLE may be accessed on the LARS computer facility via the 'GETDISK RUNTABLE' command. Any questions or problems may be directed to Cathy Kozlowski.

2.4.2 Field Data -- Radiometric

LARS maintains a Field Data Base that includes spectroradiometer and multiband radiometer data over crop, soil, and water subjects, along with information which describes the subject, such as species, LAI (leaf area index), and turbidity.

A specrometer/radiometer library tape listing is kept on-line in SCRIPT on the LARSPEC disk. To access this library, one enters the command:

"IPL LARSPEC".

"Help LIBTAPE" obtains a listing of the library tapes for all research projects. "FRTAPE" obtains a listing of the NASA/JSC field research library tapes.

Spectrometer/Radiometer experiment summaries, a brief description of many of the experiments in this data base, may be obtained by contacting Larry L. Biehl (LARS).

The data base currently consists of over 160,000 observations collected by the following:

PURDUE/LARS Exotech 20C Field System
PURDUE/LARS Exotech 20C Laboratory System
PURDUE/LARS Exotech 100 Field System
PURDUE/LARS Clevenger System
NASA/JSC Field Spectrometer System (FSS)
NASA/JSC Field Signature Acquisition System (FSAS)
NASA/JSC Exotech 20D Field System

Additional spectral data is expected to be collected by researchers at the University of Nebraska, Kansas State University, and South Dakota State University.

Any questions or inquiries concerning the spectrometer/radiometer Field Data Base should be directed to Larry L. Biehl (LARS).

2.4.3 Weather

LARS Computer facility also maintains a weather data base. There are two types of data in the data base, NASA archived historic MET Synoptic data, and daily/monthly weather summaries from NOAA/NCC at Ashville. The synoptic data, sorted temporally and by global location, has been taken from 1 to 8 regular intervals during the day, from January of 1974 to August of 1977. The daily/monthly summaries, sorted temporally, has been gathered from September of 1977 to December of 1980.

The identification scheme of the disk directory is based on the separation of stations into 100 unique blocks throughout the world, and unique station numbers for each weather station within each block. Two data accessing systems available for general locational queries are 'ADSEARCH' and 'STATESET', where 'ADSEARCH' generates output in tabular form, and 'STATESET' produces graphical displays of geographical areas. Other data accessing capabilities include routines that gather summaries of generalized information (station elevation, location, state name), and routines that produce directories of available weather data.

The LARS on-line directories and documentation can be accessed via the 'GETDISK DATABASE' command. Documentation has been written in HELP format to facilitate fast and easy usage ('HELP metdata'). In addition, any problems may be directed to Luke Kraemer (LARS).

Future plans include the addition of U.S. co-op weather data sets spanning 1878 to 1980, the inclusion of other data sets when they become available, updating the directories to handle these additions and enhancing the current query capabilities.

2.4.4 RT&E Data Base

LARS maintains the research, test and evaluation (RT&E) Data Base which is associated with Landsat Image Data collected in support of the nation's research program for remote sensing of Agriculture.

The collected Landsat segment data is stored on magnetic tape and has been assigned slots in the LARS tape library. The elements of this data base are referenced by segment (specific geographic location) and acquisition (data spectral measurements acquired) identifiers, with the acquisition list currently consisting of over 62,000 acquisitions.

The seqment catalog is a collection of smaller data bases which form a network of information designed to facilitate large scale experiments in assessments of agricultural applications of remote sensing. Data contained in the segment catalog includes dot label, wall-to-wall ground truth, ground observations and references to the landsat segment data stored on tape.

LARS maintains software which exercises the segment catalog. Subroutine SEGFO gathers data on all acquisitions from a segment, or will collect only user-specified acquisitions. Program FINDALL generates a detailed listing of user selected segments and acquisitions. Subroutine GETACQ is used when the exact acquisition to analyze is known. GETACQ requests the proper landsat data tape, and positions the tape to the correct file. Subroutine GTINFO searches for ground truth data and provides the user with the location of the desired data. LARS also maintains a system of subroutines (SUBSET) which queries certain data items found in the header records of the landsat data files. 'SUBSET' evaluates user-entered logical expressions, and returns a list of all acquisitions in the segment catalog which satisfy the conditions. Subroutine 'STATESET', in conjunction with 'SUBSET', graphically displays the location of the desired acquisition sites.

All user callable data base routines are fully documented internally. User documentation also exists in the form of LARS abstracts. Script files have been entered onto the system. 'GETDISK DATABASE' will access the JSCDISKS needed. The dot manual is also accessed this way.

2.5 OTHER SPECIALIZED SERVICES

2.5.1 Digitizing

Digitizing is the process of obtaining X,Y coordinate points from a plane surface such as a map, a printout or an aerial photograph. Using an electronic table digitzer, one can obtain such X,Y coordinates at up to 1/100 of an inch accuracy. These coordinates can then be used to create, for example, an ancillary border channel on a LARSYS data set or a file of checkpoints.

LARS has a Talos Cybergraph table digitizer interfaced to a PDP 11/34A. On the PDP, only very rudimentary processing is performed on the digitized data. The data is transferred from the PDP to the IBM mainframe for most processing applications. To use the table digitizer it is necessary to have both a PDP ID and an IBM ID.

Data preparation is an important step in the digitizing process. This preparation includes:

1. Selecting the maps or other surfaces to be digitized

2. Selecting the features to be digitized

3. Determining the type of digitization -- checkpoints or arcs.

Taking checkpoints is appropriate if coordinates are needed for only isolated points. Then the only data preparation is identifying those points. Taking arcs is appropriate if outlines or borders are needed. In that case, data preparation should include identifying all arc intersections and determining a numbering scheme for area left, area right and arcs.

Most digitized data requires processing on the IBM mainframe. For checkpoint files, the processing usually involves relating the checkpoints using an affine or biquadratic fit. For arc files, end points need to be edited and the arcs often need to be rasterized. For further information contact Kay Hunt.

2.5.2 COMTAL VISION ONE/20

The Comtal Vision One/20 is a color image display useful for viewing, interacting with and processing digital data. The Comtal at LARS has three 512 x 512 image planes, four 512 x 512 graphic planes, and a trackball for data interaction and coordinate location. The Comtal includes its own command language implementing such features as zooming, roaming and data enhancement of the image. It also has a microprocessor available for limited data manipulation.

The Comtal is interfaced to a PDP 11/34A. To view data on the Comtal, the data must be accessible to the IBM mainframe. Then the data is transferred from the IBM to a PDP disk file and then from the PDP disk file to the Comtal image memory. Note that to use the Comtal it is necessary to have both a PDP ID and an IBM ID. The data on the Comtal screen may be photographed by a 35mm camera. Data that has been processed on the Comtal can be transferred back to a PDP disk file. At the present time data in LARSYS or universal format and classification results can be transferred from the IBM to the Comtal via the PDP. A series of user information notes are in preparation to help the user learn about the Comtal. Contact Jeff Welch for further information.

2.5.3 Reformatting

Data reformatting refers to the preprocessing and post processing of data. Often preprocessing is a simple conversion from an outside data format to LARSYS or LARSPEC format. Preprocessing can also take the form of data enhancement such as a data rotation, rescaling, boundary addition or registration. Data registration can be particularly important for some types of data analysis. If a particular area is to be analysed, registration of a multispectral data set to a set of maps may be important. If multitemporal data is to be analysed, registration of several multispectral data sets to each other is available. Post-processing of data usually refers to converting data to an out-of-house format for processing by an outside vendor. See Appendix D under Reformatting Products for more details or contact Cathy Kozlowski.

Chapter 3

DOCUMENTATION

3.1 TRAINING MANUALS AND TAPE/SLIDE MODULES

In order for new users to become familiar with the LARS computing environment, a 15 module tape/slide introduction to the LARS computer and its operating system has been developed. The units vary in length from 30 to 60 minutes and are intended for individuals or small groups of people who need to use the Purdue/LARS computer before the next major training course is organized. The following tape slide units are available to computer users:

Introduction to VM370
CMS I
Virtual Machine Concepts
CMS II
EDIT I
EXEC I
Programming I
Introduction to SAS
Programming II
EDIT II
EXEC II
CP Commands
CMS III
RT&E Data Bases
IMSL

For use of the modules contact Jim Kast or Kay Hunt.

3.2 SYSTEM NEWS FACILITY

Users of the computer have access to a "bulletin board" or "news" facility to alert them to updates or changes in programs, facilities, schedules, etc. Through this facility, a user may request that all current news be printed at the user terminal or on a printer for review. To obtain the latest news a user need only: 1) login, 2) IPL CMS and 3) type "SRTNEWS". To input news into the system contact Dee Dee Dexter.

News is also disseminated through the logon message. Short notes are displayed at the user's terminal immediately after the user has logged on.

SCANLINES is a third means of distributing information to computer users. It is a LARS news bulletin produced and printed on a monthly basis and containing current items of interest to a wide community of users. Users wishing to receive a regular copy should contact Barbara Francis.

3.3 COMPUTER SYSTEM DOCUMENTATION

A comprehensive collection of IBM manuals describing the operating system and other IBM-supported software is maintained in the user area at the central computer site. An abridged collection should be maintained near each remote terminal. Requests for IBM manuals should be made to the Operations Supervisor.

The following list names the manuals that may be of interest to general users.

a) Virtual Machine/370 (includes all manuals for CP and CMS)

1. Introduction, GC20-1800
2. Terminal User's Guide, GC20-1810
3. CP Command Reference for General Users, SC20-1820
4. System Messages and Codes, SC20-1808
5. CMS User's Guide, SC20-1819
6. CMS Command and Macro Reference, SC20-1818

b) Reference Data (cards and handbooks for easy reference)

1. VM/370 Quick Guide for Users, GX20-1926
2. VM/370 Commands (General Users), GX20-1961
3. System/370 Reference Summary, GX20-1850

c) Program Products and Installed User Programs

1. Directory Maintenance Guide for General Users, SC20-1839
2. RSCS Networking Program Reference and Operations Manual, SH24-5005

d) FORTRAN H Extended

1. FORTRAN IV Language, GC28-6515

2. Programmer's Guide, SC28-6852

3. Compiler and Library Messages, SC28-6865

e) PASCAL/VS

1. Language Reference Manual, SH20-6168

2. Programmer's Guide, SH20-6162

3. Reference Summary, GX20-2365

f) Assembler (Macros unique to CMS are documented in the CMS Command and Macro Reference)

1. OS/VS DOS/VS - VM/370 Assembler Language, GC33-4010

2. OS/VS - VM/370 Assembler Programmer's Guide, GC33-4021

3. IBM System/370 Principles of Operation, GA22-7000

4. OS/VS1 Supervisor Services and Macro Instructions, GC24-5103

5. OS/VS1 Data Management Macro Instructions, GC26-3872

3.4 APPLICATION SOFTWARE DOCUMENTATION

3.4.1 Statistical Services Documentation

A complete set of SAS and SPSS manuals are available. Copies of the most useful books are available in each of the major terminal areas at LARS.

Copies of SAS books may be purchased through LARS or directly from SAS Institute, Cary, North Carolina. Copies of SPSS manuals may be purchased at one of the campus bookstores.

a) SAS books of general interest

1. SAS Introductory Guide (1978)

2. SAS User's Guide, 1979 Edition

3. SAS Applications Guide, 1980 Edition

4. SAS CMS Companion, 1981 Edition

5. SAS/GRAPH User's Guide, 1981 Edition

b) Supplemental and Technical Information

1. SAS 79.5 Changes and Enhancements (February 1981)

2. SAS Supplemental Library User's Guide, 1980 Edition

3. SAS/ETS User's Guide, 1980 Edition

4. SAS Programmer's Guide, 1981 Edition

5. SAS Views: Procedure Writing, 1980 Edition

c) Books on SPSS

1. SPSS Statistical Package for the Social Sciences, second edition, McGraw-Hill, New York, 1975:

2. SPSS Update, McGraw-Hill, New York, 1979.

3. SPSS Statistical Algorithms, SPSS Inc, Chicago, 1979.

3.4.2 Graphics

Reference manuals for GCS and IGL are available in the Flexlab1 and Flexlab2 terminal areas.

a) GCS Manuals

1. Primer on Computer Graphics

2. Programmer's Reference Manual

3. LARS/GCS Usage Notes

b) IGL Manuals

1. IGL User's Manual

For personal copies please contact:

a) Reference manual and primer

National Technical Information Service
CAT #AD-A059 923/3 36A 79-03 9B
Cost codes
PCA18 (paper copy) $29.00
MFA01 (micro film) $ 3.50

b) LARS Usage notes

Contact Jerry Majkowski

c) IGL User Manual

Tektronix, Inc.
6121 E. 30th St.
Indianapolis, IN 46219
317-545-2351

3.4.3 Mathematical Libraries

Reference manuals for the IMSL and SSP libraries are available in the Flexlab1 and Flexlab2 terminal areas. See section 3.1.1 for information on the IMSL tape/slide module.

3.4.4 LARSYS

The formal documentation of the LARSYS Version 3.1 System is divided into three parts: 1) LARSYS User's Manual, 2) LARSYS System Manual, 3) LARSYS Program Abstracts. Formal documentation of the LARSFRIS System (LARSYS Version 3.1 complete with seven additional processors) exists in three manuals also. Copies of these documents may be obtained from Barbara Francis.

Control card listings for all of the LARSYS and LARSYSDV functions may be obtained by: 1) logon, 2) IPL LARSYS or IPL LARSYSDV, 3) type REFERENCE "function name". The control card listing will then be printed on the line printer.

3.4.5 LARSPEC

The LARSPEC User's Manual is available at Flexlab1 and Flexlab2 terminal area. Personal copies may be obtained by contacting Jerry Majkowski.

3.4.6 Word Processing

A complete set of SCRIPT manuals describing the word processing capabilities is maintained in the user area at the central computer site. The following manuals are available:

a) SCRIPT User's Guide - Introductory overview of the function available in SCRIPT and techniques for using that function.

b) SCRIPT Reference Manual - Documents all of the control words, options, System Set Symbols and error messages of SCRIPT. It is organized as a reference manual in alphabetic order by control word. It is not and is not intended to be an introductory manual for the beginner, although such a user will certainly require access to this manual

c) SYSPAPER User's Guide - Describes the macro package, SYSPAPER, and the functions available in it.

d) SYSPUB User's Gude - Describes the macro package SYSPUB and the functions available in it.

Manuals may be requested from Barbara Francis.

3.4.7 Other Application Software Documentation

Ross Aiken has a complete file of LARS computer program abstracts. An index or individual abstracts may be requested from him.

Chapter 4

HOW TO OPERATE COMPUTER TERMINALS

4.1 OPERATING THE TERMINALS

The LARS computer supports a variety of terminals. The following sections describe the most common terminals. If these descriptions do not cover the terminal you intend to use, see your account representative.

This portion of the User's Guide does not describe logon procedures, but does describe keyboard layouts and special functions. If you have not used the LARS computer before, please read about the terminal type before proceding to the logon instructions in Chapter Five.

4.1.1 Operating 3270's

3270 is a generic identification for IBM display station terminals, which include models 3275, 3276, 3277, 3278 and 3279. These terminals support full screen operations and are unique to IBM and IBM-compatible systems. Their keyboards contain several special keys and the screen operation is different from any other type of terminal. Please read the following instructions before attempting to log on through one of these devices.

These instructions describe 3270 operation with CP and CMS. Some programs which run under CMS, such as EDIT, HELP, and DIRMAINT, will assign different screen formats and function key definitions than those described below. HELP and DIRMAINT can be used in full screen mode without additional instructions.

If you are not sure whether you are using a 3270, look to the right of the space bar on the keyboard. If there is a key on the same row that says "ENTER", then the terminal is a 3270. Otherwise, go to the section entitled "Operating ASCII Terminals."

These instructions describe only the 3277 and 3278 models. Where particular features of the 3277 are described, these features also apply to the 3275. Similarly, descriptions of the 3278 apply to the 3276 and 3279.

4.1.1.1 Screen Layout

Before examining screen layout, be sure that the power is on. The power switch is located to either the left or the right of the screen. There are also brightness and contrast controls. On the 3277, these are combined with the power switch. To turn on power, pull the knob out. Brightness and contrast are controlled by turning the separate halves of the switch. On a 3278, power is controlled by a rocker switch to the left of the screen. Brightness and contrast are controlled by separate knobs to the right of the screen.

One of the major differences between 3270's and other terminals is that the output does not scroll off the top of the screen but stays in the same place until the screen is cleared either by a program or by the user. The 3270 screen will indicate when the screen needs to be cleared.

The 3270 screens in use at LARS have 24 lines of 80 characters each. The first 22 lines are used to store commands and the computer's responses to those commands. Lines 23 and 24 are used for an input area and for machine status information (in the lower right-hand corner). The 3270 can also assign attributes to portions of the screen for such things as highlighting and protection. The first 22 lines of the screen normally are protected to prevent writing on them with the keyboard.

