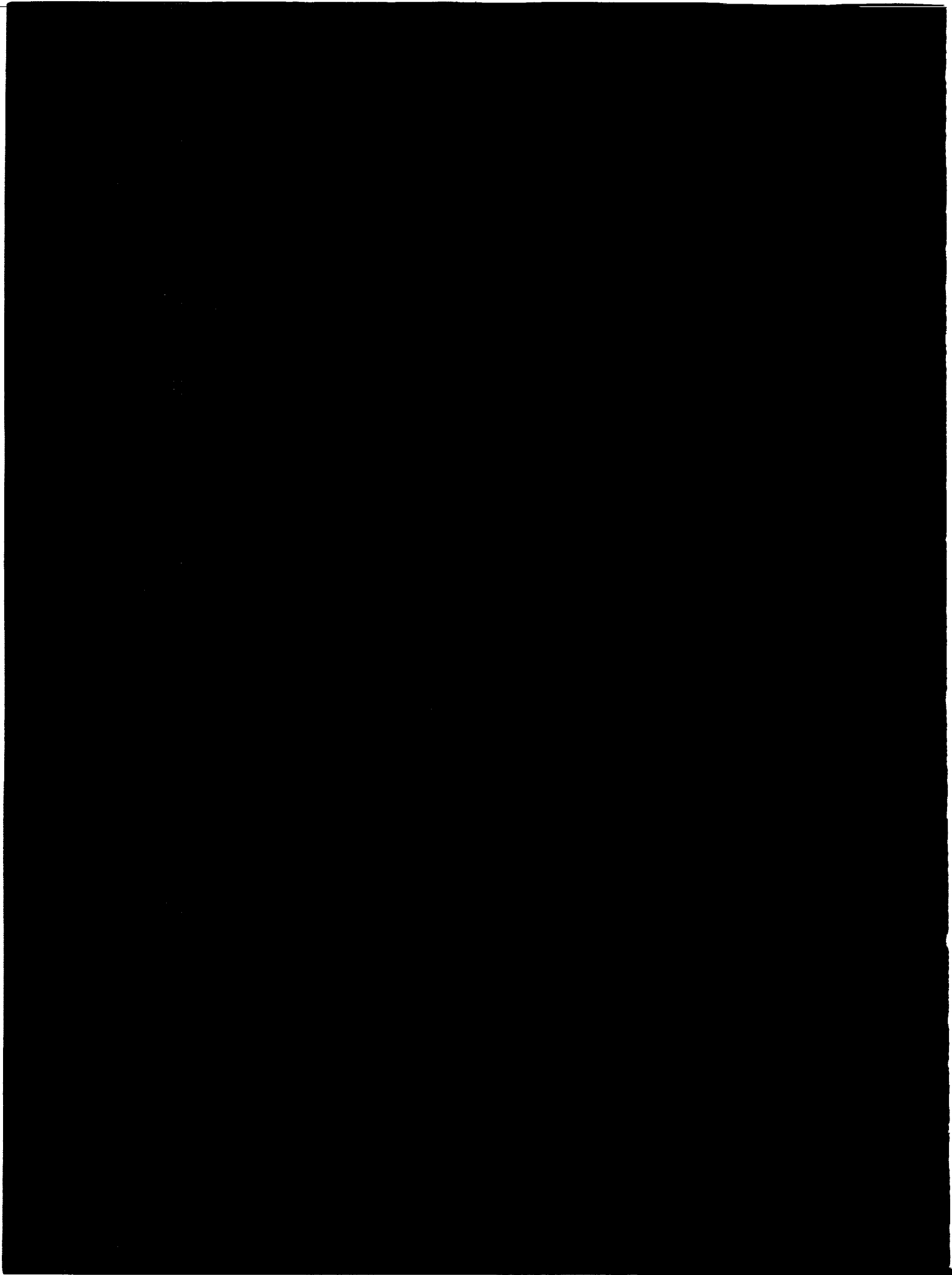


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NASA LANGLEY RESEARCH CENTER

GRAPHICS MINI MANUAL

An Introduction to Graphics at Langley Research Center

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GRAPHICS MINI MANUAL

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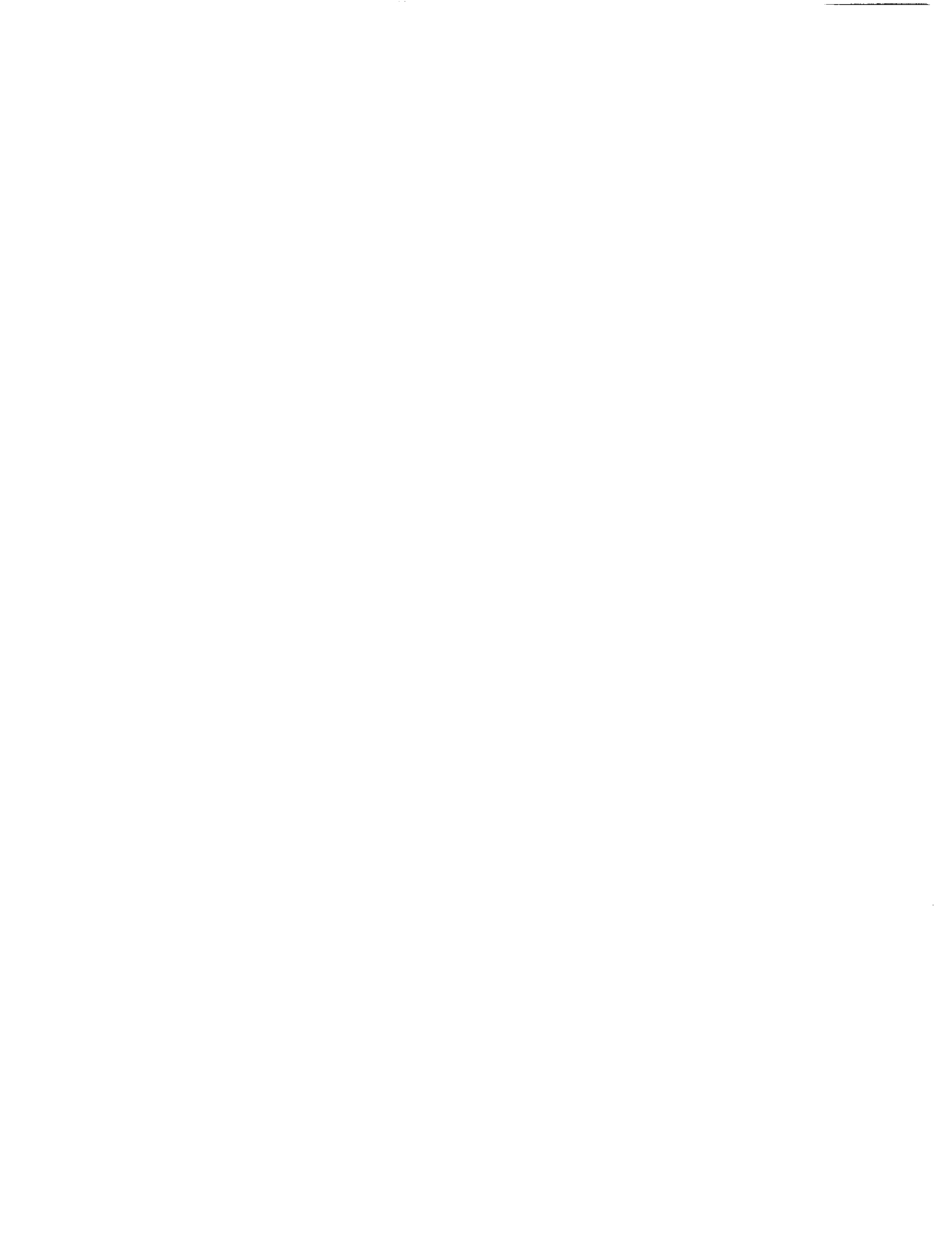


GLOSSARY

ACD	Analysis and Computation Division
CDC	Control Data Corporation
CFD	Computational Fluid Dynamics
CGM	Computer Graphics Metafile is a proposed ANSI standard for graphics output
central site	Facilities located in the 1268 building complex.
Common Graphics Library	A subroutine library which satisfies LaRC local features and requirements not supported by other LaRC graphics libraries
CORE	A proposed graphics standard developed by the Association for Computing Machinery's Special Interest Group on Graphics (SIGGRAPH)
CSCC	LaRC Central Scientific Computing Complex
device driver	A device-dependent program that supports a specific graphics device. The device driver generates device-dependent output from device-independent input and handles device-dependent interaction.
device independence	The ability to control all graphics devices uniformly
DI-3000	A CORE graphics package developed by Precision Visuals, Inc.
FSGB	Flight Software and Graphics Branch of ACD
GKS	Graphics Kernel System - A graphics software standard approved by International Standards Organization
GSPC	Graphics Standards Planning Committee of ACM SIGGRAPH
host	The computer which provides processing support to other processors, workstations, or peripheral devices
interactive graphics	Graphics which allow dynamic modification of the display graphics through graphics input devices
ISO	International Standards Organization

kernel	A low-level graphics subroutine library which contains all required functions for performing interactive and passive graphics tasks
LAN	Local Area Network
LARCGOS	A library of locally written graphics subroutines and a set of postprocessors that drive the ACD Graphics Production Devices
LARCGS	LaRC Graphics System
LaRC	Langley Research Center
local site	Graphics facilities outside the ACD central facility
menu/command driven interface	A collection of programs which prompts the user for input to generate graphics output
metafile	A sequential file which contains the device-independent picture information necessary to produce the desired graphics
metafile translator	The program which interprets the device-independent metafile commands for specific physical devices
MOVIE.BYU	A graphics display system written at Brigham Young University for modeling, display, and animation
MSS	Mass Storage System
NCAR	A library of graphics subroutines for contouring applications written at the National Center for Atmospheric Research
NCS	NOS Computing Subsystem
NOS	Network Operating System running on NCS
OCO	Operations Control Office in Building 1268, 864-6562
passive graphics	Graphics requiring no dynamic interaction with the display
PC	Personal computer
PHIGS	Programmers Hierarchical Graphics System is a proposed ANSI graphics software standard

pixel	The smallest unit available for display on a raster screen representing a single graphics point, often referred to as picture element
postprocessor	A device-dependent program that drives an ACD Graphics Production Device
PostScript	Page Description Language developed by Adobe for outputting files to a printer
production devices	Hardcopy graphics output facilities at the Central site
PVI	Precision Visuals, Inc. of Boulder, Colorado
raster graphics	Graphics information represented by a rectangular array of picture elements referred to as pixels or rasters
RM	Raster Metafile
RMT	Raster Metafile Translator
run-length encoded	Data compression scheme where a scan line of a raster image is represented as a series of runs of equal-valued pixels
SNS	Supercomputing Network Subsystem
UNIX	Operating System for the CONVEXes and CRAY-2
vector graphics	Graphics information is represented in terms of points, lines, and characters
X	X Window System
X Window System	Network transparent window-based graphical user interface system
2D	Two-dimensional
3D	Three-dimensional



1. INTRODUCTION

The purpose of this document is to describe the LaRC Central Scientific Computing Complex (CSCC) Graphics System (LARGGS). The document identifies the major software and hardware components, describes component features and capabilities, provides interface and access information, and directs potential users to more detailed documentation and other resource material.