The machine status area in the right side of the 24th line displays what the virtual machine is doing. One of the following status indicators will be displayed:

a) CP READ - This indicates that the computer is waiting for input and that the input will be read and interpreted by CP.

b) VM READ - This indicates that the computer is waiting for input and that the input will be read by the virtual machine. This status does not distinguish between CMS and an application program asking for input.

c) MORE... - This indicates that the screen is full and that the computer has more information to display. If the screen is not cleared, the computer will blink the screen 50 seconds after switching to "MORE..." status and will clear the screen automatically ten seconds after that. To keep the current screen contents, switch to "HOLDING" status by hitting the ENTER key.

d) HOLDING - This indicates that the screen is full and that the computer has more information to display. The computer will wait

for the user to clear the screen. Sometimes, clearing the screen during "HOLDING" status will cause the loss of one or two lines of output. To avoid this, switch to "MORE..." status before clearing the screen by hitting the ENTER key.

e) NOT ACCEPTED - This status occurs after an ENTER with a line of input and the computer is too busy to respond. The "NOT ACCEPTED" status will clear automatically in about ten seconds and ENTER may be tried again. NOT ACCEPTED status may also occur when the virtual machine is in "MORE..." status. In this case, the screen will have to be cleared before the entry will be accepted.

f) RUNNING - This indicates that the virtual machine is running normally or that CMS is waiting for a command. Any input typed while in "RUNNING" status will be read by either CP or CMS, depending on the setting of CP TERMINAL MODE command (TERM MODE CP or TERM MODE VM).

In addition to machine status, the 3270 will also display terminal status. This information may be displayed either in an extra line at the bottom of the screen or in blips or lights on the right side of the screen.

a) SYSTEM AVAILABLE - This indicates that the terminal is able to communicate with the computer and will accept anything typed. It will go out briefly after each ENTER but should return quickly. If it does not, this means that the computer (the real computer, not the virtual one) is down.

b) INSERT MODE - This indicates that the terminal is in insert mode and that anything typed will be inserted between the character to the left of the cursor and the character in the cursor position. The portion of the screen being inserted into must contain null characters for INSERT MODE to function. If it does not, the terminal enters the INPUT INHIBITED status. (The input area is normally filled with null characters.) INSERT MODE may be cleared at any time by hitting the RESET key.

c) INPUT INHIBITED - This indicates that the terminal will not accept any typed input. It will normally appear briefly after each ENTER and remain on until the terminal and the computer are both ready to receive more input. INPUT INHIBITED may be cleared by hitting the RESET key (this is most useful when the INPUT INHIBITED was caused by using INSERT MODE without enough null characters or by typing into a protected area).

4.1.1.2 The 3270 Keyboard

Most 3270's have four groups of keys on the keyboard. The main group contains all of the alphanumeric keys and special characters along with the RESET and ENTER keys and a few other special keys. This portion of

the keyboard is similar to a typewriter keyboard. To each side of the main group, there is a small group of special function keys. In addition, on the right side of the keyboard there is a group of Program Function (PF) keys which can be defined by programs or by the CP SET PFnn command.

The alphanumeric keys cause the corresponding character to appear on the screen. The SHIFT and LOCK keys shift or lock the keyboard into upper case.

There are two keys next to the space bar that should be mentioned again here.

1. RESET - To the left of the space bar is the RESET key, which is used to clear either INSERT MODE or INPUT INHIBITED.

2. ENTER - To the right of the space bar is the ENTER key. This key tells the computer to read everything typed since the previous ENTER. The 3270 reads the entire screen, which is important to remember when a full screen processor is being used.

There are eight keys which may be used to position the cursor on the screen. These keys will repeat their function for as long as they are held down. In the group of keys to the left of the PF keys, there are four keys with arrows. These keys move the cursor one position in the direction indicated by the arrow. All four of these keys will "wrap around" the screen. In addition, the left and right movement keys will move the cursor up or down a row as they wrap around.

In the main group of keys there are four more cursor controls. At the top right is a left-movement key identical to the one described above. It acts like a backspace key but does not delete any characters. Just below it is a "home" key which positions the cursor at the beginning of the current portion of the screen (if that portion of the screen is protected, the cursor is moved to the next unprotected position). Below that is a "return" key, which positions the cursor at the beginning of the next line on the screen (unless that position is protected, in which case it will find the next unprotected position). Note that this key does NOT perform the same function as the RETURN key on other types of terminals - it will NOT send any input to the computer.

The last cursor positioning key is on the left side of the main group of keys in the second row. It will move the cursor to the beginning of the next unprotected portion of the screen.

The group of keys on the left side of the keyboard is a single column of keys. These keys have the following functions:

1. CLEAR - This key will clear the screen of all its contents. On 3278 devices, anything in the input area will remain. On 3277's, this area is also cleared. Some of the TELEX 3270 look-alikes require the CLEAR key to be struck twice.

2. ERASE INPUT - This key will erase the entire input area and position the cursor at the beginning of that portion of the screen. DO NOT USE THIS KEY WHILE EDITING!

3. ERASE EOF - This key will erase the remainder of the line containing the cursor starting with the cursor position. All characters and blanks are replaced with null characters. If you are in the input area, the remainder of the input area will be cleared. The cursor does not move.

4. TEST REQ - This key is not defined under VM/370.

The group of keys to the right of the main group contains four additional keys. Because key markings differ with terminal types, these keys are indicated by position as well as marking.

1. DUP / PA1 (top row, left) - PA1 functions as a BREAK key. It will get the attention of CP under all circumstances unless the virtual machine is sleeping (see CP SLEEP command). The DUP function is not defined.

2. FIELD MARK / PA2 (top row, right) - The PA2 key will clear the screen except for the input area. The cursor will be positioned at the beginning of the input area. The FIELD MARK function is not defined.

3. INS MODE (second row, left) - This key puts the 3270 in INSERT MODE. See the above discussion of terminal status, for a description of INSERT MODE.

4. DEL (second row, right) - This key deletes the character in the current cursor position. The portion of the screen containing the cursor is padded at the end with a null character. Only one character is deleted per keystroke.

The PF keys may be defined as a complete or incomplete line of input, to be entered immediately or to be placed in the input area to simplify typing repetitive entries. Various programs will define PF keys for internal functions such as tabbing and scrolling through a file.

There is one additional key which appears only on 3278 devices. This is the ALT key found between the space bar and the ENTER key. It must be held down while striking another key in order to perform any function marked on the FRONT of a key (as opposed to the functions marked on the top of the keys).

The 3278 also has 24 PF keys, instead of the 12 available on the 3277. The extra PF keys are ALT functions on the top row of the keyboard.

4.1.1.3 Usage Notes

1. When logging off (or disconnecting) from a 3270 terminal, hit ENTER, PA2 or CLEAR after the logoff message is displayed. This causes LARS to be displayed in block letters and tells other users that the terminal is available. Similarly, when looking for an available 3270, look for logoff or disconnect messages as well as the block LARS. Also look for incomplete logons since CP will not clear these automatically.

2. When logging onto a 3270 with the LARS block letter display, hit ENTER or PA2 or CLEAR to clear the screen before anything is typed. Otherwise, the computer will ignore the input.

3. The 3270 terminal does not require a prompt before typing input. More commands may be typed and entered before the computer has finished processing the current one.

4. When entering a password for logon, disk links, or for DIRMAINT requests, the 3270 will not echo back the characters typed.

5. As was mentioned earlier, the 3270 will highlight certain fields on its screen. Messages are always highlighted. If CP TERM HILIGHT ON is specified, each line of input is highlighted.

6. CP provides a facility for certain characters to be used for logical functions such as character delete, line delete and so forth. See the section on EXEC's in Chapter Five for a sample EXEC that will automatically set these functions for the type of terminal being used.

7. The 3277's blink the entire screen each time the computer writes on it. Characters typed during the blink will be lost.

4.1.2 Operating ASCII Terminals

These instructions apply to all CRT terminals other than 3270's as well as terminals with printer output. Collectively, these terminals are called ASCII terminals.

4.1.2.1 Special Features of ASCII Terminals

Because of the variety of ASCII terminals available on the LARS system, it is not possible to describe all of the possible features a terminal might have. This description will include those features needed to operate a terminal and some features of CP and CMS which control interaction between the terminal and the computer.

VM/370 does not attempt to utilize some of the special features of newer ASCII terminals such as input editing and programmable keys. Some special features may be supported by programs running in the virtual machine. An example of this is SAS/GRAPH which will perform graphics output on Tektronix and other ASCII terminals with graphics capability. If you have questions about connecting a specific terminal to the LARS system, please contact Gary Brammer.

4.1.2.2 Communications With the Computer

Most ASCII terminals attached to VM/370 function in half-duplex mode. This means that the terminal can be sending information to the computer or receiving information from the computer but never both at the same time. It also means that the terminal cannot suppress passwords while logging on, linking to a disk or using some of the DIRMAINT functions.

Normally, the computer expects a complete line followed by a carriage return before it will respond.

The computer will not accept any input typed before a prompt character (".") is displayed on the terminal. If anything is typed before a prompt has been displayed, operations in the virtual machine will immediately be suspended and the prompt will be issued for input to CP. This can be done intentionally either to stop the virtual machine or to enter a CP command while a program is running. This can also be done accidentally if characters are entered before the prompt is displayed. In either case, the virtual machine can be started again by entering the CP command BEGIN. CP will continue to prompt for input and keep the virtual machine from running until BEGIN is entered (unless the CP SET RUN ON command is used, which permits the virtual machine to continue while CP commands are issued).

This cannot be emphasized enough: if a program is running in the virtual machine and CP command mode is entered, use the BEGIN command to return to the virtual machine. Under normal conditions, YOU DO NOT HAVE TO RE-IPL CMS!

ASCII terminals have a CONTROL key (usually abbreviated CTRL) which, if pressed simultaneously with another key, will perform a special function.

1. CTRL-G. Pressing CONTROL and G will ring the terminal's bell. This is useful when issuing a message from a program.

2. CTRL-H. Pressing CONTROL and H will cause the cursor to backspace. By default, this does not delete the character backspaced over. However, the terminal editing characters can be set to make CTRL-H delete characters. See the section on EXEC's in Chapter Five for a sample EXEC that will set this function for the type of terminal being used.

3. CTRL-I. Pressing CONTROL and I will generate the code for a logical tab. EDIT will expand a logical tab character to blanks when the line is stored. See the section on editing in Chapter Five for more information on using tabs.

4. CTRL-J. Pressing CONTROL and J will generate a LINE FEED function. A LINE FEED character can be used as a logical line end so that multiple lines of input can be entered on one physical line and be visually separated from each other. See the sample EXEC in Chapter Five that will set the function during log on.

5. CTRL-L. Pressing CONTROL and L will generate a FORM FEED character. On many CRT terminals this will clear the screen. On some hard-copy terminals this will cause a page eject.

4.1.2.3 Usage Notes

1. CP provides a facility for certain characters to be used for logical functions such as character delete, line delete, and so forth. See the section on EXEC's in Chapter Five for a sample EXEC that will automatically set these functions for the type of terminal being used.

2. When an ASCII terminal is available, it will display "VM/370 ONLINE", usually at the bottom of the screen. Use the BREAK key to initiate the log on sequence.

3. When the computer asks for a password, a mask will be typed to cover the password. On CRT's, because they operate in half-duplex, the password will replace the mask characters. If you are concerned about password security, type a CTRL-L after the last character of your name (the next part of the logon sequence). CP will translate it to a blank so that it will not remain in the name field.

4. Remember not to type unless the computer has prompted for input. Doing so will cause you to enter CP, and suspend operations in your virtual machine. If this happens, normal operations can be resumed by typing BEGIN.

4.1.3 Operating a Dial-Up Terminal

For the most part, using a dial-up terminal is no different than using a terminal that is permanently attached. LARS currently supports only dial-up ASCII terminals.

LARS has five public dial-up lines, all of which can be reached by calling (317) 463-7551. In addition, there are two in-house lines, at extensions 230 and 300. These are all 300-baud lines. 1200-baud access is available by dialing (317)463-7554 or (317)463-7555. Both Vadic and Bell 212 protocols are supported at 1200-baud.

4.1.3.1 Usage Notes

Each of the portable terminals at LARS contains a specific set of instructions for its dial-up and log-on procedure. When using a portable terminal from LARS be sure to follow the instructions taped to the terminal case. Below is a general procedure for dial-up and logon. Characteristics of terminals vary. If this procedure is unsuccessful for your portable terminal, contact your account representative or the LARS System Engineer.

1. If the terminal is used with several different computers, be sure it is set for 300-baud speed (high-speed on older units), and half-duplex.

2. To log on with a dial-up terminal, first power on the terminal (and the acoustic coupler if it is a separate unit). Then dial one of the numbers for a dial-up line and wait for the computer to respond with the carrier signal (a high-pitched "whistle"). Then place the telephone receiver in the coupler. Enter a carriage return to allow the computer to detect the baud rate of the terminal. If any other character is entered, the phone will have to be hung up and the call replaced. The terminal should type VM/370 ONLINE. If VM/370 ONLINE is not displayed, hang up and try again.

3. To log on to another userid immediately after logoff or disconnect, use the HOLD parameter on the LOGOFF or DISCONN command. CP will maintain communications with the terminal. Do NOT use the HOLD parameter if you are not planning to log back on immediately.

4. Most dial-up terminals have a green light labelled "carrier" that stays on while the terminal is able to talk to the computer. If this light goes out, hang up, call the computer and log on again.

In most cases, the problem was caused by noise on the telephone line. If you lost your carrier signal because the computer went down, you will have to do a complete logon. If the first line typed after the log message is "RECONNECTED", DO NOT RE-IPL CMS! You can get back to normal operations by using the "BEGIN" command.

5. Occasionally, a noisy telephone line will be encountered. The computer interprets noise as input from the terminal and will go into CP mode just as if you had typed something without being prompted. To return to normal operation, use the "BEGIN" command. Noise can also cause garbage characters to be typed on your terminal. This is harmless, although very annoying. If noise becomes a problem, disconnect (using the CP DISCONN command) and dial in again.

4.2 RSCS AND FILE TRANSFER CONTROL

Remote Job Entry (RJE) sites communicate with the Remote Spooling Communications Subsystem (RSCS) Networking. RSCS controls the transfer of printer, reader, and punch files between the RJE site and the host.

4.2.1 Start-up of RJE sites

RJE sites must be signed-on to RSCS before any file transfer can occur. Generally, the procedure requires two steps:

a) The system operator must start the link to the RJE site.

b) The RJE site must issue a sign-on command

The sign-on procedure varies depending on the RJE equipment used to communicate with RSCS. Refer to on-site instructions for specific information concerning sign-on.

4.2.1.1 RSCS Commands

The following is a list of the most useful commands that can be issued to RSCS from the RJE site console. For a complete list of commands refer to the Program Reference and Operations Manual for RSCS (IBM Publication SH24-5005-1).

Upper case letters in a command are the required characters, although all may be entered. Options to commands are listed vertically and an underscore indicates a default option if no option is entered.

BACKSPAC

BACKSPAC causes the current file being transmitted to be restarted or repositioned backward. Restricted to RSCS or remote site operator.

BAckspac File
nnn

File — specifies that the file being transmitted is to be restarted from the beginning.

nnn — specifies the number of data units to be backspaced. For a print file, nnn is the number of printer pages to be reprinted.

Uses:

To reprint some pages that were misprinted, such as when a paper jam occurs. To reprint the entire file, such as when the paper top-of-form alignment was not correct.

CHANGE

CHANGE alters one or more attributes of an inactive spool file. Restricted to RSCS or remote site operator

CHange spoolid CLass c
COpy nnn
HOld/NOhold

Spoolid — the numeric spool file identifier for the file to be changed.

CLass c — designates the new class for the file. c is a one character alphanumeric field from A to Z and 0 to 9.

COpy nnn — alters the number of copies to be made of the file. The value of nnn must be from 1 through 255.

HOld — prevents the processing of the specified file until it is released by a CHANGE command specifying NOHOLD.

NOhold release the specified file if it was in HOLD status.

Uses:

To allow a file with a class different from what is being printed to be printed. For example, a file with Class N (night) could be changed to Class A to be printed during the day. Class A is the class of files that are normally printed unless changed by a START command.

To change the number of copies of a file to be printed.

To prevent a file from being printed by changing it to a HOLD status, or to change a file status to NOHOLD to allow it to be printed.

FLUSH

FLUSH halts processing of a file currently being transmitted on a link. The file is either purged or held and link processing continues with the next file enqueued for transmission on the link. Restricted to RSCS or remote site operator.

Flush spoolid ALL
* HOld

spoolid The numeric spool file identifier for the file to be flushed. This value should be used to assure that the wrong file is not inadvertently flushed.

* specifies that the file currently being transmitted is to be flushed.

ALL specifies that all copies of the file being transmitted are to be deleted. If this option is not specified, only the current copy is deleted and the next copy, if any, is processed.

HOld specifies that the file being transmitted is not to be purged but rather is to be saved and placed in HOLD status. Processing of the file may be restarted after the file has been taken out of HOLD status by a CHANGE command.

Uses:

To discontinue printing of a file and either purge it or save it to be printed at a later time.

ORDER

ORDER causes the file queue for a particular link to be reordered as specified. The effect of the command is to redefine the order in which particular files are to be processed on the link. The specified files are placed at the top of the link queue in the specified order and the file priority is set to the highest priority. Normally, files are transmitted in order of their size with the smallest files transmitted first. Restricted to RSCS or remote site operator.

ORDer spoolid1 spoolid2 .....

Spoolid specifies the affected files, and defines the new order in which they are to be transmitted.

Uses:

To force a specific file to be printed ahead of any other files waiting to be transmitted.

PURGE

PURGE causes specified inactive files to be deleted from the queue before they are selected to be transmitted. Any file may be purged regardless of its status as long as it has not been selected for transmission. Restricted to RSCS or remote site operator.

PURge ALL
spoolid1 spoolid2 .....

ALL specifies that all files enqueued for the link are to be deleted.

spoolid specifies the particular file(s) that are to be deleted from the queue for the link.

Uses:

To delete a file that is to be printed before it starts printing.

QUERY

QUERY displays link, file or RSCS status information.

Query linkid

linkid Active
Queue

File spoolid STAT
RSCS
VM

System	Active Links Routes
linkid	Displays status information of site. Status information includes activity status, type of line driver, line address, classes of files to be transmitted, number of files in queue and number of files waiting to be queued (pending).
linkid Active	Requests information pertaining to the file currently being processed on linkid. Activity information includes spool file ID, user ID, spool file class, number of records left to transmit and total records transmitted.
linkid Queue	Requests a list of brief descriptions of each inactive file enqueued for transmission in the current queue order on linkid. Queue information includes the number of files in the queue, the number of files being sent and received and the number of files pending to be enqueued. In addition, for each file currently in the queue, a response is issued containing the spool file ID, origin location, user ID, spool file class, number of records in the file and the file hold status.
File spoolid STAT	Requests information pertaining to the particular file specified by the numeric spoolid. Status information includes activity status and the linkid on which the file is queued or being transmitted.
File spoolid VM	Requests a description of the VM/370 spool system related attributes of the file specified by spoolid. VM/370 spool related attributes include spool file class, number of copies, HOLD status, filename and type and data set name.
System Active	Requests information pertaining only to active links. Active link information includes link ID, link status, line driver type and line address.
System Links	Requests brief descriptions of each link currently defined in the system. Link information includes link ID, activity status, line drive type and line address.
System Routes	Requests a brief description of entries in the routing table. Routine descriptions show the link ID for each route definition in RSCS routing table.

Uses:

To determine the current status of a link. For example, INACTIVE means the link must be started by the operator. ACTIVE means the link has been started but not signed on. CONNECT means the link has been signed on.

To determine when a particular file will be transmitted or printed.

To determine information about any file spooled to RSCS. For example, if the spoolid is not known, the files enqueued may be queried to determine user ID, etc.

START

START can be issued to cause an active link to begin processing files of a specified set of classes. Restricted to RSCS operator if the link is not already started.

STArt linkid class c

linkid — specifies the identifier of the link to be started. Linkid is not specified by the remote site operator.

CLass c — specifies classes of files which may be processed after execution of the command. c can be either *, meaning all file classes may be processed, or from one to four classes (single characters with no interviewing blanks). If * is specified, no other classes may be specified for a link. Files are processed in the order that the classes are specified and in priority order within each particular class. If * is specified, files are processed in priority sequence only (size).

Uses:

To have a special class of files printed. For example, a class of F could designate photo quality paper. Photo quality paper could be installed and a START CLASS F command issued to print only the class F files. When all class F files have been printed, standard paper could be installed and a START CLASS A command issued to resume printing of normal output.

4.2.2 VM/370 SMSG Command to RSCS

The SMSG command allows general users from any terminal to issue a limited set of RSCS commands. These commands can be used to get link and file information. The format of the SMSG command is:

SMsg RSCS command text

Command text is any of the QUERY commands described previously.

4.2.3 TRANSFER Command

The TRANSFER command redirects inactive files specified by a spoolid to a new destination.

```
TRANSFER      RDR      Spoolid
              PRT      CLass c       FROM    userid
              PCH      ALL
                                     TO      userid      RDR
                                                         PRT
                                                         PCH
```

RDR	specifies that the reader queue is to be searched for the spoolid
PRT	specifies file(s) are to be transferred to.
PCH	Both operands can be omitted, in which case, they default to RDR.
spoolid	specifies a particular file to be transferred.
CLass c	specifies that all files of a particular class belonging to the user be transferred.
ALL	specifies that all files belonging to the user be transferred.
FROM userid	specifies from what user spooling queue the file(s) are to be transferred. If the file was sent to RSCS for processing, the userid would be RSCS.
TO userid	specifies what user spooling queue is to receive the file(s) that are to be transferred.

Uses:

1. A print file has been sent to RSCS to be printed at a remote site. To retrieve it and have it printed on the computer printer.

```
TRANSFER spoolid FROM RSCS
TRANSFER RDR spoolid TO userid PRT
```

2. A print file has been sent to RSCS to be printed at a remote site. To print it at another remote site.

```
TRANSFER spoolid FROM RSCS
TAG FILE spoolid linkid
TRANSFER spoolid TO RSCS
```

3. A file was punched to another user. You found that the file was incorrect and want to retrieve it for correction.

```
TRANSFER RDR spoolid FROM userid
READ *
```

4.2.4 RSCS Messages

Each file that is sent to RSCS causes two responses to be issued to the originating userid. The first response informs the user that the file has been received in the spooling area and gives the site where the file will be sent. The second response informs the user that the file has been sent to (or printed at) the site indicated in the first message.

Other messages from RSCS inform the user of action taken by RSCS in response to commands from the user. A complete list of the RSCS messages can be found in the Program Reference and Operations Manual for RSCS (IBM publication SH24-5005-1).

4.2.5 Communication with RSCS on remote hosts

The SMSG command described in 4.2.2 allows general users from any terminal to issue a limited set of RSCS commands and CPQ commands to RSCS located on a host other than the one to which their terminal is connected. The format of the SMSG command is:

SMsg RSCS CMD host command text host specifies the name of the RSCS link to the remote host computer command text any of the QUERY commands described or any CPQ command.

The command text can be any one of the following CPQ commands:

CPQ INDicate	displays the processor use, processor contention, main storage use and main storage contention.
CPQ LOGMsg	displays the log message of the day.
CPQ NAMES	lists all the users logged on and the terminal device address to which each is connected. If a user is disconnected, DSC is printed instead of the line address.
CPQ TIME	displays the current real clock time, the time zone, the day, the date and the connect and processor time for the RSCS virtual machine.
CPQ USER	displays the number of users logged on and the number of users logically connected to other virtual machines.
CPQ USERS userid	displays the user identification and the terminal device address of the specified user if that user is logged on. If the user is not logged on, a message to this effect is issued.

Terminals connected to LARS can send commands to RSCS at JSC by using EODL as the host parameter. Terminals connected to JSC can send commands to RSCS at LARS by using LARS as the host parameter.

Users can also use the RSCS link to a remote host computer to send messages to users connected to the remote host. The format of the SMSG command to send messages is:

SMsg RSCS MSG host userid text

host	specifies the name of the RSCS link to the remote host computer
userid	specifies the identifier of a user at the host location
text	is an arbitrary string of up to 120 characters comprising the message to be sent.

Terminals connected to LARS can send messages to users connected to JSC by using EODL for the host parameter, and terminals connected to JSC

can send messages to users connected to LARS by using LARS for the host parameter.

Further information of RSCS commands can be obtained from help files listed in the help file RSCS MENU.

Chapter 5

HOW TO USE THE COMPUTER

5.1 CMS

This section will help you learn to use CMS on the LARS computer. If you have not read the sections introducing CMS in chapter two, you should do so before proceeding with this section. Manuals mentioned in the following discussion are listed with order numbers in chapter three.

5.1.1 Logon Procedures

In order to log on the computer, you must first get its attention.

1. If you are on a 3270, use ENTER or PA2 or CLEAR to erase the block letter LARS display. If the screen contains a previous logoff message before the screen is cleared, clear it twice. The computer will respond with CP READ in the lower right corner of the screen. Before you start, be sure that the screen contains either a logoff message, a disconnect message or LARS in block letters. These tell you the terminal is available and ready.

2. If you are on an ASCII terminal, use the BREAK or ATTN key. The computer will respond with an exclamation point, a blank line, and a period (the prompt character). Before you start, be sure that the last line displayed on the screen is VM/370 ONLINE. This tells you that the terminal is available.

Once this is done, you may log on. Use the LOGON command to specify the userid. "LOGON" may be abreviated to "L". DO NOT use the abbreviation LOG. Otherwise another user will be accidentally logged off if the terminal was in use. A LOGON command for the userid VARMINT would read "LOGON VARMINT" or "L VARMINT". Hit RETURN (on an ASCII terminal) or ENTER (on a 3270) to send the LOGON command to the computer.

1. Note: If a typing mistake is made during logon, the character may be deleted by following it with the @ symbol. Multiple @

signs may be used to delete more than one character. You may also use the left bracket to delete an entire line and start over. (Use the cent sign on a 3270.) Other symbols of interest are the # sign for a logical line end (which allows typing two lines of information on one line of input) and the " symbol which is a logical escape for the the @, , , #, and " characters. Later these functions can be assigned to other characters; but for now, they will have to be used as they are.

After the computer has accepted the LOGON command, it will ask for the password of the userid. If you are on an ASCII terminal, the computer will type a mask in the input area. On a 3270, the letters typed will not appear on the screen. When you have typed the complete password, hit RETURN or ENTER to send it to the computer. (These keys will always be used to send information to the computer, unless the PF keys on a 3270 are being used.)

Next, the computer will want to know your name. It will accept up to 16 characters. The first eight will be used for the banner page on printed output. If logging on after disconnecting,the name will not have to typed again.

At this point, login is complete.

1. If reconnecting, the computer will display the log message (notes from the operator about system status), and a reconnect message. You will then be in a CP READ status; return to virtual machine by typing "BEGIN".

2. If logging on for the first time in a session, the computer will display the log message, and a logon message giving the date, time, and the word LOGON. If an automatic IPL statement is in the directory, the computer will also start CMS. Otherwise, type "IPL CMS" to tell the computer to start CMS. When CMS is ready to use, it will display a message containing "CMS", the version and level of CMS, and the date CMS was last updated.

Before executing the first command, CMS looks for a file called PROFILE EXEC. If PROFILE EXEC exists, it is passed to the EXEC processor for execution (after the first hit of the ENTER or RETURN key). A PROFILE EXEC will issue CP and CMS commands to be executed at the start of every terminal session.

When the terminal session is finished, you may log off the computer with the "LOGOFF" command. This may be abbreviated as "LOG". The virtual machine may be disconnected from a terminal by using the "DISCONN" command. This allows reconnecting at a later time without going through a complete logon and IPL. See the section on EXEC's for a BYE EXEC that will take care of the details of disconnecting and reconnecting.

5.1.2 Disk Space for CMS Users

CMS disk space is organized around the concepts of "minidisks" and "files".

A "file" is a collection of information. It may be a FORTRAN program, a list of addresses and telephone numbers, a report, or almost anything else. Files are made up of "records" which are the individual pieces of information: a line of a report or program, or one address and telephone number. When a program reads a file, it usually reads one record at a time.

Files can be created in several ways. They can be written by programs, created by typing information at a terminal and using the CMS Editor. Files can be copied, renamed, erased or modified by CMS commands and programs.

Records in a file may be variable-length or fixed-length. Normally CMS will pick the appropriate format. Within the record, information may be organized in any way desired, depending on the intended use of the file. It is important to know that the organization of data within a file has meaning only in the context for which the file was intended. The requirements for this organization will vary depending on the file's usage.

A "minidisk" is a portion of a disk storage unit and is owned by one account on the system. It may or may not be accessible by other users. Minidisks come in two flavors: they may be read-only (meaning that files can only be read from them), or they may be read/write (meaning files can be written as well as read). With CMS,there is no need to know what or where a minidisk is. You need only know that it is a place to store files and that it has a fixed capacity. If a minidisk needs more space, contact your account representative who will take care of the technical details.

Minidisks are allocated by CP and have "addresses" that look like machine addresses. Most IDs have minidisks at addresses 190, 191 and 19E. CMS accesses minidisks by assigning them a "file mode". Some of these are assigned automatically, including the three above: 190 has a file mode of "S" (the CMS system disk, which is read-only); 191 has a file mode of "A" (the private minidisk, which is read/write); and 19E has a file mode of "Y/S" (an extension of the S disk, which is also read-only). If other minidisks exist, they will have to be assigned a file mode using ACCESS. Any letter except "S" or "Y" may be used.

The CMS file system does many things including automatically allocating space on the minidisks. You, in turn, must know a little about the file system, in order to make it work.

The first thing to learn about files is how to name them. CMS file names have three parts: a "filename", a "filetype", and a "filemode". Filenames and filetypes may be one to eight characters in length and may include letters, numbers, #, @ and $. Filemodes are two characters in

length, consisting of the file mode of the disk and a number between 0 and 5 (inclusive).

Any filename may be assigned, within the above rules. The filetype, however, will have special meaning under some circumstances. In these cases, the filetype simply describes the type of file: FORTRAN for FORTRAN programs, SCRIPT for word processing input files, EXEC for EXEC command files, etc. The CMS User's Guide contains a list of filetypes that may have special meaning to CMS. Other filetypes may be assigned by other programs or processing systems. Note that when a program does not expect a file to have a particular filetype, the filetype does not matter and may be any valid name (special or otherwise).

Filemodes always have special meanings. The letter tells CMS which minidisk the file will be found on and the number tells special characteristics of the file.

1. Filemode 0 - This tells CMS that the file can be read only if the minidisk is accessed in a read/write mode. If the minidisk is read-only, CMS will ignore these files completely.

2. Filemode 1 - This is the default filemode. It does not denote any special characteristics about the file.

3. Filemode 2 - This filemode is like filemode 1 and can be used to differentiate a group of files on the same minidisk from other files.

4. Filemode 3 - This indicates a temporary file. CMS will erase these files after they have been read once.

5. Filemode 4 - This indicates a file that is in a special format which simulates an OS file structure. (OS is another operating system for IBM computers. With some restrictions, OS programs can be run under CMS and use the CMS file system.)

6. Filemode 5 - This filemode is like filemodes 1 and 2.

CMS gives some special treatment to the filemode number. If the number is not specified, it will default to 1. If the wrong mode number is specified for an existing file, the assigned number will be used. CMS files on the same minidisk are not allowed to differ in name by only the filemode number. If no filemode is specified, the default of A1 is used.

CMS organizes minidisks into fixed-length blocks. These may be 800, 1024 (1K), 2048 (2K), or 4096 (4K) bytes in length. Although any block size will work, a particular block size may be chosen for a particular minidisk. Larger block sizes are good for minidisks with a few large files because they take less time to read (but waste space when the end of a file does not fill a block). The 800 byte block size is an older format and is more restrictive in terms of minidisk size, file count and file size. We do not recommend the use of 800 byte format disks. The

FORMAT command can be used to set the blocksize for a minidisk. Beware of the fact the FORMAT will destroy all the files on the minidisk. See the section on Backup Procedures for saving and restoring the contents of a minidisk.

There is a finite amount of space on a minidisk and it is subject to a variety of usages. The "A" disk in particular is used by many CMS commands for working space. Try to keep about 20% of the "A" minidisk available for this purpose. Temporary minidisks can be obtained for the purpose of "scratch" space or temporary file storage. (Many of the language processors and other programs put their work files on the disk with the most free space.)

5.1.3 Basic Commands

5.1.3.1 Commands for New Users

For a new user, the most important CMS command to know is "HELP". The HELP command will tell how to use commands in CP and CMS and will explain system error messages. HELP also has a "menu" feature that describes commands available in CP and CMS. Many help files for commands are broken down into sections, so that you may ask for specific information about the command, such as its purpose (DESC option), its format (FORM option) or the meaning of its operands (PARM option). The system error messages are identified by the operating system identifier (DMK for CP and DMS for CMS) and the message number and severity (i.e., 120S). The HELP command can save much frustration, once you learn to use it. If you just type "HELP" in CMS, HELP will type its own help file.

System error messages have two parts: a message identification that can be used to look up the message in the HELP files or in the System Messages and Codes manual and a text portion that provides a summary of the error. By default, only the text portion is displayed. The full error message can be requested by issuing the command "SET EMSG ON".

The error message identification is ten characters in the format "mmmxxxnnns". The "mmm" portion identifies the system component (DMK for CP messages, DMS for CMS messages, DVH for DIRMAINT messages, DMT for RSCS messages and BAT for batch system messages). The "xxx" portion identifies the module which issued the message. The "nnn" portion is the error message number and is used to look up the error messages in the IBM manuals. The "s" portion tells the severity of the error (I for information, W for warning, E for error, S for severe error, T for fatal error, R for response requests and A for action requests). When HELP is used for error messages, the message number is abbreviated to "mmmnnns".

Another useful tool for learning to use CMS is to save a copy of the terminal sessions. This can be done by issuing the command "CP SPOOL CONSOLE START" (the word CP is optional under CMS). This tells CP to save a copy of all input and output to the terminal, beginning with the next line after the SPOOL command. (CP will not save EDIT and HELP output for a 3270 terminal). CP will automatically print the terminal session log after log off, or when the command "SPOOL CONSOLE STOP CLOSE" is issued. It will print in the LARS computer room unless the REMOTE command is issued to send this output elsewhere.

Although input normally goes to CMS during a terminal session, CP commands can be executed by typing them to CMS. If CMS does not recognize a command as one of its own, it automatically passes the command to CP. A command can be identified as a CP command by using the CMS command "CP" (e.g., "CP INDICATE").