The document is divided into six major sections. Following this introduction, the second section provides an overview of the LARGGS. Section three presents the software components of the LARGGS with respect to package features, device interface, and host access. The metafile system, which serves to integrate software and hardware, is presented in section four. Features and access information for supported graphics hardware devices is provided in section five. Finally, section six details information resources including hardcopy and on-line documentation and user support.

Because of changing user requirements and advancements in technology, the LARGGS continues to evolve. Due to the dynamic nature of the LARGGS, this document is not intended to be a complete user's guide for using individual graphics software packages or accessing graphics hardware devices. Instead, this document is intended to identify individual LARGGS components, describe their features and unique capabilities, and list associated package- or device-specific documentation.

2. GRAPHICS SYSTEM OVERVIEW

The use of computer graphics in the LaRC scientific research computing environment continues to expand. The increased demand for visualization in scientific computing encompasses all aspects of data inspection and data presentation. The goal of the LARCGS is to meet this demand for better scientific visualization techniques and procedures.

The LARCGS is comprised of four major components: the graphics software packages and utilities; the graphics hardware output devices; the interfaces between user and package or package and device; and the user support in the form of documentation, consultation and training. The diverse collection of graphics software ranges in functionality from low-level packages to perform "moves" and "draws" to high-level packages for generating contour and hidden-surface plots. The supported hardware devices include interactive devices such as terminals, workstations, and PC's, and hardcopy devices such as pen, electrostatic, and thermal plotters; film recorders; and laser printers. The user may interface to a graphics package by calling subroutines from a graphics software library or by entering commands and/or menu selections in the case of a stand-alone interactive graphics tool. The device interface is normally dictated by the graphics software package but may include one or more postprocessing steps when accessing hardcopy devices. The individual software and hardware components, supplied interfaces, and avenues of user support for the LARCGS are detailed in later sections of this document.

As stated previously, the purpose of the LARCGS is to satisfy the computer graphics requirements of the LaRC user community. In order to satisfy these needs, several important issues must be addressed including: functionality, usability, portability, performance, and extensibility.

Providing software packages and hardware devices that keep pace with ever-changing user requirements has proven challenging. The LARCGS approach to this functionality problem is to acquire software from commercial vendors or other government agencies and universities, or locally develop graphics software designed to solve one or more known scientific visualization problems. For example, the NCAR package(see section 3.3) was obtained to produce a variety of contour plots and RASLIB (see section 3.6) was developed locally to generate hidden surface plots for Computational Fluid Dynamics (CFD) applications. The acquisition of graphics hardware is also driven by user demand, but in this case, is also driven by advances in industry technology. As an illustration of device functionality, the LARCGS supports devices which produces either quick turn around work plots or publication quality presentation plots.

In addition to providing functional graphics software and hardware components, these components must be easy to use and readily accessible. The LARCGS is primarily a CSCC graphics system which is integrated into the LaRC computing environment, described in "Introduction to the Use of the Central Scientific Computing Complex" (document A-1). However, through the networked computing environment, distributed-site users may access LARCGS software and/or hardware components through any of the supported interface mechanisms (discussed in sections 3, 4, and 5).

The LARCGS provides for portability through conformance to ANSI graphics standards for both graphics software and graphics output. With respect to software standards, the LARCGS supports implementations of CORE, Graphics Kernel System (GKS), and Programmer's Hierarchical Interactive Graphics System (PHIGS). Details on each of these standard implementations is provided in section 3. The LARCGS supports graphics output portability by providing for both vector and raster metafile formats. The Precision Visuals, Inc., DI-3000 metafile format is the principal vector format, but the Computer Graphics Metafile (CGM) and PostScript formats are also supported. The locally developed Raster Metafile (RM) format has been adopted for porting raster graphics output. Information on both the vector and raster portable graphics output processing is provided in section 4.

Traditionally, most of the required graphics processing has been performed on a host computer. However, the growing demand for more sophisticated, and often more compute and I/O intensive, graphics output capabilities has made performance an important issue in graphics system design and implementation. The advent of affordable graphics workstations and the proliferation of Local Area Networks (LAN's) have off-loaded much of the graphics processing burden from the host to the workstation. Although the LARCGS supports host-resident graphics software, it also supports the distributive processing environment with workstation-resident packages such as PLOT3D (see section 3.13) and PVWAVE (see section 3.10).

A major goal of the LARCGS is that it be extensible in order to meet future needs of the LaRC user community. An example of the evolution of the LARCGS, is the commitment to the de facto X Window System (X) standard for supporting distributed graphics. At the time of this writing, acquisition of X software drivers for existing graphics packages and the development of local X clients has been initiated. In the case of graphics hardware, the recent release of both black-and-white and color PostScript printers (see section 5) illustrates the evolutionary growth of the LARCGS.

The diverse nature of LaRC graphics requirements has resulted in a seemingly disjoint collection of LARCGS components. However, the LARCGS components are integrated through the metafile system discussed in section 4. The majority of supported graphics software components produce one of the supported metafile formats as an output option. These portable graphics output files may be processed through the metafile system and ported to any of the supported graphics output devices. Consequently, the metafile system provides the interface between graphics software packages and graphics output devices.

The remaining sections of this document describe the major components of the LARCGS. The user is responsible for selecting a graphics software package that resides on the same host computer as the application and for selecting a graphics display device that interfaces to the designated package. In addition, a user wishing access to the ACD Graphics Production Devices must learn at least the fundamentals of the metafile system and associated processors.

3. GRAPHICS SOFTWARE

The major graphics software components that comprise the LARCGS are presented in this section. Each software package is presented in terms of functional description, device interface, and host access.

The functional description briefly discusses the utility and capability of each graphics package and identifies sources for additional documentation where further package information may be obtained. The functionality and characteristics of each software package is shown in Table 1.

The device interface section addresses the method by which individual graphics software packages interface to supported graphics output devices. Documentation, both on-line and off-line, providing device lists and device driver information is identified in this section. All discussions on graphics metafile processing is deferred until section 4.

The host access section concerns host support for each graphics software component of LARCGS. For purposes of this document, host support falls into one of three categories. First, all graphics software available on the Supercomputing Network System (SNS) and NOS Computing Subsystem (NCS) is supported. Unless otherwise stipulated, SNS support extends to all SNS hosts including **Eagle**, **Mustang**, and **Voyager**. The second support category includes graphics software distributed by ACD through a site license. The VAX/VMS versions of the Precision Visuals, Inc., (PVI) graphics software packages represent software supported under this second category. Finally, support is provided for graphics software available on workstations within ACD's graphics laboratory. Examples from this final category include PVI's PVWAVE and the PLOT3D family of distributed processing and workstation-resident graphics tools. For each graphics software component, the type of host support is indicated and pertinent on-line documentation is identified.

TABLE 1: FUNCTIONALITY AND CHARACTERISTICS OF GRAPHICS SOFTWARE PACKAGES

	FUNCTIONALITY									CHARACTERISTICS							
	GENERAL PURPOSE	CHARTS & GRAPHS	CONTOURS	SURFACES	HIDDEN LINES	HIERARCHICAL MODELING	ANIMATION	RENDERING	MAPPING	VISUALIZATION	VECTOR	RASTER	3D	MENU/COMMAND DRIVEN	SUBROUTINE CALLABLE	PORTABLE GRAPHICS FILE	WORKSTATION RESIDENT ONLY
CGL		X									X				X	X	
CONTOUR			X	X	X						X				X	X	
DI-3000	X										X		X		X	X	
DI-3000 XPM					X	X					X		X		X	X	
FIGARO	X			X	X	X		X			X	X	X	X	X		
GAS		X	X	X	X		X			X	X	X	X		X	X	X
LARCGOS		X									X				X	X	
MOVIE.BYU					X		X	X				X	X	X	X	X	
NCAR			X	X	X				X		X		X		X	X	
PICSURE		X									X			X		X	
PLOT3D		X	X	X	X					X	X	X	X		X		
PVWAVE		X	X	X	X					X	X	X	X				X
RASLIB				X						X		X		X	X		
SURF			X	X	X				X	X	X	X	X		X	X	X

3.1 DI-3000

Description

DI-3000 is the kernel of an integrated system of graphics software tools, marketed by Precision Visuals, Inc., (PVI) of Boulder, Colorado. DI-3000 is a library of over 200 FORTRAN-callable subroutines which adheres to the full functional specifications of the CORE standard. The graphics features of DI-3000 include: 2D and 3D drawing primitives, text primitives and font specification, extensive attribute settings (e.g., color), 2D/3D modeling and viewing transformations, "temporary/retained" segments and image transformations, and virtual graphics input.

DI-3000 XPM is a DI-3000 option which provides a hierarchical graphics data base, hidden line processing, and many extended primitives such as ellipses, arcs, spheres, extruded polylines and solids of revolution.

In addition to the DI-3000 subroutine library, PVI provides several high-level graphics software packages which use the DI-3000 library as a kernel to perform surface generation, grid generation, contouring, and charting. These high-level packages are discussed in later subsections.

DI-3000 and DI-3000 XPM are documented in the "DI-3000 USER'S GUIDE" (G-5).

Interface

DI-3000 and its higher-level graphics packages perform graphics output through an extensive set of device drivers provided by PVI. A DI-3000 device driver is a collection of device-specific subroutines that drive a particular graphics output device. A special device driver, the metafile driver, produces a file of portable graphics information called the metafile. The DI-3000 Metafile System is discussed in section 4.

The features of each device driver are documented in a "DEVICE DRIVER GUIDE" (DDG) (G-10). The device driver list includes drivers for most of the graphics terminals, printers, plotters, and workstations available locally.

A list of the available DI-3000 device drivers can be found in the following on-line files:

UNIX man page

man di3load

NOS permanent file

GET,DEVICE/UN=PVINFO,ST=CPF.

VMS commands

pvihelp or *di3help*

Access

The UNIX and VMS hosts run DI-3000 version 5. The NOS hosts are frozen at DI-3000 Version 4, although NOS does support Version 5 device drivers for the Metafile System (see section 5).