5.1.3.2 Minidisk Management

The cooperation of both CP and CMS is required to obtain access to any minidisk which is not linked to the userid.

To obtain a minidisk which is not linked , use the CP LINK command. The LINK command specifies the userid that owns the minidisk, the minidisk's assigned address, the address where it is to be attached, the attach mode and the password. If the password is not supplied, CP will prompt for it. If the password is "ALL", there is no need to supply a password. If no password exists for the type of link specified, the link to the disk will not be granted.

As an example, suppose you want a minidisk owned by VARMINT and VARMINT puts the minidisk at address "300". You want the disk at your address "250" in read-only mode. The disk has a read password of "READIT". The LINK command would look like:

```
LINK VARMINT 300 250 RR READIT
```

Minidisks links may specify the attach mode in several ways.

1. R - This requests read-only access to the disk, but only if no one else is currently linked to the disk. This requires a read password.

2. RR - This requests read-only access to the disk regardless of any other links to the disk. This requires a read password.

3. W - This requests read/write access to the disk, but only if no one else is currently linked to the disk. This requires a write password.

4. WR - This requests read/write access to the disk if no one else is linked to it, but read-only access otherwise. This requires a write password.

5. MR - This requests write access to the disk regardless of any read-only links already existing. This requires a multi-write password.

6. MW - This requests write access to the disk, regardless of any existing links, and regardless of the consequences. IF ANOTHER USER HAS A READ/WRITE ACCESS TO THE DISK, THIS CAN RESULT IN THE DESTRUCTION OF ALL FILES ON THE MINIDISK. This requires a multi-write password.

Once successfully linked to a minidisk, tell CMS about the disk using the ACCESS command. To ACCESS a disk, you need only specify its address and a filemode letter. For example, to access the disk we just linked as an "E" disk type:

```
ACCESS 250 E
```

Many times, when a file identifier is specified without a file mode, "A" is assumed. To have CMS treat files on the E disk as though they were on the A disk, make the E disk an extension of the A disk. Extension disks are always read-only, even if CP has given a read/write link to the disk. The ACCESS command to do this is:

```
ACCESS 250 E/A
```

The GETDISK command may be used in place of the LINK and ACCESS commands. GETDISK is a utility program written at LARS which will access minidisks. For special processing systems and temporary disk space, there is no need to know the details of the minidisk being requested. An example of using GETDISK for the preceding LINK and ACCESS would be:

```
GETDISK VARMINT 300 250 RR E PASS READIT
```

A minidisk may be released by using the RELEASE command. RELEASE reverses the action of the ACCESS command. It also has a DET option that performs the opposite of the LINK command. (CP has a DETACH command that does the same thing but does not release the disk from CMS.) The following RELEASE command would RELEASE and DETACH VARMINT's 300 minidisk as linked and accessed above:

```
RELEASE E (DET
```

A minidisk may be released without detaching it, but never detach a minidisk without releasing it. If a read/write minidisk is detached without releasing it and another minidisk is linked read/write at the same address, CMS will probably write the file directory for the first disk over the file directory for the second disk. This is another way to destroy the contents of a minidisk.

When CMS searches minidisks for a file without a specified mode, all accessed minidisks will be searched in alphabetical order. The search order can be displayed by using the command "QUERY SEARCH". General

statistics about CMS minidisks (such as the number of files, percent used, block size, etc.) can be obtained using the command "QUERY DISK fm", where "fm" is the file mode of the disk. If the file mode is omitted, CMS will display information about all accessed minidisks.

5.1.3.3 File Management

One of the most common operations in file management is to list the files on a minidisk. Using the CMS LISTFILE command, complete or selective listings for one or all of your minidisks can be obtained. Simply type "LISTFILE" and a list of all the files on the "A" disk is displayed at the terminal. Using the various operands and options of the LISTFILE command, the user can obtain much more, including selective listings, sorted listings, printed listings, CMS EXEC files listing file names and descriptive information about files (such as record format and length, file length, and date and time last written).

A few examples of the LISTFILE command will show some of its power:

1. To obtain a list of all FORTRAN files on the "A" disk:
```
LISTFILE * FORTRAN A
```

2. To obtain a list of all BATCH Assembler files modified today:
```
LISTFILE BAT* ASSEMBLE A (TODAY
```

3. To compile all the FORTRAN programs on the "A" disk:
```
LISTFILE * FORTRAN A (EXEC FNAME
CMS FORTHX
```
The EXEC option creates an EXEC called "CMS EXEC", which allows two substitution parameters before the file name. The FNAME option specifies that only the filename will be listed without the filetype or filemode.

4. To obtain a printed listing, including all descriptive information about all files on the "A" disk:
```
LISTFILE * * A (PRINT LABEL
```

To change the name of a file or to make a copy of a file under a different name, use the RENAME and COPYFILE commands. The following commands will copy and rename a FORTRAN file called "TEST":
```
COPY TEST FORTRAN A NEWTEST  FORTRAN A
RENAME TEST FORTRAN A TEST OLDFORT A
```

The COPYFILE and RENAME commands use * to represent a group of files with the same filename, filetype, or filemode. To indicate that the filename, filetype or filemode is not to be changed an = is used. COPYFILE also allows appending of existing files, portions of files to be selectively copied.

The ERASE command will delete files from minidisks. It will also allow the use of * to indicate a group of files with the same filename,

filetype or filemode. However, if * is used for both the filename and filetype, the filemode will have to be specified by letter and number. For example:

```
ERASE * * A ... will not work ...
ERASE * * A1 ... will work
```

There are also ways to view the contents of a file. The TYPE command will display part or all of a file at the terminal. The PRINT command will send a copy of a file to the printer of your choice. Later we will see how to send printed output to various print sites.

5.1.3.4 The BACKUP Command

The BACKUP command is used to save copies of minidisks at any time. This is the only form of permanent tape storage for files. Users should periodically back up disks and keep track of the tape(s) used.

The full syntax of the BACKUP command is explained in Appendix D. Briefly, it will create a list of the files on the disk and write the list as the first and last disk files dumped. The list is called "CONTENTS MEMO A5". The CONTENTS MEMO can be read from the backup tape to determine what files are stored on each file of the tape.

BACKUP searches a tape for the last file written and insures that the next set of backup files is written beyond that point. User's can, however, specify a file number on the tape where the data is to be written. This will effectively erase any data beyond that point on the tape.

BACKUP uses the CMS TAPE command to copy the minidisk to tape. The TAPE DUMP command (as used in this case) writes all of the files on the disk as one tape file. The TAPE LOAD command allows selective reading from BACKUP-created tapes.

The CMS tape format is a complicated format which is designed for use only under CMS. Part of the complexity supports the concept of device independence among minidisks: files can be dumped from a minidisk on one type of physical device and restored to a different type of device. What is lost in this arrangement is portability - BACKUP tapes can only be read by computers running CMS. To write files to a tape in a format that can be read on other types of systems, use the MOVEFILE command.

5.1.3.5 System Backup Procedures

All physical disks on the LARS computer are copied to tape once a week. These tapes are saved for two weeks, then re-used. The primary purpose of these backups is for protection against disk failures.

These backup tapes are available for restoring minidisks in case of problems such as a file system problem that destroys files on the disk or on accidental erasure of important information. If you need to restore files to a minidisk from the system backup tapes, contact the Operations Supervisor.

5.1.4 Printing and File Transfer Capabilities

The discussion of how to obtain various types of output (printout, punched cards, graphics output, photoqual, etc.) necessarily involves the use of a user's unit record devices. During logon, CP defines one virtual card reader (RDR) at address 00c, one virtual card punch (PUN) at address 00d and one virtual printer (PRT) at address 00d. Any output that might be directed to one of these devices is controlled through the use of various spooling features. Therefore, the final disposition of any output depends upon the spooling characteristics assigned to the PRT,PUN and RDR.

The manipulation of the spooling characteristics of all unit record devices is accomplished through the use of the CP SPOOL command. An extensive help file for the SPOOL command is available by entering " HELP CP SPOOL".

The SPOOL command has a number of options for each unit record device. However, before begining to alter the characteristics of output devices, one does well to know the default characteristics for a virtual machine. Typing the CP command "QUERY UR" will display a status of the unit record devices attached. You will see that PRT and PUN devices are spooled as follow:

```
PUN  00D CL A NOCONT COPY 01 READY
PRT  00E CL A NOCONT COPY 01 READY
     00E FOR "userid" DIST "name"
```

Deciphering this information provides a handy way to explain how to define these devices for particular types of output. Beginning with the printer since as this is the most often used output device, notice the first two fields above (PRT 00E). This is the device name and virtual address of the printer. The next two fields, CL and A designate class. All spool files are grouped by class which the user can define to be any alphanumeric value of A though Z or 0 through 9. Spooling the virtual printer to a certain class directs output to the real printer to be handled in a specific manner.

Normally, virtual printers will be spooled class A since this is how the system printer is normally run. As such, only class A print files will be output. However, there are two other classes the user might

have occasion to use. Output that is produced when the virtual printer is spooled class F will be printed on fotoquality paper with a special dark ribbon. This class of output is generated twice a day at LARS; once between 12:30 and 1:00 and again at 5:00 pm.

To change the class of printed output use the SPOOL command in the following fashion:

SPOOL PRT CLASS F
where f is the class of output desired

Another useful class of printed output is class N. This type of output is designated to be printed at night, usually between 6:00 pm and midnight. The most common usage of this class is for output over 10,000 records in length. This insures that the printer is more or less free for small print files during the day before a large print file is allowed to take over the printer for a long period of time.

The next field of interest is NOCONT/CONT (refer to query of unit record devices above). This spooling option controls the continuous printing of all spool files. Using the NOCONT option means that each output produced by the user will be printed separately with a banner page at the top. Users may choose to have all printer output produced in a continuous file, which is to say that subsequent banner pages between output files is removed and the next printed file begins at the top of a new page. To spool printer in a continuous fashion issue the following spool command:

SPOOL PRT CONT

As a note of caution, remember that no real output will be generated by continuously spooled printers until that printer has been closed. To close the printer issue the " CLOSE PRT " command. At this point all previously generated output files will be printed. Further output will begin spooling to another continuous file (until the printer is closed again).

The NOHOLD characteristic of the printer specifies that all files produced will go directly to the real printer for output. The user can change this option to HOLD status. Under HOLD status, no files will be directed to the output device until changed by the user. To change the NOHOLD status to HOLD issue the following command:

SPOOL PRT HOLD

The final spooling characteristic of concern to the user is the COPY option. If the user wishes to obtain multiple copies of an output, the number of copies can be specified by setting the copy option. This is accomplished by issuing the following spool command:

SPOOL PRT COPY XX
where xx is the number of copies desired

All the various spooling characteristics for the printer described above are also valid for punched output. To make similar changes in the characteristics of the punch insert the proper device name or address.

A final note of caution: All spool commands remain in effect until changed, so be careful to make sure they are correct before the generation of output. Although characteristics of a spooled file can be altered, this can only be done before the file has gone to the real output device. To change the characteristic of a spooled file before it has gone to the real device the user must first obtain the 4 digit spool file id. Once this 4 digit code has been obtained files can be manipulated with the use of the CHANGE, TRANSFER, PURGE and ORDER commands. There are HELP files for these commands. Also, consult the CMS COMMAND AND MACRO REFERENCE.

5.1.4.1 File Transfer Capabilities

CMS and RSCS support file transfer capabilities so that output files can be moved from one userid to another and from one remote site to another. The transfer of output to another userid is an extension of the ability to control the spooling characteristics of unit record devices.

The task of transferring a file to another userid involves spooling your output device to another userid. For example, issuing the spool command " SPOOL PRT TO MRX ", takes all subsequent files produced by your printer and puts them under the control of that user and you cannot alter them further. This holds true for both printer and punch output.

In addition to being able to transfer files to another user, you can send output to a remote site by using the REMOTE command. The REMOTE command combines the tasks of both the spool and tag commands. To direct output to the Flexlab2 printer issue the following command:

```
REMOTE 00E TO FLEXLAB2
```

In addition to being able to specify a remote site name on the remote command the user can also specify COMPUTER as an option. When this option is in effect all output is directed to the system printer located in the computer room at Flexlab2.

5.1.5 Exec Processors and Exec Files

5.1.5.1 Introduction

Anyone who uses CMS with some frequency will issue the same CP and CMS commands in a repetitive sequences to perform a given task. CMS supports a command language processor which allows users to build command sequences to be executed by invoking a single command. A "program" made up of these various CMS and CP commands is called an EXEC file. An EXEC is a set of command procedures, written in the EXEC language, which is tailored to meet the needs of an individual application.

In its simplest form, an EXEC file may contain only a single command which contains no variables and expects no arguments to be passed to it. However, EXEC's can become very complex. EXEC files are easily created through the use of the editor. When building an EXEC, the user must give the file a filetype of EXEC. This is how the EXEC processor differentiates this file from other files which may have the same filename. The user should be aware that when creating files with the editor, records are by default variable format with a logical record length of 80 characters. It is possible to create a fixed length EXEC file. However, the EXEC processor will only scan the first 72 characters of each record.

To run an EXEC once it has been created, enter the file name of the EXEC. To begin the processing of an EXEC from within another EXEC, preface the call to the EXEC with the CMS command EXEC.

5.1.6 Inter-User Communications

Users on the LARS system have two major ways to transmit message text from one virtual machine to another. The method most often used is the 'message' command. The message command transmits a single line of message text to a specified userid if the userid is currently logged on the system. The format of the message command is:

MSG userid msgtext

where:

userid is the identification of the user who is to receive the message

* specifies that you are sending a message to yourself

msgtext is the text of the message that is to be transmitted. The length of the message is limited by the number of characters remaining on an input line after entering the command and appropriate userid.

If the userid designated to receive the message is not logged on or has suppressed the receiving of messages, the message is not transmitted and the sender is notified. A user may suppress the reception of messages by issuing SET MSG OFF. This may be a useful practice for those outputting a SCRIPT file to a Diablo terminal because incoming messages will appear in the text of the file.

An incoming message is displayed at the terminal when the terminal is ready to receive output. Therefore, if the user at a terminal is entering data the message is not displayed until the end-of-line (carriage return or enter) is received.

A message which is not received by a user is not saved. For those wishing to communicate with a user not yet logged on to the system, the MAIL facility is available. MAIL is the second major method for inter-user communication supported at LARS.

MAIL is an EXEC used to send message-type files to other system users, provide notificaion that MAIL is being held for a user and provide delivery of these files upon request.

Mail may be checked or received by typing "mail" whenever the "A" disk is accessed R/W. Users can save mail as it is received. Mail not claimed after one month will be destroyed. You may check for mail automatically by inserting "EXEC Mail" in your profile exec.

The format of the mail command is:

Mail	Userid	Fileid
	Listname	
	Synonym	
	*	

Note: LARSYS, LARSYSDV and LARSPEC users should type "EXEC Mail" to use the mail system.

where:

Userid The virtual machine id that you want to send mail.

Listname The name of a mailing list containing one or more virtual machine IDs that are to receive the same piece of mail.

Synonym A synonym for a virtual machine id that you want to send mail.

*	Indicates that you wish to send mail to this id.
Fileid	The file name, file mode and (optionally) file type of file containing the mail to be sent. It must be a fixed format 80-byte record file. If this parameter is omitted, the CMS editor is called to create a mail file.

MAIL is an self-explanatory interactive EXEC so that one of the easiet ways to use mail is to type in "mail userid". You will be prompted for further input.

MAIL also permits synonyms for userid's and distribution lists that allow sending mail to more than one other user at a time. A sample distribution list is shown below.

```
(1)             Smith JSC9999
(2)      List   Route1
(3)             John convert9
(4)             Reform99
(5)     Endlist
(6)             Al LCI9999
(7)     List Route2
(8)             Mike FM9999
(9)             George Test Id9
(10)    List Route3
(11)            JSC999A
(12)            JSC999B
(13)            Purdue Rosebowl
```

Line (1) is an example of a synonym: "mail Smith" would allow you to edit a new file which would be sent to JSC9999. Synonym entries may be placed at any point in the file. Lines (2), (7) and (10) start distribution lists. Each list is terminated by either "endlist", "list", or end of file. Lists may include either synonym entries or the id name. To send mail to a list, use the list name, i.e., "mail route1" (for the list in line (2)). Distribution lists are free format. If one is created, MAIL will expect it to be called "mailing list a1".

5.1.7 LARS Extensions to VM/370

In an effort to enhance the interactive research environment provided by VM370 the Computer Products personnel have made a number of modifications to VM/370. What follows is a list and brief description of the extensions which we feel are of most use to LARS users. In some cases these enhancements are extensions of facilities already provided. In other cases, they are new and separate additions to VM/370.

EXEC Language Modifications

Several features were added to the language in order to improve performance and add capabilities to the EXEC processor. Three new commands, &PRINT, &BEGPRINT and &LINK were added. &PRINT and &BEGPRINT function in the same manner as &PUNCH and &BEGPUNCH. These commands cause a line to be printed on the spooled virtual printer. The first character of each line printed is interpreted as a carrige control character.

&LINK is used to transfer control to a label or line number in the same fashion as &GOTO. The difference is that &LINK sets the value of a special variable (called &RETADDR) to the number of the line which follows the &LINK statement.

In addition to adding the above special commands, three major processing options were modified. First, statements which are not recognized by CMS (while processing an EXEC) are automatically passed to CP. Therefore, the explict use of the CP command in EXEC files is no longer necessary. The second processing feature changed was to make the occurrance of a duplicate label raise an error condition which will terminate the EXEC procedure.

The third and final processing change was the addition of the &INCORE statement. The &INCORE statement is used to specify the method by which an EXEC will be processed. The ON option (the default if the EXEC is less then 100 lines) causes the entire EXEC file to be read into free storage. If the OFF option is specified, the EXEC is read from disk one item at a time as needed during execution.

Several built-in functions were added to the EXEC language as an aid to programmers. These functions include the following:

a) &CONT - Returns the contents in hexadecimal from the specified hexadecimal memory location.

b) &CCONT - Returns the contents of a specified memory location as an eight byte character string.

c) &HTD - Converts a hexadecimal value to decimal

d) &DTH - Converts a decimal value to hexadecimal

e) &HTE - Converts a hexadecimal value to character(EBCDIC)

f) &DATE - Returns current date as MM/DD/YY

g) &TOD - Returns current time as HH:MM:SS

h) &STAT - Returns the number of records which are available on an accessed disk

i) &STOR - Returns the size of the virtual machine in thousands of bytes (NNNK)

The above functions may be used on the right hand side of an arithmetic assignment statement. &DATE, &TOD and &STOR require no arguments; all others listed above will require one argument. &STAT may be used with no argument. In this case the A-disk is queried. &STAT will return a value of -1 if the specified disk is not accessed.

The final enhancement of the EXEC language was to add three new arithmetic operators.

* Multiplication

/ Division

Modulus

Arithmetic assignment statements are still processed left to right with no operator precedence rules in effect.

Multiple IPL Names

The CMS saved system which is IPL'ed (initial program load) by general users is pointed to by a "name table" in control program. Initialization of an IPL'ed system varies according to the name which is supplied by the user in the IPL command. In addition to CMS, the following systems can be IPL'ed from the LARS system:

REFORM
LARSYS
LARSPEC
LARSYSDV
BATCH

See the help file for IPL for a detailed description of the IPL command.

Tape Drive Definition

Normally VM/370 allows the user to define four dedicated tape drives for a job. System Services has added the capability of defining up to five tape drives (tap1 through tap5) per job. See the "help file" on TAPMOUNT for detailed information on how to attach these drives to a virtual system.

Set STMP on/off

The SET STMP command allows the user to request that all prompts or messages written to a virtual console are proceeded by a time stamp. This was done to allow time identification on spooled console output. The format of the command is:

SET STMP ON - to begin time stamp

SET STMP OFF - to stop time stamp

Batch Processing for CMS

The BATCH command allows users to run jobs in a non-interactive environment. Consult section 5.3 of this users guide for a detailed description of BATCH. Batch Users Guides are also available at all sites.

EMSG and IMSG Save/Restore Options

A save and restore option has been added to the SET EMSG and SET IMSG command. The save option stores the current value of the EMSG or IMSG setting. Any previous saved setting is destroyed. The restore option resets the EMSG or IMSG setting to its previously saved value. If a restore is requested when there is no prior saved value, the restore option is flagged as invalid and the setting remains unchanged.

Enhanced Transfer Command

This version is compatible with the original IBM command but has two new operational operands. These operands allow a user to specify which queue (PRT or PUN or RDR) is to be searched for the specified file(s) and into which queue (PRT or PUN or RDR) these files are to be transferred . Both operands can be omitted, in which case they default to RDR making the command identical to the original IBM command.
Only the following combinations are valid:

* 'RDR' type files may be transferred to an RDR queue

* 'PRT' and 'CON' type files may be transferred to an RDR or PRT queue

* 'PUN' type files may be transferred to an RDR or PUN queue

The format of the enhanced TRANSFER command is as follows:

			FROM	userid
				ALL
	RDR	Spoolid		
Transfer	PRT	CLASS x		
	PCH	ALL		
				RDR
			TO (userid)	PRT
				PCH

Example 1: A printer file (1749) from id SP2 was sent to RSCS to be printed at FLEXLAB2. The file is to be retrieved and printed instead on the computer printer.

TRANSFER 1749 FROM RSCS
TRANSFER RDR 1749 TO SP2 PRT

The file will now be printed at the computer site. (In this and the following examples, SP2 is an example ID, use your own ID when using the transfer).

Example 2: After a file has been SPOOLed back into your own card reader, it is still possible to print that file.

```
QUERY READER  (to find spoolid of PRT
                type file)
TRANSFER RDR 1738 TO SP2 PRT
```

The file will now be printed at the computer site.

Example 3: Same as above, but the file is to be printed on the FLEXLAB1 Printronix printer:

```
QUERY READER (to find spoolid of the
              PRT type file)
TAG FILE 1743 FLEXLAB1
TRANSFER RDR 1743 TO RSCS
```

Example 4: You have created a printer file that is set to be printed in the computer room. You want to retrieve it and send it to be printed at FLEXLAB2.

```
QUERY PRINTER  (to find spoolid of PRT
                file)
TRANSFER PRT 1827 TO SP2 RDR
TAG FILE 1827 FLEXLAB2
TRANSFER RDR 1827 TO RSCS
```

NOTE: While files routed to RSCS may be retrieved and printed in the computer room, they cannot be transferred to another remote site with this command.

Listfile Options Enhancements

The options on the listfile command have been enhanced such that the presentation of all these options is clearly beyond this section of the LARS Users Manual. However, the user should know that these changes expand the selection of files to be listed (e.g. by creation date), the disposition of the listfile report (e.g. as a memo file) and manner in which the files listed can be sorted. A user is advised to consult the "help file" available as it is the most comprehensive summary of this commands abilities.

5.1.8 Additional CP/CMS Commands

In addition to changes and enhancements made to VM/370, LARS staff provides a set of useful commands which we consider additional CP/CMS commands. What follows is a brief description of these commands. For further information consult the associated "help files".

BACKUP

The BACKUP command is used to "backup" (which is to say copy) CMS disk files onto tape in TAPE DUMP format. In addition to backing up all the files on a specified disk, BACKUP prints a contents memo of each file put on tape. The format of the command is:

backup tapeno mode1,...,moden (options

Where: tapeno is the tape number to write backup files.
mode1,...,moden are the modes of the disk(s) to be backed up.
options allow sorting and listing the files backed up.

BATCH

The BATCH command provides the user with a complete interface with the batch system run at LARS. Through this command, the user is able to submit, change, cancel, hold and release jobs in the batch system. In addition, the BATCH command allows the user to query the batch monitor about a particular job or all jobs on the batch system. The help file on BATCH should be consulted as there are numerous capabilities with this command.

CONTENTS

The CONTENTS command is used to create a file called "Contents Memo A1" on the A-Disk. This file contains a sorted list of all files on an accessed disk. The contents memo also contains statistics information for the disk. The contents command requires one argument (mode) and its format is as follows:

CONTENTS MODE or *

If no mode is given a listing is given, for the A-Disk. Using the * generates a listing for all accessed disks. The user can specify any accessed disks as a valid mode argument.

GETDISK

The GETDISK command allows users to link and access minidisks which are not normally attached to a virtual machine. A primary feature of

GETDISK is that it knows the address of the major processing systems and data bases supported by LARS. Through this vehicle the user can attach and access LARSYS, LARSYSDV, LARSPEC, SPSS, SAS, RTE, REFORM, RUNTABLE, etc. In addition to accessing major processing disks, GETDISK is used to attach temporary disk space. The general format of the command is:

```
GETDISK    (ANYID)  ADDR   VADDR  MODE  A  PASS (Password)
             or
           TEMP
```

WHERE:

ANYID	is any id on the system
ADDR	is the real address of the disk to link and access
VADDR	is the virtual addresss you wish to attach the disk as
MODE	is the mode you wish to access the disk by
A	is whether you want read or write access to the disk
PASS	is the keyword for password
(PASSWORD)	is the proper read or write password for that disk

There is an extensive help file available for the GETDISK command. Please consult this for the options available.

MAIL

The MAIL command is used to send short message files to other system users even if the user is not on the system at the time mail is sent. Therefore, MAIL also provides automatic notification that mail is being held or sent. The mail system provides interactive self-explanatory instructions for the user.

To check to see if any mail is being held for your virtual machine type: "MAIL". If you wish to send mail to another user, type Mail - followed by the userid to which you wish to send mail. If a user is currently logged on, MAIL will send the user a message when mail is being held. Mail also contains a facility for sending mail to more than one userid at a time. This option for creating a mailing list is described in detail in the mail helpfile.

Note: Users may check for mail "automatically" by inserting "EXEC MAIL" in their PROFILE EXEC. Then each time that id is logged on, a check for mail will be made.

QREAL

The QREAL command allows a user to obtain real device information about a virtual device asssignment in a form useful for programs or EXECS. The format of the command is:

```
QREAL     VADDR     (STACK
```

WHERE: VADDR is any virtual address in the range of 000 - 5FF
STACK, the stack option, is only checked if the real device is a minidisk. In this case the label of the minidisk and the number of usable cylinders are stacked at the console.

The real device information obtained is passed back as the return code which can be interpreted as follows:

```
    0 - Virtual address is not defined
    1 - Error detected by QREAL
 XXXX - (0002-9990) device type for a minidisk
 9994 - Disconnected console or graphics device
 9995 - Virtual dial device
 9996 - Virtual timing device
 9998 - Spooled device spooled to a userid
 9999 - Spooled device spooled for a userid
1XXXX - Real device address to which a virtual device
        is assigned + 10,000
```

SEND/RECEIVE

The SEND and RECEIVE commands are used to transfer CMS disk files from a userid to another userid on another system on the network (e.g. from LARS to EODL). There are two ways to obtain detailed explanation of these commands. The first is to issue HELP SEND. The second is to type "SEND", or "RECEIVE"

The format of the send command is:

```
SEND     userid     listfile - options
```

Where: userid is the userid at the other site to receive the files being sent (note: if you are at LARS, files will be sent to EODL, and vice versa)

listfile-options is any set of parameters for the listfile command compatible with "EXEC PRE2 SOFF 0 FMODE".

If no listfile options are given, the currently accessed 'A-disk' will be transfered. If the user is unfamiliar with the listfile command, type 'HELP LISTFILE' for an explanation of the possible parameters for use in the SEND command.

Note: Currently SEND and RECEIVE work only for LARS to EODL and EODL to LARS transfers. Upon completion of either of these commands, the virtual machine's card reader or spooled punch may be changed.

The format of the RECEIVE command is:

```
RECEIVE     Spool-file-number     Minidisk - Address
```

Where: Spool-file-number is the number of files in the users virtual card reader.
Minidisk - address is the address of the minidisk in which the user would like to place the files to be received.

TAPMOUNT

TAPMOUNT coordinates all aspects of requesting a tape for CMS users. TAPMOUNT requests a tape drive (if one is not already attached at the proper address), tells the operator what tape to mount, insures that the right type of drive is attached and check write ring status. If tape is already mounted on an attached drive at the given address, it is unloaded. Unless the NOWAIT option is used, the tape will be ready for use upon termination of the TAPMOUNT program.

The format of the tapmount command is:

TAPMOUNT TAPE tapn ringflag (unittype) (nowait)

tape — the number or name of the tape to be mounted.

tapn — the tape drive that the tape is to be mounted on. Valid drives are TAP1 through TAP5 and correspond to virtual addresses 181 through 185.

ringflag — either "RI" if the tape requires a write ring (enabling output to tape) or "RO" otherwise.

UNITTYPE — type of tape drive required.
ANY - Any type tape drives is acceptable.
9TRK - Only nine track drives are acceptable (default).
7TRK - drive must be a seven track drive.
800 - drive must have 800 BPI density capability.
1600 - drive must have 1600 bpi density capability.
6250 - drive must have 6250 bpi density capability.

Nowait — causes TAPMOUNT to terminate after the tape is requested. WAIT, the default, causes TAPMOUNT to wait for the tape drive to be attached (if necessary) and checks for proper ring in/out status before returning control to the user.

WHERE

The WHERE command permits simple and flexible control of print and punch file destinations. In its simplest form (no parameters), the user's output is routed to the location of whatever terminal the user is logged on to. It also permits selective routing of either printed or punched output, examination of output site selection by exec files or

programs, and routing to sites other than the one where the user is logged on.

Routing is not job specific; it remains in effect until (1) the user logs off, or (2) it is changed by CMS "Where" or CP "Spool", "Tag", or "Remote" commands.

The format of the where command is:

WHERE	Stackres			
	Term	Termno	CUU1	CUU2
	Place	Loc	CUU1	CUU2
	?			

Stackres - is a keyword indicating that the resulting print and punch sites are to be placed in the console stack, lifo.

Term - is a keywork indicating that the user's print and punch sites are to be those located at the same place as the specified terminal.

Termno - is the real address of a terminal at the site where printer and punch output are to be routed.

Place - is a keyword which indicates the user is naming a remote site where printed and punched output are to be sent.

Loc - is the name of the remote site selected for the place option.

CUU - is the virtual device address whose output is to be routed by the WHERE command. Normally, "00d" is the user's virtual punch, and "00E" is the user's virtual printer. If the TERM option is specified, CUU's are optional; printer and punch will both be set if CUU's are omitted.

? - indicates that WHERE is to stack the current settings for remote printing and punching into the console stack, lifo.

5.1.9 Running Batch Jobs

LARS supports a batch system facility designed to allow users to submit jobs that need not be run interactively. As such, the batch system is useful when the user has several tasks to run at once or wishes to process jobs at a basic service rate. There are three basic components of the batch system:

* A batch command which provides users with a complete interface to the system.

* A batch monitor which receives and schedules all jobs sent to the batch system.

* A batch server machine which is designed to closely resemble a CMS terminal session and execute the job as submitted.

Although there is extensive interactive help in running batch through the use of the batch command, the user is well advised to consult the "Batch User's Guide". The Batch User's Guide is a detailed manual that provides much aid in the use of the batch system at LARS.

The Batch Command

In order to successfully run jobs in the batch environment, the user must be familiar with the primary interface to the system. The BATCH command provides a complete interface with the batch system. It enables a user to submit jobs and assists in their preparation. Jobs can be changed after they have been submitted or canceled before or during execution. Jobs can be put on hold and released. The monitor can be queried for information about a particular job, all jobs for a user or about the system in general.

The format of the BATCH command is:

BATCH	SUBMIT	fileid1	fileid2	
	CHANGE	jobid		
	HOLD			
	RELEASE	jobid		
	CANCEL	ALL		
		JOB	jobid	
	QUERY	USER	userid	*
		SYSTEM		

It is necessary that a user select one of the functions shown above. However, if is not specified, BATCH will prompt for a function before proceeding further.

The BATCH command normally proceeds by asking questions about what the user intends to do. If in doubt enter a question mark "?" or the work "HELP" in response to any request. The batch command will request the information needed and wait for a response.

The functions of the Batch Command are:

Submit	This initiates job preparation and/or submission. If no further operands are included, BATCH assumes assistance is needed in preparing a job. Otherwise, the fileid's specified are submitted as one batch job. The first file must contain all of the job cards for the job; the rest are included as instream files within the job. If fileids are specified, batch will not prompt for input at any stage of its operation.
CHange	Change permits users to change parameters that were entered on the job cards of a job which has already been submitted but has not yet begun execution. Becuase of the complexity of change syntax, changes must be done in a prompting mode.
Hold	Hold permits user to place jobs on "hold" so that the monitor will not schedule them for execution until released.
Release	Release permits termination of hold status from jobs, so that the monitor will schedule them for execution. Change will not remove a hold status assigned by the system operator.
Cancel	Cancel allows cancellation of one job, before or during execution.
Query	Query provides information about jobs already in the system. If you specify a jobid in the command line, it must be one of your own jobs. Otherwise, you can obtain limited information about jobs owned by other system users, or about current batch system activities.
fileid	Fileid is the name of a CMS disk file. It must be of the form "filename filetype filemode".
jobid	Jobid is a job identifier. All jobs in the batch system have an identifier assigned by the monitor. Users will be told this number when submitting jobs. Additionally a user identifier may be specified during job submission or with the change function. If a jobid is specified, batch will not prompt for responses (except for the change function).
ALL	ALL specifies that all of a user's jobs in the system will be affected by a HOLD, RELEASE, or CANCEL.

JOB — JOB indicates a query of the history of activity for a specified job. This history does not include any job parameters; use the change function to see job characteristics.

USER — USER indicates a query of current status for all jobs owned by a specified user.

userid — userid names an account known to CP. You may query for general information about jobs owned by other users. You may type an asterisk ("*") to obtain the same information about your own jobs.

SYSTEM — SYSTEM indicates a query for general information about the batch system's activities. This will include queue lengths, scheduling criterion and other information.

The design of the batch command allows powerful user control with only general knowledge of its function. Any specific information, from the major functions down to the detailed format of job cards, is available through the batch command's HELP facilities as mentioned above. If a description is needed when batch asks for information, a reply of "HELP" or "?" is always acceptable.

Interactive Batch Job Submission

Interactive job submission has two purposes: preparing jobs for submission and submitting them. The first function may be performed without continuing on to the second. A prepared job may be submitted non-interactively on a later occasion.

Users are not required to learn the format of any of the job cards. The batch command will format them using information entered or approved by the user.