The method of access to DI-3000 for each host class is markedly different. The following paragraphs provide directions for locating access methods on supported hosts.

UNIX

The use of DI-3000 on SNS UNIX hosts is detailed in the UNIX man page accessed by entering:

man di3load

The man page provides information on option specification, device selection and the setting of required environment variables. These environment variables must be set before using DI-3000.

NOS

For information, see the NOS permanent file:

GET,DINDX/UN=PVINFO,ST=CPF.

This file identifies where to find DI-3000 command files, test programs, and introductory documentation.

VMS

The use of DI-3000 on VMS hosts is documented by VMS commands which are accessed by entering:

pvihelp or *di3help*

The commands provide details on defining logical names, selecting device drivers, and creating shareable images. The VMS hosts require several logical names to be defined before invoking DI-3000.

3.2 CONTOUR

Description

The Contouring System (CONTOUR), a library of FORTRAN-callable subroutines, provides contouring and grid generation capabilities. The contour plotting routines include a 2D "quick-look" map with linearly interpolated contour lines, a 2D map with smooth contour lines, and a 3D surface map with hidden lines removed. Two routines handle randomly located data. The first generates a grid from the random data, while the second draws a contour map from the resulting grid.

The system allows the user to produce attractive maps with relatively few subroutine calls - each having a minimum number of arguments. A rich set of options allows extensive control of map characteristics through invocation of calls to the option setting routines.

Additional information on CONTOUR is contained in the "CONTOURING SYSTEM USER'S GUIDE" (G-8).

Interface

CONTOUR (a PVI product) uses DI-3000 for all plotting and therefore has access to all of the supported DI-3000 devices (see section 3.1).

Access

CONTOUR is available on the following hosts:

UNIX

Information concerning the use of CONTOUR on SNS UNIX machines may be obtained by entering:

man di3load

The man page provides information on option specification, device selection and the setting of required environment variables. These environment variables must be set before using DI-3000 and CONTOUR.

NOS

For information, see the NOS permanent file:

GET,CTNDX/UN=PVINFORM,ST=CPF.

This file identifies where to find CONTOUR command files, test programs, and introductory documentation.

VMS

The use of CONTOUR on VMS hosts is documented by VMS commands accessed by entering:

pvihelp or *di3help*

These commands provide details on defining logical names, selecting device drivers, and creating shareable images. The VMS hosts require several logical names to be defined before invoking CONTOUR.

3.3 NCAR

The NCAR graphics software at LaRC consists of two major components. One component is a set of high-level utility routines for 3D surface plotting, geographic map generation, and velocity displays. The other component is a group of low-level graphics routines used to support the higher level subroutines. Additionally, the low-level routines may be used independently to perform general graphing functions.

For more specific information, consult the document "NCAR GRAPHICS SOFTWARE" (G-9 (NOS)).

3.3.1 NCAR (NOS)

Description

NCAR on NOS is interfaced to DI-3000. This is done through a library of low-level routines called the NCAR Connector. For more information refer to G-9 (NOS) and the "NCAR CONNECTOR GRAPHICS PACKAGE USER'S GUIDE" available in User Consultation.

Interface

Since NCAR on NOS is interfaced to DI-3000, it has access to all supported DI-3000 graphics devices (see section 3.1).

Access

Information for using NCAR on NOS is provided in the permanent file:

```
GET,NCNDX/UN=PVINFO,ST=CPF.
```

This file identifies where to find NCAR command files, test programs, and introductory documentation.

3.3.2 NCAR GKS (UNIX)

Description

NCAR GKS Version 2.00 is a collection of FORTRAN 77 programs and subroutines that can be used to generate and plot scientific data. NCAR GKS conforms to the Graphical Kernel System (GKS) standard, level 0A. Individual NCAR GKS utilities include those which contour data fields on regularly-spaced and irregularly-spaced grids, produce world maps using any of ten projections, display 2D vector fields, draw 3D displays of functions of two variables and draw iso-surfaces from a 3D array.

The "NCAR GRAPHICS USER'S GUIDE VERSION 2.00" (G-9) is available from OCO.

Interface

NCAR GKS generates graphics output in the form of a Computer Graphics Metafile (CGM) (see section 4). The NCAR CGM Translator is used to process NCAR CGM files. The NCAR CGM Translator supports a variety of devices which are listed in the UNIX man page:

man nctran

Access

NCAR GKS is available on the SNS UNIX hosts. For information on the use of NCAR GKS and on linking an application with the correct NCAR utilities, consult the UNIX man page:

man ncar

For information on device selection, consult the UNIX man page:

man nctran

Both man pages provide information on environment variables which must be set before using NCAR GKS.

3.4 COMMON GRAPHICS LIBRARY (CGL)

Description

The CGL is a simple-to-use, FORTRAN-callable graphics package which can generate publication and/or viewgraph quality charts. The library is designed for users with no graphics experience, yet is versatile enough to compose and design detailed charts for publication purposes. The library's graphics features include:

- multiple plots per frame
- multiple data sets per plot
- access to multiple fonts (e.g., Greek, math symbols, etc.) and text mnemonics (e.g., subscripts, superscripts, etc.)
- color capability
- the creation of metafiles (for hardcopy postprocessing)
- automatic scaling and increment selection to produce axes suitable for publication quality reports

The CGL has two user interface levels - the Langley Easy (LEZ) routines, and the Low-Level routines. The LEZ routines provide a simple, stand-alone means to generate complete report quality charts (typically with only a few calls to the CGL).

The Low-Level routines allow the user to manipulate chart components, and thereby design specific report-quality charts for unique or unusual purposes. The features at this level can be used alone or in conjunction with other packages (e.g., LEZ, etc.) to enhance or augment their capabilities.

The Common Graphics Library is documented in two volumes which are available from OCO:

- "COMMON GRAPHICS LIBRARY (CGL) VOLUME I: LEZ USER'S GUIDE" (G-12)
- "COMMON GRAPHICS LIBRARY (CGL) VOLUME II: LOW-LEVEL USER'S GUIDE" (G-13)

Interface

CGL uses DI-3000 as its underlying graphics package (see section 3.1). The library is written in machine-independent ANSI FORTRAN 77, providing support for centralized and/or distributed computer systems.

Access

A single production version of the CGL is available on various machines at NASA Langley Research Center which support DI-3000. The method of access to the CGL for each host class is markedly different. The following paragraphs provide directions for locating access methods for various hosts.

UNIX

The use of the CGL on SNS UNIX hosts is detailed in the UNIX man pages accessed by entering:

man cgl or man di3load

General information concerning the CGL, the current version, available test cases, and access information may be obtained by entering:

man cgl

Specific information on referencing the library in program execution (i.e., option specification, device selection and the setting of required environment variables) may be obtained by entering:

man di3load

These environment variables must be set before using the CGL.

NOS

Information concerning the CGL on NOS is available on the following NOS permanent files:

GET,CGNDX/UN=PVINFO,ST=CPF.

GET,CGINTRO/UN=PVINFO,ST=CPF.

CGNDX provides an index of CGL related information (i.e., procedure files, general description of the CGL, execution sequence, available test cases, differences in revisions, introduction documentation, etc.)

CGINTRO provides a general description of the CGL, including the execution sequence, available test cases, differences in revisions, and introductory documentation.

VMS

The use of the CGL on VMS hosts is documented by VMS commands which are accessed by entering:

cglhelp or di3help

These commands provide details on defining logical names, selecting device drivers, and creating shareable images. The VMS hosts require several logical names to be defined before invoking the CGL.

3.5 MOVIE.BYU

Description

MOVIE.BYU (MOVIE.Brigham Young University) is a collection of FORTRAN programs for the display and manipulation of data representing mathematical, architectural, and topological models whose geometry may be described in terms of panel or solid elements, or contour lines. Working with various data files, the programs display the data as either line drawings or continuous-tone images, generate title or geometric model files, and convert contour definitions into polygonal element mosaics.

Additionally, the Raster Graphics Display Library (RGDL) is available to the LaRC user community. The RGDL is a collection of FORTRAN subroutines that allow the user to access raster graphics display capabilities. The RGDL is the basis for the interactive MOVIE.BYU graphics display system.

MOVIE.BYU is documented in the "MOVIE.BYU TRAINING MANUAL". The Raster Graphics Display Library is documented in the report "NASA RASTER GRAPHICS DISPLAY LIBRARY" (ECGL-87-03). Both documents are available for reference from User Consultation.

Interface

The MOVIE.BYU graphics display system and the RGDL perform graphics output to a variety of output devices and also generates a MOVIE.BYU specific file that can be converted to a Raster Metafile (see section 4). A list of available devices and details on converting the MOVIE.BYU specific graphics output file may be found in the man page for MOVIE.BYU. This man page may be accessed by:

man moviebyu

Access

MOVIE.BYU and the Raster Graphics Display Library are available on the following SNS UNIX hosts:

(Eagle and Mustang)

The use of MOVIE.BYU and the RGDL is detailed in the UNIX man page for MOVIE.BYU accessed by entering:

man moviebyu

3.6 RASLIB

Description

RASLIB is a library of FORTRAN subroutines to provide a means of generating solid or smooth shaded (512 x 512) raster images of 2D or 3D grids. Text information may be overlaid in a variety of sizes and colors.

RASLIB is documented in the "RASDOC MANUAL", which is available from User Consultation.

Interface

A RASLIB application program will generate a disk file containing an image in Raster Metafile format which may be viewed by using the Raster Metafile Translator (RMT) (see section 4).

Access

RASLIB is currently available on the following hosts:

UNIX

Information concerning the use of RASLIB on SNS UNIX machines may be obtained by entering:

man raslib

The man page provides information on using RASLIB in the UNIX environment and references several test programs as examples.

NOS

Information concerning the use of RASLIB on NOS is available on the following file:

GET,RASDOC/UN=PVINFO,ST=CPF.

This file identifies where to find RASLIB command lines, test programs, and introductory documentation.

3.7 DI-TEXTPRO

Description

DI-TEXTPRO is a DI-3000 text option for providing high-quality polygonal text. It features twelve typefaces, italic for all typefaces, an outline/solid fill option, and full support for superscripting, subscripting, and underlining.

The DI-TEXTPRO documentation is Appendix D of the "DI-3000 USER'S GUIDE" (G-5) and is available from OCO.

Interface

Since DI-TEXTPRO is a PVI product, it has access to all of the supported DI-3000 graphic devices (see section 3.1).

Access

DI-TEXTPRO is available on the following hosts:

UNIX

Information concerning the use of DI-TEXTPRO on SNS UNIX machines may be obtained by entering:

man di3load

The man page provides information on option specification, device selection, and the setting of environment variables.