A complete description is provided in the BATCH USER GUIDE. Batch will ask series of questions that help it prepare job cards. As a general rule, if the question requires a "yes" or "no" answer, respond as follows:

you may ask for help,
supply the requested information,
enter a blank or enter null line to tell batch you want to go to the next section of the submission process

During submission the user will be prompted for the following information:

* The distribution code to be used on the banner page of printed output. This will default to the user name for the virtual machine.

* Whether or not the monitor is to provide diagnostics generated when it checks the job cards. The response must be "yes" or "no". This listing is not strictly necessary since the same check is performed before batch will send the job to the monitor. If the diagnostic listing is requested, a prompt will be issued for the print locations.

* Whether or not a user identifier is to be specified for this job. This identifier can be used to trace the job through the batch system. This identifier can also be used to make other jobs wait for this job to complete by a technique called job chaining. If no user identifier is to be assigned hit return or enter.

Note: The monitor will assign a separate identifier to every job. However this identifier can not be used for chaining.

* What parameters are to be used on "/set" cards. Until some familiarity is gained with these parameters, respond with "help", which will display a list of the parameters and their defaults. For other than the defaults, enter the parameter and a value.

* The files to be sent with the batch job. These must be either card image or variable record length with a maximum length not greater than 80. These files will be copied to the server machine's A disk at the point in the job where they appear. If many files or large files are needed in the job, it is better to link to the disk where they reside if possible.

At this point, the job cards have been prepared and all that remains is to add the needed CMS and CP commands plus any responses programs may expect from the terminal. To do this, BATCH uses the CMS editor. These commands should be added to the bottom of the file. Do not add the end-of-job card; BATCH will do that.

Notes: If the job card check is successful. Is the job to be sent to the monitor? If the reply is "yes", BATCH will send the job. You will be told the job identifier assigned by the monitor. If the reply is "no", job submittal is skipped.

If the job card check finds minor errors, you have the choice of editing the job or going ahead with the job submission.

If the job card check finds serious errors, you have the choice of editing the job or giving up. If errors are not corrected, the job may not be submitted.

Any errors found by the job card checking routine will be displayed at the terminal. If no such messages are displayed, there were no errors.

At any point the job submission process can be stopped by typing "quit" in response to any question. Whether you "quit" or not, you will be asked if a copy of the job is to be saved for later use.

If the reply is "yes", you will be asked for the filename and filetype of the saved job file. BATCH will insure that the job is successfully saved before it terminates.

Non-Interactive Job Submission

Once a batch job has been prepared and saved, it may submitted again and again by giving the fileid on the BATCH command line. Second and subsequent fileid's are included as instream files. For instance, you might have a batch job called "batfort compile" that would compile all FORTRAN files on the server machine's "A" disk and return the results to your virtual reader. You could then send a FORTRAN file to be compiled in the batch system by entering:

```
BATCH SUBMIT batfort compile a sample fortran a
```

See Appendix B of the Batch Users Guide for sample batch jobs and terminal sessions using the BATCH command. One of the examples will show how to create the batfort compile job and save it for repeated use.

Placing a Job on Hold

If a submitted job has not yet begun execution, it may be kept from starting by putting that job on "HOLD". This will cause the monitor to ignore the job during scheduling as long as it remains in HOLD status. To put a job on hold, use the BATCH HOLD facility. For example:

```
BATCH HOLD Clasify1
```

The monitor will search for a job with a identifier of "clasify1" and put it on hold, if it has not already started execution. Either the user or system identifier may be used. All jobs for an ID can be put on hold by specifying "ALL" in place of a job identifier.

A user hold can not be released by anyone except the original user or another person using your account.

Releasing a job from HOLD

A job which has been put on user hold may be released. For example:

```
BATCH RELEASE Clasify1
```

This releases the job which was put on hold in the previous example. The time spent in hold status is not considered by the monitor's scheduling system. Again, all jobs for an ID may be released by specifying "ALL" in place of a job identifier.

Note: RELEASE will not release a job that has been put on "system HOLD". Only the system operator can RELEASE A SYSTEM HOLD.

Cancelling a job

A job may be cancelled at any time between its entry into the batch system and the time it completes execution. If a job is cancelled that has started execution, you will be charged for the portion of the job that actually ran.

To cancel a job, use the BATCH CANCEL For example:

```
BATCH CANCEL clasify1
```

The monitor will search for a job with a identifier of "clasify1" and cancel it. It will search for an active job with that name before it searches its job queue. Either the user or system identifier may be used. All jobs for an ID may be cancelled by specifying "All" in place of a job identifier.

Changing Job Parameters After Job Submission

By using the change function, you may change almost any of the information on your job cards. Users may do this at any time until the monitor's scheduling system selects your job for execution. When requesting the change function, the monitor will put a temporary "hold" on your job, which lasts until you complete your changes, or for a maximum of ten minutes.

After the batch command receives a copy of your job parameters from the monitor, it will show you this information along with a list of keywords. The keywords specify the job parameters you are allowed to change.

After the parameters are displayed, users may type a list of the keywords whose values are to be changed. If there are only two possible values for the parameter, batch will change the value without asking you for more information. Otherwise, you will be asked separately for each new value. Once all the keywords are processed, batch will again display all the parameters. Users may type more keywords; or, if you have made all the changes you want, you may enter a blank line to send your changes to the monitor.

The Query Function

The query function allows you to ask the monitor for information about your jobs, someone else's jobs, or about the monitor's current activity.

If the user has selected to use the job parameter, you can obtain a detailed history of all events pertaining to one of your jobs. These events are recorded in the job status field of the information the monitor returns. Each change in status is accompanied by the date and time the change occurred. If the job has begun execution, you will also be told the name of the server machine it is running in, and the print and punch sites for the job.

If you use the user parameter, you can obtain the current status of all jobs owned by a specified user. You can obtain information about users other than yourself. The information contained in the reply is similar to that returned by the job parameter.

If you use the system parameter, the monitor will tell you about its own activity. This will include the date and time the batch system will shut down, the number of jobs active or in queue, as well as the settings of various operator controls. These controls are explained below.

* The basic control will be either on or off. If basic is on, jobs requesting basic rate charges will be allowed to run. (priority rate jobs will be able to run, too.) Basic is set on automatically at midnight, and off at 8:00 a.m. The system operator may set basic on or off at other times.

* The loadlevel control affects the batch scheduler. If it is set off, the monitor will relax some of its scheduling restrictions. These restrictions limit the size and number of batch jobs as a function of interactive user response times. With loadlevel off, the batch system will attempt to push batch jobs through without regard for the overall system load. Loadlevel is normally set on, so that the monitor attempts to optimize interactive response time at the expense of batch throughput.

* The quiesce control can restrict the batch monitor from running any jobs. If quiesce is set on, the monitor will accept new jobs, monitor any jobs already running, and perform all its usual services except for starting new jobs. Quiesce is usually set off.

* The fairshare control restricts the number of active jobs that are owned by any one user. For example, if fairshare is set at "2" and you submit five jobs, the monitor will never let more than two of your jobs be active at any time, regardless of any other factors. This control helps prevent one user from dominating the batch system resources.

Preparation of punched card jobs

The batch system will accept jobs submitted on punched cards. However, the card file must enter the computer system either from a CP-owned card reader or from a remote site through RSCS. Sending a job to the batch system by spooling the virtual punch to BATCHDV will not work.

The file for a punched card differs slightly from that used in interactive submission. The most important difference is a password card must be included that specifies the logon password of the account to which the job will be charged. A /error card should be included so that the monitor will generate a diagnostic listing during job card checking and print it at a selected site. This diagnostic listing will include the job identifier assigned to the job by the batch monitor if the job card check completes successfully.

The job must be preceeded by an ID card, so that CP or RSCS will know where to send it. The correct format for this card is 'ID' starting in column 1 and 'BATCHDV' starting in column 10. BATCHDV is the userid of the batch monitor.

5.1.10 Programming Languages

LARS currently supports three computer languages on the VM/CMS system: Fortan IV H (extended), Pascal/VS and VM/370 Assembler.

FORTRAN

The FORTRAN IV language is useful for writing applications that involve mathematical computations and other manipulations of numerical data. Programs constructed in FORTRAN at LARS are compiled with the Fortran IV H (EXTENDED) compiler. This compiler provides extensive error checking when translating programs into text and provides detailed diagnostic error messages. Those using the Fortran H (EXTENDED) compiler should consult the following publications:

IBM System/360 and System/370 Fortran IV Language
IBM OS Fortran IV (H EXTENDED) compiler Programmers Guide
IBM OS Fortran IV (H EXTENDED) Compiler and Library (MOD II) Messages.

PASCAL

The PASCAL language at LARS is a high level language originally designed to teach computer programming. The PASCAL/VS compiler provides many PASCAL language extensions. Those language extensions include: separate compilation, dynamic character strings and extended I/O capabilities. In addition, PASCAL/VS includes an interactive symbolic terminal oriented debugger that allows the user to debug programs interactively. Users of Pascal should consult:

PASCAL/VS Language Reference Manual SH20-6163-1

370/Assembler

The assembler language is a symbolic programming language that lies closest to machine language in form and content. Users will find the assembler language useful when:

a) They need to control a program closely, down to the byte or bit level.

b) They must write subroutines for functions that are not provided for in other languages.

Users of assembler should consult the following publications:

OS/VS - DOS/VSE - VM/370 Assembler Language
OS/VS - VM/370 Assembler Programmer's Guide
IBM System/370 Principals of Operation

5.1.11 Digitizing Capability

Through the use of a digitizing table, data, such as can be obtained from maps, can be put into a digital form that can be processed by programs. The processing provides methods to manipulate the digitized data into forms that can be combined with other data to aid the researcher. The processing methods provide:

a) AUTOMATIC CLOSURE — digitized data consisting of arcs will automatically have the arc end points changed to create closed polygons.

b) EDITING — the digitized data can be displayed on a Tektronix 4000 series graphics terminal. The digitized data points can be changed to correct any mistakes.

c) CONVERSION — using check points identified on the digitized map, the arcsearcher can convert the X, Y coordinates of each digitized point into latitude, longitude or row, column coordinates.

d) PROJECTION — if the data has been converted into latitude, longitude, it can be projected into a defined map projection, such as Albers Equal area.

e) RASTERIZATION — the digitized data can be converted from an X, Y or row, column type of coordinate system to a raster format that is compatible with LARSYS processing.

The digitizing hardware is currently located at LARS and requires LARS staff to perform the digitization or to train the researcher in use of the equipment. The software used to manipulate the digitized data is in a development /testing stage and requires training and assistance from LARS staff for its use.

5.1.12 LARS Tape Utilities

LARS maintains four tape handling routines which perform various utility functions. The first routine (TAPEINIT) performs a tape initialize function. This routine executes an exhaustive read and write test on a tape and thus, erases the contents of the tape. Another routine available (CHKTAPE) reads in a tape and prints out a summary of the format of the tape. This routine also detects tape errors such as parity and also reports their occurrance on the listing. This routine does not disturb the contents of the tape. The next routine (TAPEDUMP) provides a wide range of functions which enables selective printing of the contents of a tape. Print formats available include hexadecimal, Alphanumeric, binary, floating point, etc. Contents of the tape are not disturbed. The final routine is TAPCOPY which performs a byte for byte copy from an input tape to an output tape. To request one of these tape functions, contact the Manager of Operations at LARS.

Appendix A

LARS SERVICES AND RATES

Purdue University/LARS
System Services Products and Rates
July 1, 1981 - June 30, 1982

DEPT. REF.	ITEM	UNIT	RATE UNIT	PROFIT RATE
COMPUTER PRODUCTS				
02000	Computer Service	1 hour	$160.00	$224.00
02005	Priority Service	1 hour	160.00	224.00
02010	Disk Storage Space	1 meg mo	3.50	4.90
02015	7-Track Tape Drive	1 hour	50.00	70.00
02065	Professional Assistant Staff	1 hour	26.60	***
02075	Service Staff	1 hour	15.85	***
02085	Student Staff	1 hour	10.25	***
REFORMATTING PRODUCTS				
02101	Reformatting Software Prod.	1 min.	30.00	42.00
02165	Professional Assistant Staff	1 hour	26.60	***
02185	Student Staff	1 hour	10.25	***
SUPPORT PRODUCTS				
02200	Design Service	1 hour	23.00	***
02205	Scan Lines Subscriptions	1 year	7.50	***
02215	Printed Material	1 page	.08	***
02220	Slides	1 slide	2.50	***
02225	Transparencies	1 trans.	.85	***
02265	Professional Assistant Staff	1 hour	26.60	***
02270	Technical Assistant Staff	1 hour	20.35	***
02275	Service Staff	1 hour	15.85	***
02280	Clerical Staff	1 hour	14.85	***

APPLICATIONS SOFTWARE PRODUCTS

02400	Statistical Service	1 hour	150.00	210.00
02405	LARSYS	1 hour	375.00	525.00
02410	LARSPEC	1 min.	10.00	14.00
02465	Professional Assistant Staff	1 hour	26.60	***
02485	Student Staff	1 hour	10.25	***

LOCAL TERMINAL PRODUCTS

02500	Local Terminal	1 hour	8.00	11.20
02505	Computer Tapes	1 tape	17.50	24.50
02510	Varian Plotter Output	1 foot	.75	1.05
02515	Table Digitizer	1 hour	20.00	28.00
02560	Professional Staff	1 hour	53.55	***
02565	Professional Assistant Staff	1 hour	26.60	***
02585	Student Staff	1 hour	10.25	***

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Appendix B

REQUEST FOR SERVICES FORM

Revised 05/81

REQUEST FOR SERVICES
LARS SYSTEM SERVICES
UNIVERSITY ACCOUNTS

Department _____ Applicant _____

☐ New Account ☐ Changes in Existing Account

Funding _____ Additional Funding _____

Start Date _____ Decrease in Funding _____

Termination Date _____ New Termination Date _____

Project Name and Description: _____

Manager A: _____

Manager B: _____

System Services Representative (to be completed by LARS) _____

Project Leader/Principal Investigator Approval: I understand that on the termination date above or when my account runs to a near zero balance, my account will be closed unless I modify the request.

Date: _____ Signature: _____

University Account _____ Dept.Ref. (if any) _____

Head of Department or School Approval: I certify that funds are available in the above account and authorize the LARS System Services to begin work immediately and bill the account. In the event funds are not available in the account indicated, other funds will be made available to pay for the work completed.

Signature: _____

Instructions: Form is available from LARS System Services Account Clerk, applicant fills in blanks above with aid from facility personnel, approval is obtained from project leader/principal investigators and department head, form is submitted to Account Clerk, a facility account number is assigned, account is approved by Deputy Director of LARS, and copies of forms are sent to all persons listed above and the Operations Supervisor.

LARS Master Account Number: _____

Approved by Deputy Director of LARS: _____

Appendix C

REQUEST FOR COMPUTER ID FORM

Revised 05/81

REQUEST FOR LARS COMPUTER ID

(1) Date of Request _____

(2) Requested by _____
(Principal Investigator/Manager)

(3) Name of Master Account or project to be charged

_____

(4) Total dollar amount to be allowed (optional)

_____

(5) Expiration date for this ID (optional)

_____

(6) ID Requested (8 characters or less)

_____

(7) Password Requested (8 characters or less)
(Used at logon time)

_____

(OPERATIONS USE ONLY)

Account No. _____

USERID _____

Password _____

Approved _____ Init _____

Installed _____ Init _____

Referenced _____ Init _____

Deleted _____ Init _____

Modifications:	Date	Init
_____	____	_____
_____	____	_____
_____	____	_____
_____	____	_____
_____	____	_____

(8) Special Facilities

A. Disk Size (meg/bytes) _____

B. Read Password (optional) _____

C. Write Password (optional) _____

D. Multiple Write Password (optional) _____

E. Special Disk Links (optional) _____

F. Core Size (960K default) _____

(9) Description of work to be done (optional) _____

_____

(10) Person(s) who will be using this ID _____

_____

(11) PDP ID[ ] (default 6,7)

A. ID _____ PASSWORD _____

B. COMTAL ____ TEK ____ TABLE DIG ____ VAR ____

C. Disks Requests Larger than 5m
Contact Operations

(OPERATIONS USE ONLY)

UIC _____ INSTALL _____

ID _____ DELETE _____

PASS _____

APP _____

(12) Tapes to be written on using this ID: (optional)

Tape No.	Owner's Name	Tape Usage
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Appendix D

PRODUCTS AND SERVICES

D.1 COMPUTER PRODUCTS

D.1.1 Computer Service

Computer Service is the basic product of the LARS System Services Facility. Computer Service provides a variety of services in support of research and applications of remote sensing as well as general computing.

System Support Services

System support includes two major types of activities; the first of which are required to provide the human interface between the computer system (hardware and software) and its users. This includes:

a. Processing request for, assigning and maintaining computer usage accounts (including ID's) for users to access the system.

b. Maintaining the existing accounting system and assisting in its use to provide the essential types of accounting data to project leaders, and providing information required to bill projects for their usage of the system.

c. Creating, maintaining and distributing such user documentation as is necessary for users to make effective use of the system. This presently includes:

   1. General documentation (LARS Computer User's Guide)
   2. IBM product documentation

d. Maintaining and presenting to users and staff an introductory course on CP and CMS once a semester.

e. Providing consultation to users relating to problems or questions encountered in the use of any of the supported system components.