NOS

Information for using DI-TEXTPRO on NOS is provided in the permanent file:

GET,TXTNDX/UN=PVINFO,ST=CPF.

This file identifies where to find introductory documentation for DI-TEXTPRO.

3.8 LARCGOS

Description

Langley Graphics Output System (LARCGOS), is a locally developed and maintained 2D vector graphics package. LARCGOS is a library of FORTRAN callable subroutines that generates a plot vector file which is processed through a static plotter, or other postprocessing software. LARCGOS offers basic X/Y line plot, publication quality, and also Hershey Font capabilities. LARCGOS is limited in its use of color and it has no graphic input capability.

Since LARCGOS is frozen, users developing graphics programs are advised to use the more modern and complete graphics library, the Common Graphics Library (CGL) (see section 3.4).

LARCGOS is documented in the "LANGLEY GRAPHICS SYSTEM MANUAL" (G-3).

3.8.1 LARCGOS (NOS)

Description

This version of LARCGOS presumes the FORTRAN compiler permits the user to default parameters on subroutine call statements. LARCGOS uses this feature to allow for easier usage. The parameters which may be defaulted are specified in G-3.

Interface

LARCGOS generates a graphics output file referred to as a plot vector file named SAVPLT. The plot vector file may be postprocessed to produce graphics output in either of two ways. SAVPLT may be plotted using one of the device specific PLOT postprocessors (see section 5.1). The PLOT commands are documented in G-3. SAVPLT may also be converted to a DI-3000 metafile using the SAV2MF program. The SAV2MF program is documented in a NOS permanent file which may be accessed by:

```
GET,SAV2DOC/UN=PVINFO,ST=CPF.
```

The metafile is processed using the DI-3000 Metafile System which is discussed in section 4. Since the host-dependent plot vector format will not be interfaced to future devices, the use of the SAV2MF program is encouraged for old programs.

Access

The LARCGOS library is accessible on NOS by loading it as a user library. The library is stored under the username UN=LIBRARY. Specific loading instructions for NOS are discussed in G-3.

3.8.2 LARCGOS (UNIX)

Description

The Langley Unified Version of LARCGOS (LUV0) provides for software portability in the local distributed computing environments.

Users porting LARCGOS (NOS) codes to LUV0 are reminded that all parameters must be specified on subroutine calls. The "LANGLEY GRAPHICS SYSTEM MANUAL" (G-3) gives the values and their defaults.

Interface

LARCGOS (LUV0) produces a portable (ASCII) graphics output file referred to as a plot vector file and named NOSPLT. The NOSPLT file is converted to a DI-3000 version 5 metafile using the NOS2MF program.

Documentation on NOS2MF is on-line and may be accessed with:

```
man nos2mf
```

The resulting metafile is processed using the DI-3000 Metafile System discussed in section 4.

Some implementations of LARCGOS (LUV0) provide an interactive plot capability using the Tektronix PLOT10 subroutine library. Users interested in this capability should consult their local system administrators.

Access

LARCGOS (LUV0) resides on SNS UNIX hosts (**Eagle, Mustang**) as a user library.

The usage and loading documentation on UNIX is on-line and may be accessed by entering:

```
man larcgos
```

Since PLOT10 is not available on SNS UNIX hosts, LARCGOS (LUV0) does not support interactive plotting.

3.9 PICSURE

Description

PicSure is a menu/command driven software tool capable of producing line charts, bar charts, text charts and pie charts. Its symbol definition and locator input features also facilitate building organization charts and flow diagrams. Other important features include dynamic positioning of chart elements, control of the size and color of chart elements, control of all text attributes, and fast assembly of multicharts into a single image.

PicSure is documented in the "PICSURE USER'S GUIDE" (G-11).

Interface

PicSure uses the DI-3000 library as a kernel and therefore has access to the complete set of DI-3000 device drivers and metafile system (see section 3.1). PicSure users may access up to eight device drivers within a single PicSure session. This facilitates previewing a chart on the primary interactive device and sending output to a secondary hardcopy device within the same PicSure session. A list of the available DI-3000 device drivers can be found on-line:

UNIX man page

man picsure

VMS help command

pvihelp

Access

PicSure is currently available on the following SNS hosts:

UNIX (Mustang)

The use of PicSure on UNIX is detailed in the UNIX man page for PicSure accessed by entering:

man picsure

The man page provides information on device selection and the setting of required environment variables. These environment variables must be set before invoking PicSure.

VMS

The use of PICSURE on VMS hosts is documented by the VMS command:

pvihelp

This command provides details on defining logical names and selecting device drivers. The VMS computers require logical names to be defined before invoking PicSure.

3.10 PVWAVE

Description

Precision Visual's Workstation Analysis and Visualization Environment (PVWAVE) is an end-user software system that allows users to interactively display, reduce, analyze and visualize technical data. Data may be visualized in the form of charts, graphs, scatterplots, contour maps, surfaces, and images.

The data reduction and analysis features of PVWAVE include curve fitting, data selection filters, common mathematical and statistical functions, matrix manipulation, random number generators, complex number operations, Fast Fourier Transforms, and special math functions (Bessel, error function, Gamma). PVWAVE's 2D plotting capabilities include time series line graphs, scatterplots, bar graphs, and histograms, 2D vector field plotting, polar plots, and log/linear axis scaling. Contour plots, hidden-line mesh surface plots, gridding of non-uniformly spaced data, and light-source shading of 3D surfaces and polygonally defined objects are provided for 3D data representation. General graphics utilities, image processing functions, and data input/output functions are also provided.

PVWAVE is also a structured programming language and includes features such as variables and expressions; multiple data types; multi-field structures and arrays; arithmetic, relational, and boolean operations; file, window, and terminal input/output; IF...THEN...ELSE; FOR and WHILE loops; REPEAT...UNTIL loops; procedure and function calls; CASE statements; string processing utilities; and error handling utilities.

PVWAVE is documented in the "PVWAVE VERSION 2 USER'S GUIDE SUN" (available in the graphics lab).

Interface

PVWAVE supports graphics output to a SUN console running the Sunview windowing system, a Tektronix compatible terminal, and a PostScript file. Support for these devices are documented in Appendix E of the "PVWAVE VERSION 2 USER'S GUIDE SUN".

Access

PVWAVE Version 2.0 is available through the graphics lab for the SUN environment. The method of access is discussed in Chapter 2 of the "PVWAVE USER'S GUIDE", and is also detailed in the SUNOS man page for PVWAVE which may be accessed by entering:

man wave

Extensive on-line help is available within PVWAVE for variables, procedures, functions, device, and files.

The PVWAVE Demonstration System provides an introduction to PVWAVE's most important features and capabilities. Access to the Demonstration System is described in "PVWAVE VERSION 2 DEMONSTRATION SYSTEM GUIDE SUN".

3.11 FIGARO

Description

FIGARO is a commercial implementation (by Template Graphics Software, Inc.) of the Programmers Hierarchical Interactive Graphics System (PHIGS) which was adopted by ANSI as a 3D graphics standard (X3H3-1988) in October, 1988. FIGARO is a graphics tool which controls the definition, modification, and display of hierarchical graphics data from a centralized database. FIGARO features include 3D graphics output primitives, 3D modeling transformations, 3D viewing (with optional perspective), and a 3D workstation transformation.

FIGARO is documented in the:

"FIGARO REFERENCE MANUAL" (G-15)
"FIGARO TRAINING MANUAL" (G-16)

Interface

FIGARO interfaces to a wide cross-section of graphics terminals, plotters, printers, and film recorders. A list of available FIGARO device drivers can be found in the following UNIX man page:

man figaro

Access

FIGARO is currently available on the following host:

UNIX (Mustang)

FIGARO may be invoked as a subroutine library from a FORTRAN program or as a stand-alone program from the PHIGS Command Interpreter (PCI). The PCI accepts input interactively or reads commands from a script. The use of FIGARO is detailed in the UNIX man page:

man figaro

The man page provides information on device selection and the setting of required environment variables. These environment variables must be set before invoking FIGARO.

3.12 GKS

Description

The Graphics Kernel System (GKS) was approved by ANSI (X3H3,1985) as the graphics standard for developing 2D graphics applications. Although LaRC has been using the DI-3000 graphics software based on the de facto CORE standard as the basis for the 2D/3D graphics applications development, efforts are underway to procure a GKS commercial package which runs on the SNS computer system and supports a wide variety of graphics devices including those used in an X Window System environment.

3.13 PLOT3D, GAS and SURF

PLOT3D

Description

PLOT3D is a FORTRAN program developed at NASA Ames which interactively displays 2D and 3D grids and solutions resulting from CFD computations. The program plots a variety of scalar functions, vector functions or particle traces. The user can manipulate wire frames, shades surfaces, color contours, and vector fields and can annotate displays with titles and color bars. The output of PLOT3D can be interactively displayed and manipulated on a graphics workstation or can be written to a file for later use.

PLOT3D expects as input both a grid file and a solution file. The grid file contains the (x,y,z) location of every point on the grid, and the solution file contains flow field data at each grid point. The user can plot a wide variety of 2D and 3D functions for any portion of this grid. On a Silicon Graphics IRIS workstation, the resulting plot can be rotated, translated, or enlarged in real time using the mouse.

Interface

Images created by PLOT3D can be plotted on a Seiko color printer, a QMS Lasergrafix 1200, or a standard PostScript printer. In addition, an extension to PLOT3D is available which can produce a file in Raster Metafile Format (see section 4.3.2).

At the end of a PLOT3D session, a journal file is created which contains all the commands which have been entered. This journal is used as input to PLOT3X to produce graphics files for the Graphics Animation System (GAS). GAS is then used to create an animation sequence which can be videotaped.

Access

PLOT3D is capable of running on a variety of machines. It usually stands alone on a Silicon Graphics IRIS workstation, but it may be distributed between a host machine and the IRIS. In the distributed mode, the calculations are performed on a host machine, such as the CRAY, and the graphics information is sent over the network to the workstation for interactive display.

PLOT3D and PLOT3X are currently available on **Eagle, Mustang, and Voyager** at Langley. They are also installed on **navier** and **reynolds** at Ames. Help can be obtained on any of these systems with the *man plot3d* command. PLOT3D/3X for the IRIS workstation can be obtained by accessing the anonymous FTP account on **uxv**. In addition, the "PLOT3D USER'S MANUAL is available from NAS Documentation Center which may be contacted at (415) 604-4632 or (FTS) 464-4632.