The control programs and other systems programs used on the LARS computer are provided by the computer manufacturer. In most cases, they are also supported by the manufacturer (i.e. fixes are provided for encountered problems). This support assumes that the LARS Computer

Products staff isolates and reports the problem and incorporates and tests the fix after it has been received. In addition, LARS has found it necessary to make and support a minimum number of local enhancements to the manufacturer-provided programs in order to support the Laboratory's operational needs, and to support development and use of applications programs such as LARSYS.

The various operating systems components that are supported include:

I. VM/370 Release 6 + BSEPP 2.0

a. CP. This is the control program for the computer itself. It is one of the components of VM/370. It must be modified whenever any changes to the system hardware are made, including adding or modifying terminals.

b. CMS. This is the operating system used for most user virtual machines. Components of CMS that are supported include:

1. FORTRAN language compilation and execution;
2. Assembler language compilation and execution; and
3. Program and data management facilities, such as the editor and source update routines.

Note that other languages, such as COBOL or PL/I are not supported.

II. RSCS Networking Release 2.0. This is the Remote Spooling Communication System. RSCS provides access to the computer system from remote job entry systems and other computers connected to the network.

III. The LARS batch machine facility. This includes a single batch controller virtual machine and several separate virtual machines to process batch jobs. This system is LARS produced and provided.

IV. Other. A very low level of support and expertise will be provided relative to the OS/VS1 operating system.

Support of all the system components listed implies (at this level) generating the control programs and keeping them current (IBM will not support back releases), isolating and identifying serious system bugs and getting IBM to fix them (in case of IBM supported programs), and making minor corrections and enhancements that are necessary from time to time. It also includes assisting the Operations staff in diagnosing and isolating causes for system malfunctions that may be either hardware or software problems.

Availability of Computer Service

User access to the computer is available through two modes of operation. The basic and least expensive mode is the batch mode. The other is the terminal or interactive mode discussed in the section on Priority Service. Computer jobs submitted to the batch system either through a local input device or through a terminal can be expected to have a turnaround time of 24 hours.

The system is in operation from 6am Monday through 5pm Saturday except for 2 hours of scheduled maintainance from 7 to 9 am Friday. The system is not operational during Purdue holidays. Also, if a holiday falls on Friday then the system will not be operational on the following Saturday. The objective of the facility is that there should not be more than an average of 3 unscheduled shutdowns experienced by the user in a week and that the system should be recovered within an average of one hour of a failure.

Computer service is available to anyone who has obtained a System Services master account and had established computer ID's by filling out a request form available through the LARS Computational Facility operations group. Questions relating to the establishment of ID's, availability of ID's, availability of the Computational Facility Users Guide and general availability of service can be directed to the Operations Group. Specific or general questions about the computer hardware and software systems used can be directed to the Computer Products staff.

How is Computer Service Measured?

Computer Service is measured in units of CPU hours or fractions thereof. This is the time which the computer central processor devotes to the execution of programs for the user. The CPU time will normally be less than the wall-clock time.

D.1.2 Priority Service

Users accessing the computer through priority service will receive all the services of computer service plus additional services and improved response. The user can obtain priority service, in addition to computer service, either by accessing the computer system in the interactive mode of operation, or by submitting a batch job requesting priority service.

Special Hardware and Personnel

Priority service has been established as a computer product to provide interactive operation and reduce job turnaround time by supplying special capabilities. Priority service requires additional computer operations personnel to maintain special remote terminal support software, and additional pieces of computer hardware to handle priority jobs.

A primary piece of software which is supported by the Computer Products personnel is the Emulator Program for the Comten 3670 Communications Controller. This program is required for operation of all terminals, local and remote. It must be regenerated each time any change is made to the number or type of terminals.

The 3670 communications controller is used to allow user terminals to access the system in interactive mode. The additional three 3420 tape drives allow faster response to user jobs requiring tape drives.

Special Services

Users of the LARS computer system who submit jobs to be run in batch mode can expect their jobs to be run and the output available within 24 hours from the time the job was submitted. Several users have requested that some types of batch jobs be treated like interactive jobs to obtain quick turnaround. Most usage of the system is by interactive terminal users who prefer nearly immediate turnaround. In response to these needs, batch priority service has been established. This service allows jobs to be selectively run when batch jobs would not normally be run.

To meet these demands, personnel time has been assigned to provide the systems programming support and extra computer operations support. The personnel assigned to this task will facilitate the priority service by providing the following services:

a. Interactive mode of operation which provides fast response to commands and inquiries.

b. Rapid turnaround for batch jobs which request priority service.

c. Faster response to requests for service either for jobs running in batch mode or interactive mode.

d. User requests (such as tape mounts and devices attachment) should be acknowledged within two minutes. Card input or printer output at the central site should be available within five minutes of production. Card output should be available within 8 hours.

e. Availability of tape units such that a user can obtain one tape unit within ten minutes of a request, two tape units within one hour and more than two tapes units within 15 hours.

Availability

Priority service is requested by specifying priority rate on a batch job or by using the computer system in the interactive mode of operation. Priority service is available any time the computer is in operation. The hours of operation can be found in the description of computer service.

Measure of Service

Priority service is measured in units of CPU hours or fractions thereof and is charged in addition to the units of computer service. The number of units will match the units of computer service for which priority service is requested.

D.1.3 Disk Storage Service

Disk storage service provides facilities for the on-line storage of data, programs, or procedures for an extended period of time. It provides ease of entering, modifying or recalling data through the use of the facilities of VM/370.

Description

After a computational services master account has been established, a user may request one or more computer ID's. Associated with these ID's may be private disk space defined for the virtual machine that may be used to store programs, procedures, and data from one terminal session to the next. The project manager who is responsible for ID's for a project may contact the Operations group if additional disk storage space is desired.

The user of an ID can directly contact the Operations group to have a read or write password assigned to a disk. A disk password is necessary if a CMS user needs to obtain access to the disk while logged on under another ID.

Availability

After a System Services master account is established for a LARS project, one or more computer ID's are set up by request to the Operations group. An ID request form is available from the Operations group, which has space provided for requesting disk storage space. Storage space may be requested for each ID or may be requested or deleted at a later date.

Measure of Service

The basic unit of disk storage space is the megabyte-month which is defined as the usage of one million bytes (characters) of disk storage space for one calendar month.

D.2 LOCAL TERMINAL PRODUCTS

D.2.1 Local Terminal

Local Terminal service provides the terminal facilities enabling FLEXLAB1 and FLEXLAB2 users access to the LARS computers. This access includes interactive editing, job submission, and graphics. Local Terminal also investigates new terminal capabilities and attempts to improve existing access methods.

Description of Service

Local Terminal provides access to the LARS computers through a variety of devices. The primary terminal is the INFOTON GTX which is an uppercase ASCII CRT. This terminal is planned to be completely phased out of usage in three years and will be replaced by upper/lowercase, semi-intellegent ASCII devices. Full screen 3277 display terminals are also being made available for word processing, systems support, and general usage. These terminals enable advanced editing capabilities and assist in systems maintenance. LARS also owns three DECwriter LA36 terminals. These terminals are hard copy and one also has line-drawing capabilities.

Local Terminal also maintains a Tektronix 4054 graphics terminal with a hard-copy unit. This device can be used as a high resolution, line-drawing device, an interactive terminal, or a stand-alone processor. In addition, this terminal is accessable from both the IBM and the PDP. Local Terminal also provides four portable terminals on a signout basis. These terminals can be used to access the IBM computer from either in-house lines or off-site phone numbers.

Availability of Service

Availability of this service is the same as the hours of operation of the computer. It will normally be available 5 days per week, 24 hours a day and 26 hours on the weekend, except for two hours of scheduled computer maintenance and unscheduled shutdowns.

Any user with an active IBM computer ID will be able to log into the IBM system using this equipment and gain access to the computer system. Any user with an active PDP ID/UIC will be able to log into the PDP 11/34A minicomputer system using the PDP terminals and gain access to this system. This service accompanies any local usage of computer service during the time logged into the system.

Measure of Service

Local terminal service is measured in terms of hours of connect time. The number of units is the number of wall clock hours during which a terminal is connected to the user's ID.

D.2.2 Computer Tapes

The Computational Facility purchases large quantities of digital magnetic tapes and, as a service, resells the tapes to users of the Facility. The tapes may be used as a storage media for data to be entered into the LARS remote sensing data base or for any other appropriate activity where a large volume of permanent storage media is required.

Description of Service

The LARS Computational Facility currently manages about 8000 reels of magnetic tape. Many of these reels comprise a data base of remote sensing multispectral image data. In addition, individual users may have tapes assigned to them for use in storing their own data or results.

Digital magnetic tapes may be requested through the computer operations staff who will turn them over directly to the user or provide temporary storage for them in the computer room. The user may also request digital tapes through the Computer Operations Supervisor or a full time computer operator. If they are to be kept in the computer room tape storage area, the computer operations staff will assign tape numbers to them and place them in correspondingly numbered slots in the tape racks. The computer center staff will ensure that each assigned reel bears a "tape identification label" containing the following information:

a. Tape number
b. General use for which tape is intended
c. Name of person responsible for tape
d. List of ID's authorized to write on tape

Although each tape is assigned to a specific person (the 'owner') who is responsible for its contents, the computer operators and operations supervisor are responsible for the physical handling of the reels. Tapes to be removed from the computer room must be authorized in advance by the owner of the tape or the computer operations supervisor. Any tape may be read and requested by any user, however, only ID's authorized by the tape 'owner' and listed on the "tape identification label" will be able to request that a tape be mounted so that it can be written on.

Availability of Service

The primary means of obtaining digital tapes is by requesting one or more tapes when filling out a request for computer ID form. This form goes to the Computer Operations Supervisor. When the form is returned to the user, it will show the tape numbers that have been assigned to the digital tapes. A project manager filling out an ID request may request tapes in this fashion.

Requests for quantities of 40 tapes and larger should be requested 60 days in advance because of the delivery time.

Measure of Service

A fixed price is charged per reel of digital tape purchased. The charge is made directly to the user's System Services master account.

D.2.3 Table Digitizer

The table digitizer is a special device for producing digital data coordinates from a photograph, topographic map or chart to a resolution of up to 1000 units per inch. The device outputs the digital data onto standard PDP 11/34 disk files. This allows pictorial map, vector or data defined by lines to be translated into a form usable as digital computer input.

Background

The table digitizer has multiple purposes at LARS in support of data analysis activities. One of its primary functions is to produce digital data as ground control checkpoints from topographical maps, or other pictorial input. Other uses include the generation of field description cards to assist LARSYS analysis by rapidly producing ground truth information.

Usage of the Digitizer

The majority of LARS usage of the device has been indirect resulting from a user request for a custom reformatting job which necessitates the usage of the digitizer. Conversion of line data to cartesian coordinate numerical data is its prime task. The digitizer is a valuable tool for providing input describing the locations of field boundaries, rivers, roads and other boundary characteristics from maps. In general, the digitizer has application for any project which has a need for digital data to be produced from a precise pictorial image. The data from the digitizer can be translated into a LARSYS Classification tape for display as an image channel.

Hardware and Operation

The device is owned by LARS. The rate is derived from recharging a portion of the estimated software and hardware, maintenance of the table digitizer and host PDP 11/34A. The use of the device requires a small amount of instruction training from one of the Reformatting Staff.

Availability

Direct usage of the table digitizer may be requested through the Manager of Local Terminals. Availability is subject to the hours which the Flex II Computer Facility is open, as well as the digitizer sign-up schedule.

Measure of Service

The rate is fixed as a charge for each hour of table digitizer usage. The charge will be accompanied by a separate charge for the time of a trained operator unless the user has his own operator. Users may become trained operators via training available through the Manager of Local Terminals.

D.2.4 Printer-Plotter Output

Varian plotter output is the hardcopy output produced by the LARS Varian Model STATOS 4211 electro-static printer-plotter. Varian hardcopy output consists of special eleven inch wide roll paper which is electro-statically printed or plotted via a wet ink process. The output is strictly black and white or matrix gray level. Both printing and plotting modes are available on either report grade or semi-transparent paper.

Background

The Varian STATOS 4211 electrostatic printer-plotter is a peripheral device to the MULTILITER remote terminal. The 4211 has a direct memory access hardware interface to the host PDP 11/34 operating system, RSX-11M, V3.2, applications software can make use of the 4211 in either printing or plotting mode.

Description

For applications running on the IBM main frame computer under LARSYSDV, plot files for grayscale outputs of image data may be generated by using the *GDATA or *GRESULTS for LARSYS image data and classification data formatted files respectively. Matrix patterns may be 4x5, 5x5, 5x7, or 20x25 dot configurations. LARSYS software permits from two to sixty gray levels or patterns. Special user designed gray level or geometric patterns also may be accepted by *GDATA or *GRESULTS for appropriate dot configurations.

Output products with proper aspect ratios may be approximated by using the appropriate patterns. The 4x5 pattern is ideally suited to any data requiring equal aspect ratio. The 5x7 is best for non-corrected Landsat data.

Line or vector plot files may be generated by having applications software call the appropriate subroutines from VARIAN DATA PLOT III software found in PLTLIB TXTLIB normally found on the CMS system disk; or by accessing GCS library of routines. Refer to GCS documentation for creation of vector plotting files.

After the file has been produced on the IBM mainframe, it is transferred via the RJE software to the RK05 scratch disk for such files on the PDP 11/34. Files are restricted to around two megabytes of data or nominally one thousand by one thousand pixels of Landsat data in one channel utilizing 5x7 patterns. The 11/34 processor PLOT is then utilized to cause the 4211 to output black and white eleven inch wide roll paper hardcopy.

Availability

Plots generally will be exclusively handled by Local Terminal personnel. Files may be created at any time. Plots will be turned around to the user on a maximum forty-eight hour basis with operations normally occurring daily excepting weekends.

Measure of Service

Plots gray level or vector will be charged at a rate per linear foot. Initial header footage is excluded.

D.3 SOFTWARE PRODUCTS

Application software products are special software services unique to LARS and remote sensing. These products were established to cover the ongoing cost of maintaining the software. Several software tools are installed on the LARS system to enhance the data processing and display capabilities of the LARS users. The Statistical Analysis System (SAS) and a special graphics package (SAS/GRAPH) designed for the display of data sets and results were installed during 1980. The LARSYS analysis system is designed to support the user software requirements for the analysis of data collected by various multispectral scanner systems. In contrast, LARSPEC is a system designed to support the user software requirements for the analysis of data collected by various spectroradiometers.

The software products available are easy to use, well-documented and have helpful diagnostics. Training and consultation in the use of the products is available. Existing software problems will be investigated and corrected as they occur. The program libraries and documentation are updated periodically as needed and the most recent releases of each system will be made available.

D.3.1 Statistical Services

Many projects at LARS use a variety of statistical techniques for analysis of remote sensing and field data. Much of the data manipulation and statistical calculations are currently performed on the LARS computer using SAS.

SAS stands for the Statistical Analysis System, a set of computer programs created in the Statistics Department at North Carolina State University. The programs are now developed and marketed by an independent firm, SAS Institute Inc. in Cary, North Caolina.

SAS provides a wide range of statistical procedures including linear and nonlinear regression, anova, various descriptive statistics, clustering, classification, factor analysis, and a powerful univariate and multivariate general linear model procedure.

SAS contains powerful and flexible data manipulation and management tools. It can read hierarchical files, variable length records, and multiple record types. It can sort, merge, and concatenate data sets. It reads blocked tapes easily.

SAS also has plot and chart routines for line printers and a set of procedures, called SAS/GRAPH, for high-resolution graphics terminals and pen plotters. SAS/GRAPH routines create two- and three-dimensional bar charts, pie charts, line plots, contour plots, and three-dimensional response surface plots. SAS/GRAPH also draws state and county maps and fancy title pages.

In addition to SAS, Statistical Services supports SPSS (Statistical Package for the Social Sciences). SPSS is less versatile than SAS, but it contains a greater variety of easy-to-use nonparametric tests.

IMSL (International Mathematical and Statistical Library) is also available and now consists of a comprehensive set of 495 Fortran subroutines solving most mathematical and statistical problems. IMSL provides analysis of variance, differential equations, nonparametric statistics, regression analyses, linear programming, vector and matrix arithmetic, econometrics, and various other statistical procedures.

SAS, SPSS and IMSL are well-documented systems (printed documentation as well as an educational tape/slide minicourse), but additional user assistance is required, especially for SAS. The purpose of statistical services is to make data management analysis techniques available and comprehensible to all interested users of the LARS computer. Specifically, the service includes the following:

a. Installation of the most recent release of SAS, SAS/GRAPH, SPSS, and IMSL.

b. Testing on LARS computer of SAS, SAS/GRAPH, SPSS, and IMSL, identification of problems, reporting of problems to SAS Institute, and the IMSL technical contact and correction of these problems whenever possible.

c. Training and assistance in the use of statistical routines for all interested users of the LARS computer.

d. Participation in the SAS user's group, and attendance at its annual conference.

e. Assistance to users who want to interface their own Fortran programs with SAS.

f. Periodic articles in Scanlines about SAS, SAS/GRAPH, IMSL, SPSS and other statistical software.

g. Maintenance of a central file of user documentation of statistical routines.