GAS

Description

GAS (Graphics Animation System) is a program for the IRIS workstation which allows the user to interactively view, render, and record a 3D animation sequence onto film, videotape, or video digital disk. Wireframes, shaded surfaces, and function mapped parts can be combined with titles and legends to produce presentation quality videos. In addition, several plots can be overlaid to compare and correlate different functions or datasets. GAS has been used primarily to animate pressure distributions, vortices, particle traces, and shock waves around the surface of aircraft models.

Interface

The mouse-driven menu and window environment of GAS provide a friendly and simple user interface. A viewport displays all graphics, titles, and legends, a text window prompts the user for keyboard input, and a hierarchical menu shows the commands available at the current level.

Input into GAS is in the form of ARCGraph (Ames Research Center Graphics) files which are generated by SURF, PLOT3X, or any program using the ARCGraph libraries. These device-independent files contain vector, raster, and 3D polygon data which can be readily viewed and modified on the screen. GAS can interpolate between chosen views to produce a smooth animation which can be recorded. Selected images can also be dumped to a QMS laser printer or a Seiko color printer.

GAS is written in C and is exclusively designed for a Silicon Graphics IRIS workstation having 32 bit-planes, near/far clipping capability, and z-buffering hardware. A variety of video recorders, cameras, monitors, and encoders which are explained in the "GAS USER'S MANUAL" are supported.

Access

Source code for GAS can be obtained by accessing the anonymous FTP account on **uxv**. Installation instructions and examples are included for the IRIS 2XXX/3XXX workstations. In addition, the "GAS USER'S MANUAL" is available from the NAS Documentation Center which may be contacted at (415) 604-4632 or (FTS) 464-4632.

SURF

Description

SURF is a surface model generator program developed for the Silicon Graphics IRIS workstation. The program reads PLOT3D grid and solution files and creates a 3-dimensional model which can contain wireframe, shaded, or function-mapped parts (pressure, density, temperature, etc.). The model can be interactively viewed, edited, or colored, and up to 20 light sources can be selected. The resulting object can be saved to a file which can be loaded into the Graphics Animation System (GAS). GAS is then used to create an animation sequence which can be videotaped.

Interface

SURF uses a mouse-driven menu interface similar to GAS to perform most operations. This interface is supported only on Silicon Graphics IRIS 2XXX/3XXX series workstations running UNIX. For optimum performance, the workstation should have at least 4MB of memory, 32 bit-planes, z-buffer and z-clipping capability, and floating-point hardware support.

The output from SURF is a device-independent file format known as ARCGraph. This data file can contain vector, raster, or 3D polygon information which can be read directly into GAS to create the key frames for an animation sequence. ARCGraph files are also generated by PLOT3X.

Access

Source code for SURF can be obtained by accessing the anonymous FTP account on **uxv**. Installation instructions and examples for the IRIS 2XXX/3XXX are included. In addition, the "SURF USER'S GUIDE" is available from the NAS Documentation Center which may be contacted at (415) 604-4632 or (FTS)464-4632.

4. METAFILE SYSTEM

The graphics software packages and graphics output devices supported by the LARCGS are integrated through portable graphics output files referred to as metafiles. Although the LARCGS supports a large and diverse collection of software packages (see section 3), each with its own set of device drivers, and a wide variety of output devices (see section 5); the graphics metafile provides the common interface between software package and output device. Direct support is provided for both vector and raster metafile formats and indirect support for other standard graphics output formats is also included. The PVI DI-3000 metafile format has been adopted as the standard vector metafile format. The locally designed Raster Metafile (RM) format has been adopted as the standard raster metafile format. As an example of indirect support, both DI-3000 metafile and RM formatted files may be converted to Adobe's PostScript format. In addition, DI-3000 metafiles may be converted to the ANSI standard Computer Graphics Metafile (CGM) and vice-versa. For graphics software packages that produce none of the directly or indirectly supported metafile formats, software translators or translation tools have been provided to assist in any necessary conversion efforts. The metafile interfaces supported by each LARCGS graphics package are shown in figure 1.

The following subsections detail the LARCGS metafile system and metafile processing. Vector and raster metafile processing are detailed, indirectly supported graphics output formats are discussed, and graphics output conversion options are identified.

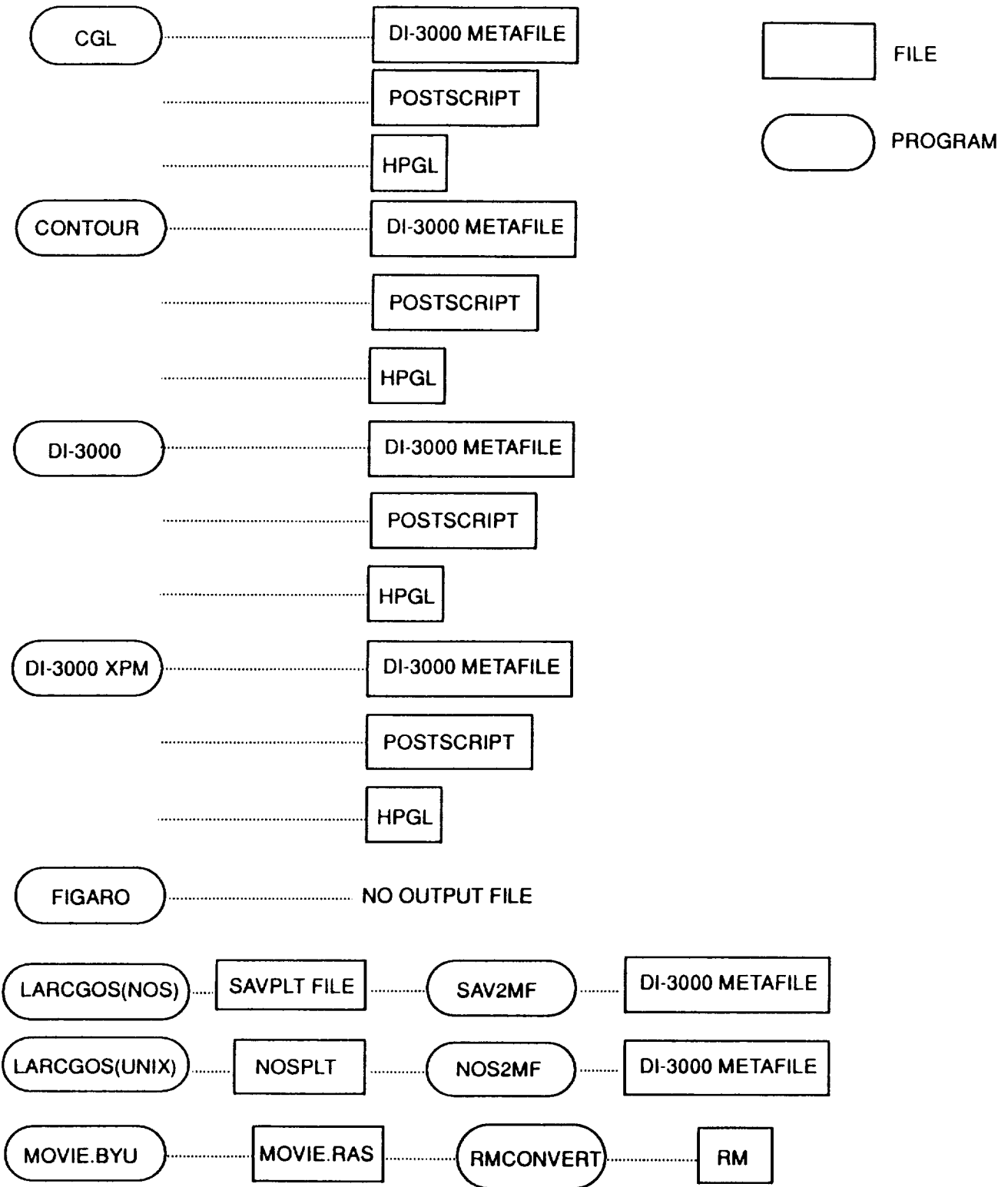


Figure 1: GRAPHICS METAFILE INTERFACES

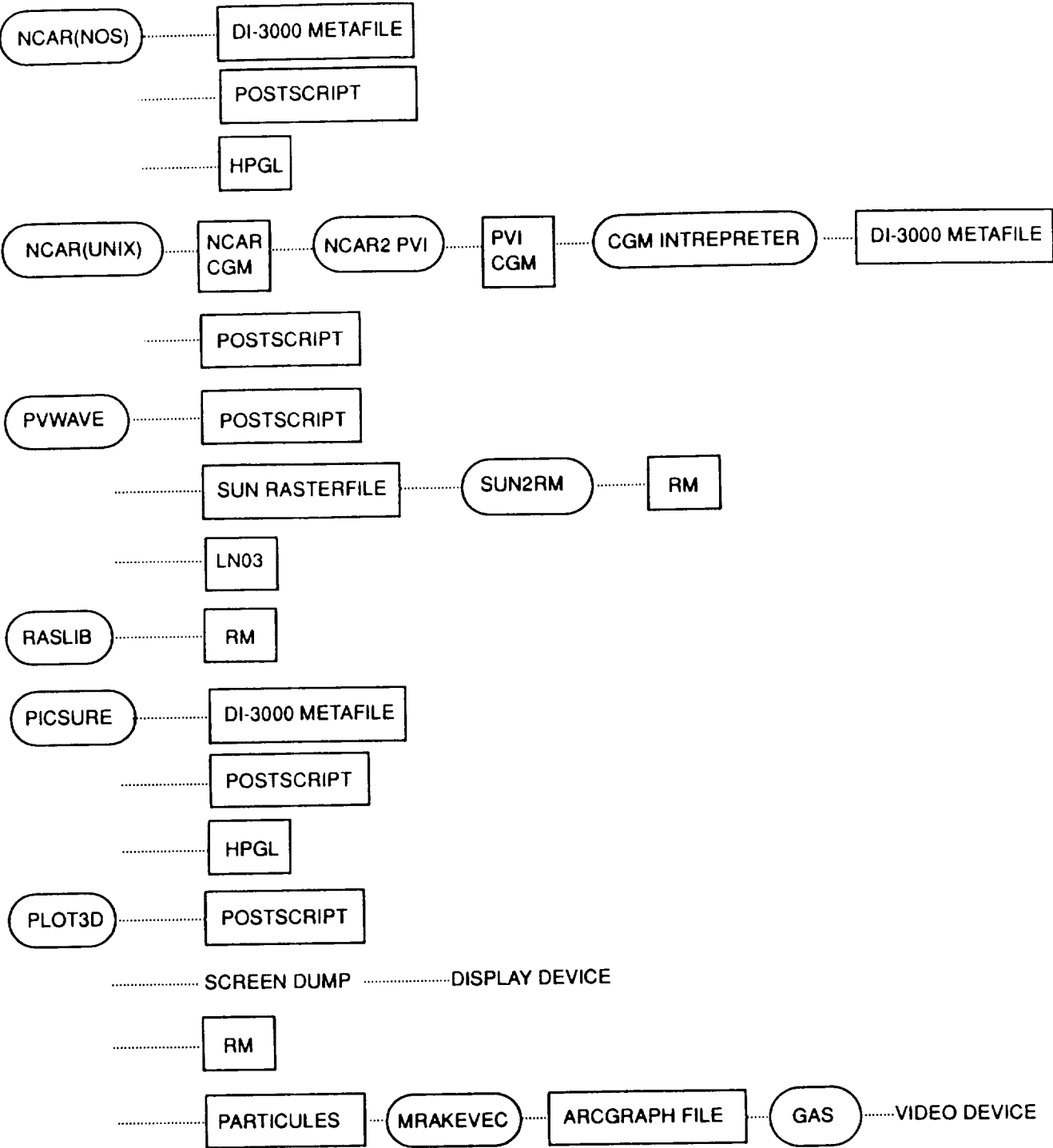


Figure 1 Continued.

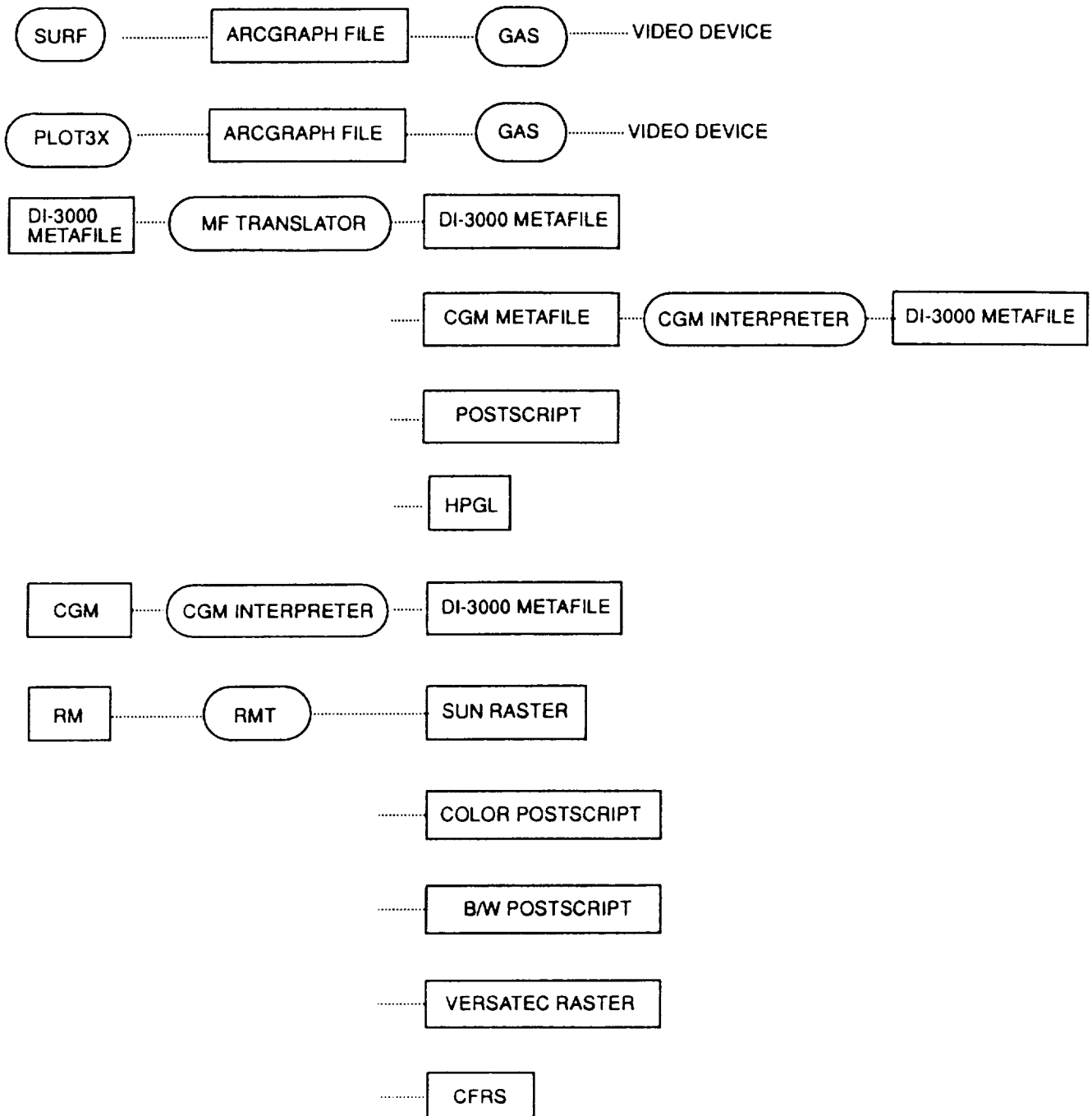


Figure 1 Concluded.

4.1 Vector Data Processing

LaRC has adopted the PVI proprietary metafile format as the current standard for processing vector metafiles into hardcopy on the ACD hardware production devices. The PVI metafile system, documented in the "METAFILE TRANSLATOR USER'S GUIDE" (G-6), is a stand-alone, interactive software tool for the storage, retrieval, manipulation and transport of graphical images for viewing and hardcopy. The system includes support for both the PVI proprietary metafile and the ANSI and ISO approved CGM metafile format. It is intended that the ANSI approved CGM metafile format will eventually replace the PVI proprietary metafile format as the LaRC standard.

The PVI Metafile System provides a mechanism for creating metafiles and subsequently viewing them on one or more graphics devices. The Metafile System consists of two major components:

- . the Metafile Driver
- . the Metafile Translator

The Metafile Driver writes the graphical information from the graphics session to an output file, the metafile. In DI-3000 (see section 3.1), the Metafile Driver can be initialized and selected at the start of each graphics session. In PicSure (see section 3.9), the Metafile Driver is initialized with the 'Metafile Name' command. These operations are discussed in detail in the user's guide for each product that can generate a metafile. Similarly, the Metafile Driver can be used within an applications program to access a metafile for input. The Metafile Driver also reads graphical information from a previously created metafile into an application program or graphics session.

The Metafile Translator is an interactive program that interprets metafiles and sends graphics output to a selected graphics device. Pictures may be read from up to five metafiles concurrently. Pictures may be positioned, scaled, and superimposed on each other. Pictures from different metafiles may be combined and written to a new metafile. The new metafile may be a PVI metafile or a CGM metafile. The flow of information through the Metafile Translator is shown in figure 2.

Vector data processing requires invoking the Metafile Translator with an appropriate device driver and displaying the graphics pictures on the graphics device. If the target device is a terminal or workstation, the pictures are normally displayed on the screen. If the target is a hardcopy device, the Metafile Translator produces a device-specific formatted output file that must be ported to the output device. A complete list of graphics devices supported by the Metafile Translator may be found in the UNIX man page accessed by entering:

man mfrtran

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In the SNS environment, a series of graphics filters (generically named *mfdev*) have been provided to automate device access. Information on the available graphics filters and their use may be obtained by entering:

man mfdev

The Metafile Translator together with the associated device drivers and graphics filters are available on the SNS platforms. Detailed access information may be obtained from the UNIX man pages listed below:

man mftran and *man mfdev*

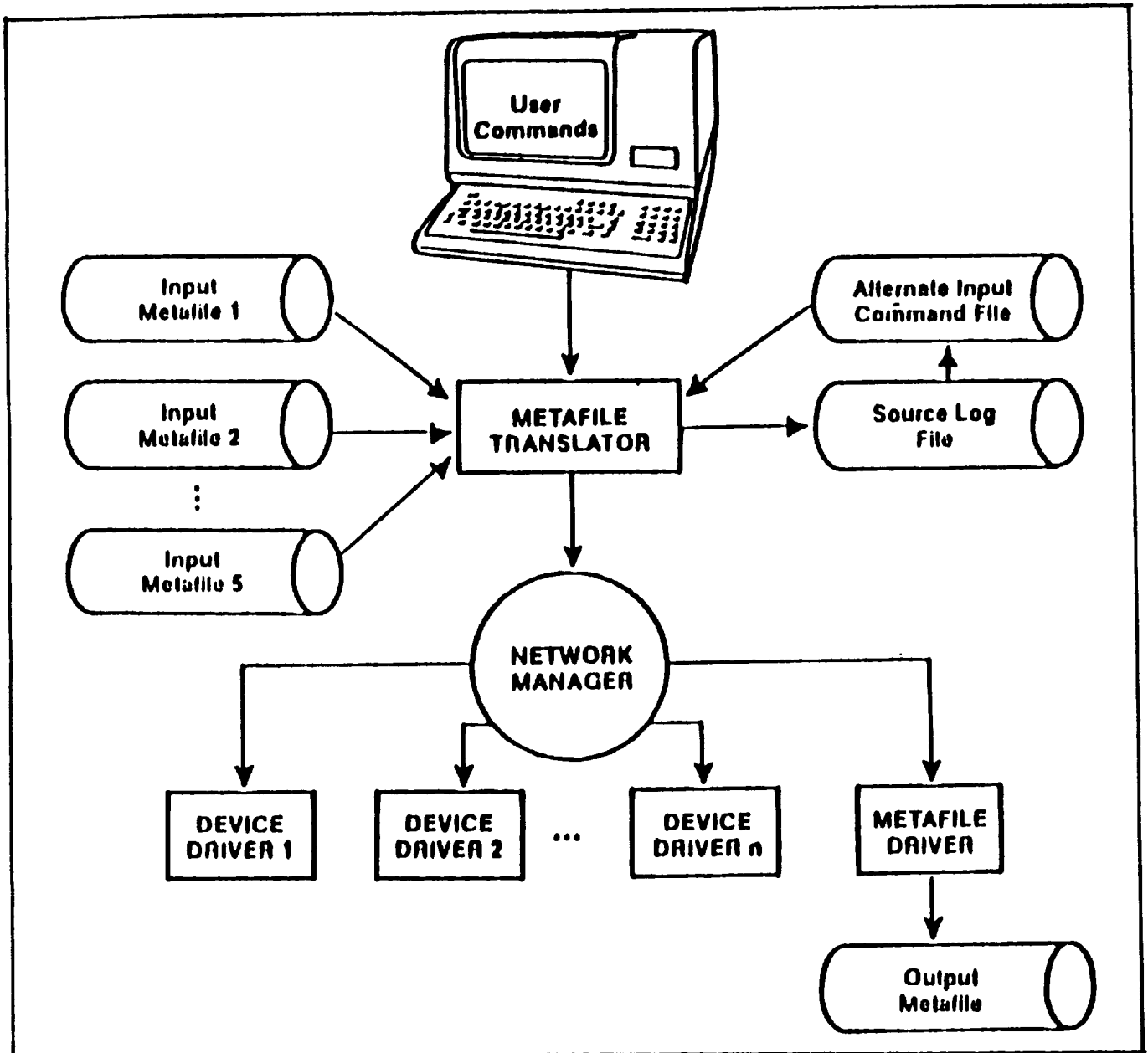


Figure 2: METAFILE TRANSLATOR FLOW

4.2 Raster Data Processing

In an effort to standardize the processing of raster image data, the LARCGS has adopted the locally specified Raster Metafile (RM) format. Once an image has been represented in RM format, the image may be processed using the Raster Metafile Translator (RMT) and displayed using one of the device drivers associated with the RMT. Raster data processing within the LARCGS is documented in the "RASTER METAFILE AND RASTER METAFILE TRANSLATOR" (G-14).