Availability of Service

SAS, SAS/GRAPH, SPSS, and IMSL are available for use at all times when the LARS computer is in operation. User assistance is available from the statistical consultant during the normal working day.

Measure of Service

Statistical Service is measured in CPU hours used by SAS, SAS/GRAPH,and SPSS programs. The service includes training and assistance in the use of SAS, SPSS, and IMSL. It does not include writing SAS or other programs that would be of use only to one project. Such specialized work is charged directly to projects through the Professional Assistant Staff product and a recharge for computer time used.

D.3.2 LARSPEC

LARSPEC is a system of programs designed to support the basic user software requirements for the analysis of data collected by various spectroradiometers in situ and in the Laboratory. These instruments have been used primarily to collect spectral data on crops and soils. LARSPEC provides the basic analysis aids for the experimenter in the form of three processors: IDLIST, GSPEC and DSEL.

a. Data Identification List Processor (IDLIST). This processor is used to provide descriptive information about data observations. A subset or the complete set of available descriptive parameters can be listed for selected observations. An additional feature of IDLIST is its ability to output a subset of agronomic, geometric, meteorological, experimenter or soils parameters in a format for subsequent data analysis using other software. There is also the capability to create a user defined data base from LARSPEC tapes. This data base is stored on a large disk for quick access by other processors.

b. Data Graph Processor (GSPEC) GSPEC provides graphical output of data observations. Plots may represent an individual observation or the average of several observations. GSPEC is used for data verification, exploratory analysis of spectral characteristics and qualitative assessments of relationships between reflectance and wavelength and/or agronomic or soil characteristcs.

   Since the plotting routines in GSPEC use GCS (Graphics Compatibility System), the plotting capabilities are numerous. They include the use of polar coordinates, logarithmic scales, redefinition of dependent variables, curvefitting and general scaling and plot specifications. Also a total of five different plotting devices are available, including a DECwriter terminal, a Tektronix Graphics terminal and a Varian Plotter.

c. Data Selection Processor (DSEL). Data reduction capabilities are incorporated in this processor through several statistical procedures. Initially, average response values (band means) are calculated using the average response of samples collected within the specified wavelength limits.

   The band means can be printed along with other descriptive statistics, which include standard deviation, range, variance and percent deviation. A matrix of interband correlations can also be requested. Also, a LARSYS-compatible statistics deck can be punched for use with that software system. A second type of deck that can be punched includes the band means and, optionally, the agronomic, geometric, meteorological, experimenter or soils parameters (the same set as IDLIST produces); this deck may be used as input to other statistical analysis packages.

   Spectral subclasses within a crop or soil type can be identified using the clustering option available.

The purpose of LARSPEC support is to maintain and modify the software system to the extent provided by the budget. Specifically, the service provides the following:

a. Existing software problems will be investigated within 2 days and corrected within 5 additional days if they produce erroneous results, do not produce output as requested by user control cards, or result in entering the CMS debug environment.

b. Control card formats and descriptions will be available to all users through files located on the LARSPEC disk.

c. Software modifications will be carried out to the extent of available funding, and then usually for minor changes and enhancements. Any specialized user requirements will be directly supported by funds from the project requiring them.

d. The system will be updated to make corrections and modifications available to users. After each update, the LARSPEC system and source disks will be backed up to magnetic tape. A written record will be kept. As each new release is installed or with a new operating system installation, a set of test procedures will be run to insure system and release reliability.

e. User assistance is available as needed. Consulting needed in excess of one hour will be charged at the professional staff rate.

f. A User's Manual illustrating the capabilities of the system will be maintained. This will provide more extensive documentation than the existing control card description files mentioned in (2). An up-to-date copy will be maintained in each user area.

Availability of Service

The LARSPEC programs are available for use at all times when the LARS computer is in operation. They can be run in either interactive or batch mode. User problems and requests should be brought to the attention of the person responsible for the support of this service.

Measure of Service

LARSPEC usage is measured in CPU minutes used by the programs.

D.3.3 LARSYS

LARSYS is a system of programs designed to support the user software requirements for the analysis of data collected by various multispectral scanner systems. A large quantity of Landsat satellite data exists, and there are also aircraft and Skylab data. The system is divided into two parts; standard LARSYS and developmental LARSYS or

LARSYSDV. Standard LARSYS consists of 18 processors and some additional routines which have proven to be useful utilities for users (tape copy and dump routines, routines to obtain the source and object code for BMD-the Biomedical Statistical Package and SSP-the IBM Scientific Subroutine Package). Routines for the maintenance and test of the LARSYS processors and their hardware interfaces are also included. LARSYSDV came into existence during 1975 and includes new processors and modifications to the standard LARSYS processors. LARSYS programming standards have been, to a great extent, maintained in the LARSYSDV processors, but program abstracts and user documentation may or may not exist. There is in every case, though, a control card description for the processor on the system disk.

The 18 standard LARSYS processors are:

a. PICTUREPRINT. Histograms and displays image data in picture form on the line printer for each channel.

b. IMAGEDISPLAY. Histograms and displays selected channels of image data on the digital display.

c. CLUSTER. Using reflectance values from all channels, groups the data into classes and displays the results on the line printer.

d. STATISTICS. Calculates statistics on fields of data which the user has divided into classes.

e. SEPARABILITY. Calculates transformed divergence between all class pairs, for every set of channels requested by the user.

f. CLASSIFYPOINTS. Assigns each pixel in a user selected region using the maximum likelihood algorithm. The results are written onto tape or disk.

g. SAMPLECLASSIFY. Assigns each user identified field to a class using first and second order statistics and displays the results on the line printer.

h. PRINTRESULTS. Prints a map and tabulates the number of pixels classified into each class using the classification results located on tape or disk.

i. IDPRINT. Displays the information contained in the LARSYS identification records.

j. DUPLICATERUN. Moves a data run from tape to tape, adjusting entries in the identification record.

k. TRANSFERDATA. Prints the actual data values on the tape for any number of channels.

l. COPYRESULTS. Copies classification results from disk or tape to another tape.

m. LISTRESULTS. Prints selected information located in the header records of the classification results stored on tape.

n. PUNCHSTATISTICS. Punches a copy of the statistics deck located on a classification results tape.

o. LINEGRAPH. Graphs a line of MSS data on the line printer.

p. COLUMNGRAPH. Graphs a column of MSS data on the line printer.

q. HISTOGRAM. Histograms data and may punch a deck of the histogram information.

r. GRAPHHISTOGRAM. On the line printer, displays the histogram produced by PICTUREPRINT, IMAGEDISPLAY or HISTOGRAM processors.

At this time, the LARSYSDV system contains 7 processors developed since LARSYS Version 3.0 and some modified versions of LARSYS processors which will be completely supported. These processors are completely documented in the LARSFRIS documentation. Modified LARSYS Processors are located on the LARSYSDV system disk. The 7 supported LARSYSDV processors are:

a. SECHO Classifier. Groups the data into homogeneous areas, and classifies each homogeneous area using first and second order statistics.

b. MERGESTATISTICS. Combines more than one statistics deck into one deck.

c. RATIO. Using the mean vectors of classes in a statistics deck, calculates and prints the ratio of the values for the specified channels and the sum for each class.

d. COMPARERESULTS. Compares two separate results files, pixel for pixel, and produces an output results file.

e. BIPLOT. Plots in 2-dimensional feature space: means ellipses of concentration, classifications.

f. CHANNELTRANSFORMATION. Copies MSS data runs and creates new algebraic combinations of existing channels.

g. SMOOTHRESULTS. Processes blocks of classified data and produces a smoothed results file.

Other processors on the LARSYSDV disk will be maintained at a very minimal level until personnel time is available to verify and maintain them.

The purpose of LARSYS support is to maintain and modify the software system to the extent provided by the budget. Specifically, the service provides the following:

a. Software problems occurring in the 25 processors described above will be investigated within 2 days, and corrected within 5 additional days if there are no extenuating circumstances, and if:

   1. they produce erroneous results, and the problems cannot be circumvented;

   2. output requested is missing (i.e., the function terminated abnormally).

b. Software problems occurring in other processors will be investigated within a month and corrected, if feasible.

c. Consultation with users on questions, problems or suggestions concerning LARSYS and LARSYSDV.

d. Control card descriptions for each processor available to the user through files located on the LARSYS and LARSYSDV system disks, and notebooks located in the terminal area.

e. Software modifications planned and carried out to the extent of available funding.

f. Documentation for the 25 processors beyond control card description files. The documentation will follow documentation standards existing for standard LARSYS.

g. A Program Library for LARSYS routines.

h. A document will be maintained describing procedures for investigating and correcting software problems, modifying existing processors, implementing new processors and updating LARSYS and LARSYSDV.

i. Test procedures for all supported processors and routines.

Availability of Service

The LARSYS and LARSYSDV programs are available for use at all times when the LARS computer is in operation. They can be run in either interactive or batch mode. User problems and requests should be brought to the attention of the Manager of Software Products.

Measure of Service

LARSYS usage is measured in CPU hours used.

D.4 SUPPORT PRODUCTS

The Support Porducts Group provide specialized services and products to LARS staff and users of System Services. Included are: Printed Material, LARSYS documentation, design and graphics services, slides, transparencies, Scan Line and personnel support - Professional Assistant, Technical Assistant, Service and Clerical Staff time.

D.4.1 Printed Material

The Printed Material service assists staff in the preparation and production of all documents from memoranda to multi-volume reports. The per page rate supports: advice on duplicating method, turn-around time, paper size, weight and color; editing to ensure figures are complete and manuscript meets contractual, LARS and printing specifications; duplication; distribution of printed document. In addition, the Publications Coordinator will maintain the original manuscript, if desired, and keep a file of all pertinent information pertaining to the production of the document. Contact Davida Parks at Flexlab1 for this service.

D.4.2 LARSYS Documentation

LARSYS is the Software package developed at LARS and first distributed in 1973. The LARSYS documents available are: The LARSYS User's Manual, The LARSYS System Manual, The LARSYS Documentation Package, The LARSYS Educational Package and The LARSFRIS Manual. For additional information regarding these documents see the LARS Administrative Plan or the Manager of Support Products.

D.4.3 Design Services

Design Services personnel assist the user with all aspects of visual presentations from initial concept to finished product. This includes slides, illustrations, displays, brochures, graphs, etc. Assistance is provided to help the user direct visual concepts to an intended audience. In addition, new methods, techniques and ideas are researched in an effort to help the user better project his message. Consultation services regarding cost estimates, formats, techniques, and the like are also available. Contact Sue Ferringer at Flexlab2 for this service.

D.4.4 Scan Lines Subscription

The Scan Lines subscription product was established to enable agencies, companies or individuals external to LARS and Purdue University to receive this 10-issue newsletter. Scan Lines contains information about existing and future LARS projects, System Services information with specific computational facility updates, travel, addresses, papers, symposia, etc.

D.4.5 Slides

The Slide Library contains master and duplicate slides and is maintained to provide personnel with visual materials for presentations, discussions, lectures and the like. A notebook of frequently used slides is maintained in each lab for the user to consult when ordering duplicates. In addition, a catalog of new slides is circulated each quarter to alert staff to additions to the file. There is a per slide rate which supports this service.

D.4.6 Transparencies

Transparencies are prepared by the Support Products Staff at Flexlab1 and come in a variety of colors. Black lettering is available on red, yellow, green, light blue and dark blue backgrounds. Red and green lettering is available on clear backgrounds. These can be framed upon request. Turn around time is usually within the hour and the cost of each transparency is based on a fixed price for time and materials.

D.4.7 LARSFRIS Documentation

The LARSFRIS documents contain user instructions for the proper user and application of the Software which comprises the LARSFRIS package.

LARSFRIS represents a compilation of software developed over a number of years by the staff at Purdue University's Laboratory for Applications of Remote Sensing. The software packages are designed to help the user analyze digital image data such as that collected by the Landsat Multispectral scanner.

D.5 REFORMATTING PRODUCTS

The objective of Reformatting Services is to meet the data preprocessing and post processing needs of the various research projects within LARS. These needs include reformatting digital tape data from another format to Larsys-III format or LARSPEC format, data enhancement, and post processing data to be sent outside LARS.

Reformatting Services supports three services to meet its objective:

Reformatting Software Products;
Professional Assistant Staff Time; and
Student Staff Time.

Within the Reformatting Services product descriptions there are detailed explanations of each service.

* Reformatting Software Products

Reformatting software products can be divided into four parts: Reformatting from outside format to LARSYS-III format; reformatting from outside format to Larspec format; reformatting from LARSYS format to LARSYS format; and reformatting from LARSYS format to an outside format. All reformatting processing is done on the LARS 4341 IBM computer system.

* Outside Format to LARSYS-III Format

LARSYS and LARSYSDV analysis systems require the data to be in either LARSYS-III format or universal format. Therefore, to run the analysis systems on data in an outside format.

Much of the data received in outside formats is MSS (Multi-Spectral Scanner) data collected by the Landsat satellites. Reformatting can handle Landsat available from the EROS Data Center, The Brazilian receiving station, and the Canadian Centre for Remote Sensing. Landsat bulk CCT's from the EROS Data Center can either be in the X format produced at the Goddard Space Flight Center or the EDIPS format. X format is also called BIP2 or band by pixel squared. Landsat bulk tapes in EDIPS format can also be handled. Presently the software can handle BIL-MP (band interleaved - MSS, geometrically corrected) BSQ-RP (band sequential - RBV, geometrically corrected) or BSQ-MP (band sequential - MSS, geometrically corrected). However BSQ-MP format will be used only if the BIL format is not available. Data in INPERTS format produced by the Brazilian receiving station can also be reformatted to LARSYS. The Canadian Centre for Remote Sensing also has a format based on the universal format. Because some reformatting preprocesses require the input data to be in LARSYS-III format,

processors are available to convert from universal format to LARSYS format. Other outside formats are handled on a custom basis. The final result of all reformatting from an outside format to LARSYS-III format is a LARSYS data run stored on magnetic tape in 9 track 1600 BPI format. After a preliminary data quality check, the run is entered in the LARS runtable and assigned a tape in the LARS tape library.

* Reformat to LARSPEC Format

Data collected with the Exotech 20C multiband spectrometer or the Exotech model 100 multiband radiometer can be reformatted to LARSPEC format for further analysis by the LARSPEC analysis system. Input includes bulk data tapes (for Exotech 20C data), raw data values and ancillary data that has been collected by the requestor and pre- processed into acceptable by the requestor into an acceptable format. Output is the spectral and ancillary data on 9 track 1600 BPI tapes in LARSPEC format. After a preliminary data quality check, the data is entered in the Field Research Spectrometer Data Library and assigned a tape in the LARS tape library.

* LARSYS to LARSYS Reformatting

Reformatting Services can offer several options to correct or enhance data in LARSYS format. This correction may be as easy as adding ID information or as complex as registering one data set to another. Input is spectral and ancillary tape data in LARSYS-III format. Any auxillary information such as maps or ancillary data not on tape should be supplied by the requestor. The enhancements available are:

* ID information correction;
* calibration added to Landsat data;
* combining channels from different runs where this combination does not include registering channels;
* subsetting the data either by channels, samples, or lines;
* connecting two frames of Landsat data that originally came from the same flight line;
* geometric correction;

Image registration:

* addition of boundaries;
* or principal component processing

The geometric correction processor orients the data to northand makes linear correction for scanner skew and earth rotation. The data can also be rescaled for display on either the color display or the line printer.

Image registration can either be from one data image to another data image or to an arbitrary map grid supplied by the

requestor. Checkpoint collection is with the aid of the color display and/or the table digitizer. On the average 50 check points are needed for accurate registration and an rms error of .5 is considered acceptable.

In boundary processing, the boundary can be supplied by the requestor or digitized from maps. The boundary data can be added to the input tape either as separate channels on the output data tape or as zeroed data outside of boundary areas.

The principal components processor produces a new data run from the "principal components" of the input run.

Other LARSYS to LARSYS reformatting are handled on a custom basis.

The final result of all reformatting from LARSYS to LARSYS format is a LARSYS data run stored on magnetic tape in 9-track 1600 BPI format. After a preliminary data quality check, the run is entered in the LARS runtable and assigned a tape in the LARS tape library.

* Reformat from LARSYS III Format to an Outside Format

Some projects need data to be sent out of the laboratory for further processing. Sometimes this data is sent in LARSYS-III format and other times an out-of-house vendor needs a specific format. At the present time reformatting can translate a data tape to the format needed by the J. Sefel & Associates Company in Houston or to a universal format. Reformatting to other outside specifications are handled on a custom basis.

The final result of reformatting from LARSYS to outside format is either supplying the requestor with the data in the desired format accompanied by a cover letter giving all tape specifications or sending the data out-of-house on the requestor's behalf.

Measure of Service

Reformatting Software usage is measured in CPU minutes consumed by the reformatting programs. A rough estimate of the cost of a particular combination of reformatting processors may be obtained by contacting the reformatting manager.

Availability of Service

Reformatting activities are performed on a scheduled basis. A project's work may be scheduled by contacting the manager of reformatting services with a specific list of reformatting requirements and data locations. If assistance is needed in developing the list of

preprocessing functions and locating data, it will be provided at the hourly rate for professional assistant staff. The manager will be able to supply an estimated completion date for a project's specific data and preprocessing requirements.