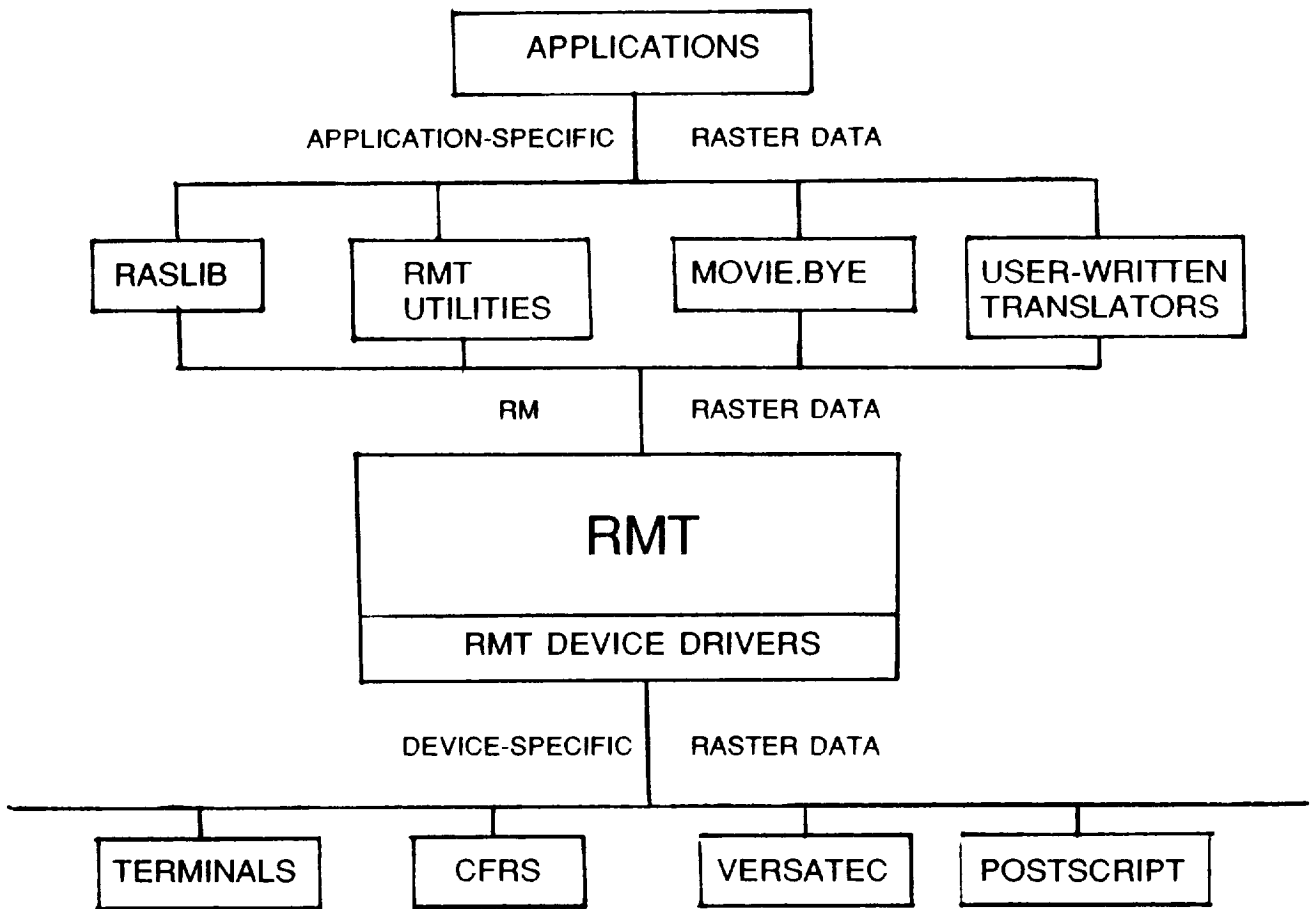
The major steps required in raster image data processing are illustrated in figure 3. The first processing step is the generation of or conversion to RM format. If a software package outputs the RM format directly (such as RASLIB (see section 3.6)), no conversion phase is required. If image format conversion is required, it may be possible to exercise an existing translation utility or it may be necessary to develop a new one. The availability of existing translators is discussed in section 4.3.2. If a new raster data translator is required, a FORTRAN-callable RM utility library and a FORTRAN skeleton conversion program are provided to assist in the development effort (see document G-14 for further information). The methods of RM image generation/conversion are illustrated in figure 3. Once the image is in RM format, the RMT may be used to display the image or to perform other RM image processing including image clipping or resizing, image composition, image to device compatibility conversions, etc. The capabilities of the RMT are documented in G-14.

The final step in RM image processing is displaying the image on the selected device. The RM has been interfaced (through the RMT) to a variety of terminals/workstations, film recorders, laser printers, etc. A complete list of graphics output devices supported by the RMT is provided in G-14 and a UNIX man page accessed by entering:

man rmtran

In order to display the image, the user links the appropriate device driver at load time (see *rmtran* man page) and invokes the RMT DRAW command (see document G-14). If the designated device is a terminal or workstation, the image is normally displayed on the screen. However, in the case of hardcopy devices, the RMT produces a device-specific formatted output file that must be ported to the output device. In the SNS environment, a series of graphics filters (generically named *rmdev*) have been provided to automate device access. Information on the available graphics filters and their use may be obtained by entering:

man rmdev



Raster Metafile (RM) - LaRC specified generic raster image format

Raster Metafile Translator (RMT) - Command-driven program to read/write, process, and display RM image data

Color Film Recording System (CFRS) - System for producing film output from computer generated graphics data

Figure 3: LaRC RASTER METAFILE

4.3 Metafile Conversion Support

Many of the popular software application packages used at the Center contain embedded graphics output facilities which produce either vector and/or raster graphics output. Because the vector and/or raster graphics output formats are often package-specific, the LARCGS provides software conversion tools aimed at converting package specific formats into either DI-3000 metafile or RM format. These conversion tools may take the form of a stand-alone postprocessor which converts a package-specific graphics output format into a supported metafile format or a FORTRAN-callable subroutine library that may be utilized to develop a postprocessor for any given format.

The following subsections describe the software conversion tools available for DI-3000 metafile and RM formats. Since the development of additional conversion tools is dynamic in nature; the user should consult the on-line documentation, identified in each subsection, to determine the availability and status of the metafile conversion utilities.

4.3.1 Vector Metafile Conversion

A processor to convert to/from PVI metafile format may be developed from the format specifications provided in document G-5. However, some conversion utilities and tools have already been developed to aid in the translation process. The capability of the PVI Extended Metafile System to convert from/to PVI metafile format to/from CGM format (discussed in section 4.1) is one example of such a utility.

The SAV2MF utility on NOS and the NOS2MF utility on the SNS CONVEX C2 platforms are translation utilities which convert LARCGOS (see section 3.8) graphics output files into PVI metafiles. The SAV2MF program is documented as a NOS permanent file which may be accessed by:

```
GET,SAV2DOC/UN=PVININFO,ST=CPF.
```

NOS2MF is documented on-line in the form of a UNIX man page which may be accessed by entering:

```
man nos2mf
```

SAV2MF and NOS2MF were developed using two FORTRAN-callable subroutine libraries, MFLIB and MFINT. MFLIB is a low-level utility library which provides routines for generating most PVI metafile opcodes. MFINT is a higher-level library which sits atop MFLIB and creates PVI metafiles through a series of DI-3000 like subroutine calls. Both libraries are available on the SNS CONVEX hosts in the area:

```
/usr/local/unsupported/graphics/metafile/vector
```

under the names:

```
mflib.a and mfint.a
```

and on NOS as permanent files accessed via:

```
GET,MFLIB/UN=PVININFO,ST=CPF.  
GET,MFINT/UN=PVININFO,ST=CPF.
```

The documentation for both libraries is a composite listing of the prologues from each of the subroutines comprising the libraries. On SNS the documentation is located in the aforementioned area under the names:

```
mflib.doc and mfint.doc
```

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For NOS the documentation is available on permanent files accessed as follows:

```
GET,MFLIBD/UN=PVINFO,ST=CPF.  
GET,MFINTD/UN=PVINFO,ST=CPF.
```

The output from the NCAR GKS (UNIX) contouring system (see section 3.3.2) is an NCAR-specific CGM file which may be processed only by the NCAR CGM interpreter. A postprocessor which converts NCAR CGM into a CGM format conforming to the PVI Extended Metafile System is available on SNS. This postprocessor has been interfaced to the NCAR CGM translator as a separate device, `pvicgm`. Further information on the use of this processor is available on-line and may be accessed by entering:

```
man nctran
```

As other PVI metafile or CGM translation tools become publicly available, they will be announced using the UNIX *notes* under the *graphics* topic.

4.3.2 Raster Metafile Conversion

A processor to convert to/from RM format may be developed from the RM format specifications detailed in document G-14. However, the RMT utility library offers an alternative to conversion processor development that hides the details of the RM format. The FORTRAN-callable RMT utility library provides routines which read/write all major components of RM formatted images. A skeleton FORTRAN program illustrating the use of the RMT utility library on a typical image conversion problem is also provided. Information on the use of and access to both the RMT utility library and the skeleton program are provided in G-14 and in the UNIX man page accessed by entering:

man rmtran

In many instances, conversion utilities may already exist. Some graphics and/or application packages may provide an option for directly outputting RM formatted images. An example of direct RM image output is provided by RASLIB (see section 3.6). The reader should consult relevant package documentation to determine the existence of an RM output option. In other cases, packages- or platform-specific processors have already been developed to convert to/from the RM format. FORTRAN programs converting to/from RM format from/to SUN MICROSYSTEM's Pixrect image format are provided as part of the standard RMT release (see *man rmtran*). As new RM format converters of interest to the general user community become available, they will be identified on SNS using the UNIX *notes* facility under the *graphics* topic and will reside in the area:

/usr/local/unsupported/graphics/metafile/raster

5. GRAPHICS HARDWARE

The demand for more and better quality graphics output, coupled with the technological advances in affordably-priced graphics hardware, have resulted in a diverse collection of graphics output devices being supported at the Center. This collection of graphics hardware devices includes: pen, electrostatic and thermal plotters; a variety of vector, raster, monochrome and color terminals; engineering workstations and PC's; dot matrix and line printers; film recorders and laser printers/plotters. The features of the ACD Graphics Production Devices are shown in Table 2. The list is dynamic in nature. Graphics hardware devices can be grouped into two distinct categories each providing varying degrees of support. The two categories are the off-line ACD Graphics Production Devices, and the large set of devices supported at "local sites" distributed throughout the Center.

Hardware device support means providing an interface from one or more graphics software packages to the device. Each of the ACD supported software packages interfaces to a hardware device through a software device driver.

A device driver is a device- (and possibly package-) dependent software utility that generates device-specific graphics output. In the case of an interactive device, the device driver outputs graphics directly to the display surface. If the selected device is an off-line hardcopy graphics output device, the driver generates a device-specific graphics output file. Normally, a separate device driver is associated with each graphics output device. The available device drivers for each of the graphics software packages supported by the LARCGS are identified in section 3.

In an effort to standardize the interface between software package and device, the LARCGS supports portable graphics files called metafiles. As explained in section 4, the metafile provides a common format that is recognized by all supported devices. Direct support for vector data is provided through the DI-3000 metafile format, and direct support for raster data is provided through the locally adopted RM format. In addition, indirect support is provided for other portable graphics output files such as PostScript and CGM. The metafile generation capabilities of supported graphics packages are identified in section 3.

The recommended approach for interfacing to supported hardcopy devices is through a graphics metafile. Metafile interpreters (see section 4) are available to convert portable graphics output into device-specific graphics output. The usage of the metafile interpreter is host-specific and is explained in the next subsection. In addition to the device interface, the features and capabilities unique to each device are identified.

TABLE 2: ACD GRAPHICS PRODUCTION DEVICE FEATURES

	CHARACTERISTICS							FORMAT			
	B/W	COLOR	FILM	TRANSPARENCY	A-SIZE	B-SIZE	GREATER THAN B-SIZE	ROLL	VECTOR INPUT	RASTER INPUT	POSTSCRIPT
CALCOMP 11" DRUM PLOTTER	X	X			X		X	X	X		
CALCOMP 34" DRUM PLOTTER	X	X					X	X	X		
COLOR FILM RECORDING SYSTEM		X	X	X					X	X	
IBM LASER PRINTER	X								X		
QMS LASER PRINTER	X				X						X
VERSATEC ELECTROSTATIC PLOTTER		X					X	X	X	X	
VERSATEC THERMAL PLOTTER		X		X	X	X			X	X	

5.1 ACD Graphics Production Devices

The ACD Graphics Production Devices are maintained and operated for the LaRC user by ACD. The hardware is located in the plotting area (restricted area) of ACD, and is interfaced through one of the portable graphics output files discussed in section 4. The ACD Graphics Production Devices and the metafile formats that each device either directly or indirectly supports are listed in Table 3.

Access to the ACD Graphics Production Devices is host-specific. On NCS, device access is accomplished through one of the PLOT postprocessors. On SNS, the *mfdev* (vector) and *rmdev* (raster) graphics filters provide access to the ACD Graphics Production Devices. Host-specific access to each of the ACD Graphics Production Devices is categorized in Table 3.

Both the postprocessors and the graphics filters allow the user to control graphics output processing through the specification of plot parameters, plotting instructions, and metafile translator commands. The use of plot parameters and plotting instructions is documented in the "LANGLEY GRAPHICS SYSTEM" (G-3). The use of translator commands is documented in the references identified in section 4. Information on the use of the graphics filters is obtainable on-line on the SNS hosts by entering:

man mfdev or *man rmdev*

Information on the PLOT. postprocessors is available from document G-3 and the "DEVICE DRIVER GUIDES" (G-10).

New ACD Graphics Production Devices will be accessible from the SNS machines only. Users on other hosts will have to insure their data is in a proper format and move the data to one of the SNS machines in order to access the new devices.

The following subsections detail the features and capabilities unique to each ACD Graphics Production Device. Information on accessing the devices from different machines and the input formats (vector or raster) accepted by each device are also given. The characteristics of each device are summarized in Table 4.

TABLE 3. ACD GRAPHICS PRODUCTION DEVICE DRIVERS

<u>UNIX</u>			
Devices	Vector	Raster	PostScript
CALCOMP 11" drum plotter CALCOMP 34" drum plotter VERSATEC 39" color electrostatic plotter VERSATEC thermal plotter - A size drawing - B size drawing IBM laser printer/plotter Color film recording system - 16-mm - 35-mm - 8 x 10 viewgraphs - 4 x 5 negatives QMS laser printer/plotter (B/W)	<i>mfc</i> 11 <i>mfc</i> 34 <i>mfv</i> 39 <i>mf</i> vera <i>mf</i> verb <i>mf</i> ibm3800 <i>mfc</i> 16 <i>mfc</i> 35 <i>mfc</i> 8 <i>mfc</i> 4	<i>rmv</i> 39 <i>rm</i> vera <i>rm</i> verb <i>rmc</i> 16 <i>rmc</i> 35 <i>rmc</i> 8 <i>rmc</i> 4	<i>lpr -Ppsjet+</i>
<u>NOS</u> CALCOMP 11" drum plotter CALCOMP 34" drum plotter VERSATEC 39" color electrostatic plotter VERSATEC thermal plotter - A size drawing - B size drawing IBM laser printer/plotter Color film recording system - 16-mm - 35-mm - 8 x 10 viewgraphs - 4 x 5 negatives QMS laser printer/plotter (B/W)	PLOT.ZCAL,11 PLOT.ZCAL,34 PLOT.ZVER,39 PLOT.ZVER,A PLOT.ZVER,B PLOT.ZLASER PLOT.ZCEL,16 PLOT.ZCEL,35 PLOT.ZCEL,8 PLOT.ZCEL,4	PLOT.VERRAS,39 PLOT.VERRAS,A PLOT.VERRAS,B PLOT.CELRAS,16 PLOT.CELRAS,35 PLOT.CELRAS,8 PLOT.CELRAS,4	<i>lpr -Ppsjet+</i>

TABLE 4: OPTIONS FOR ACD GRAPHICS PRODUCTION DEVICES

UNIX Option	NOS Option	Description	CAL34	CAL11	VER39	VERA	VERB	CELxx	IBM3800
-h	HEIGHT	height of plot	34	11	39	8	10	n	7.5
-w	WIDTH	width of plot	34	11	39	8	10	n	7.5
-x	XO	x offset	0	0	n	n	n	n	0
-y	YO	y offset	0	n	n	n	n	n	0
-p	PAGE	page size	n	y	n	n	n	n	n
-r	RVAX	rotate 90 degrees	y	y	n	y	y	n	y
-c	COPY	number of copies	n	n	n	n	n	1	n
-1	PW1	width of pen 1	n	n	2	2	2	n	n
-2	PW2	width of pen 2	n	n	2	2	2	n	n
-3	PW3	width of pen 3	n	n	2	2	2	n	n
-4	PW4	width of pen 4	n	n	2	2	2	n	n
-5	PW5	width of pen 5	n	n	2	2	2	n	n
-6	PW6	width of pen 6	n	n	2	2	2	n	n
-7	PW7	width of pen 7	n	n	2	2	2	n	n
-8	PW8	width of pen 8	n	n	2	2	2	n	n
maximum height			34	11	39	8.11	10.66	n	13.88
maximum width			1320	1320	156	8.91	14.91	n	7.50

5.1.1 CALCOMP

Description

The Calcomp is a high-speed, two-axis, interchangeable drum plotter designed for plotting one variable against another in response to digital incremental signals. The resolution is .0005 inch in both directions and the quality of the plots is suitable for publication. The drum plotters use either ballpoint or Leroy pens and permit up to five pen sizes in each of four colors. Blank and preprinted grid paper are available in continuous roll for the 11" and 34" drum plotters. The Calcomp 11-inch drum plotter can also accommodate a continuous roll of blank paper perforated each 8.5 inches (600A paper).

Information on the Calcomp plotter is available from documents G-3 and G-10 and from the SNS on-line documentation file accessed by entering:

man mfdev

Access

The CALCOMP plotters can be accessed with one of the following control statements:

Vector Input

UNIX

<i>mfc11</i>	11" paper
<i>mfc34</i>	34" paper

NOS

PLOT.ZCAL,11	11" paper
PLOT.ZCAL,34	34" paper

5.1.2 VERSATEC ECP-42

Description

The Versatec ECP-42 is an electrostatic plotter capable of plotting in black and white or in color and uses continuous roll paper. The resolution of the device is 40,000 points per square inch (or 200 points per linear inch). The quality could be acceptable for publication if the plots are generated larger than page size and reduced photographically by the Langley publication process. Since plotted output has only a .002 inch resolution, some lines and symbols look jagged with no reduction. Plots up to 13 feet can be drawn. When plotting in color, the plot is drawn with one registration pass, followed by four color passes (black, cyan, magenta and yellow). Automatic dual-axis tracking gives consistent registration between passes.

The Versatec ECP-42 accepts vector and raster data as input. In vector mode, the ECP-42 produces 256 colors and is capable of performing hardware fill on complex polygons. In raster mode, the Versatec has a maximum resolution of 8000 X 8000 pixels at eight colors.

Information on the Versatec ECP-42 plotter is available in document G-10 and from the SNS on-line files by entering:

man mfdev or *man rmdev*

Access

The VERSATEC electrostatic plotter is accessed with one of the following control statements:

Vector Input

UNIX

mfver39 39" paper

NOS

PLOT.ZVER,39 39" paper

Raster Input

UNIX

rmver39 39" paper

NOS

PLOT.VERRAS,39 39" paper

5.1.3 VERSATEC VERSACOLOR

Description

The Versatec Versacolor is a thermal plotter capable of plotting in monochrome or color. It can produce full color A-size and B-size plots. It offers 300 dots per inch resolution.

The VERSATEC Versacolor plotter accepts vector and raster input. The vector software provides for seven line colors and 256 pre-defined colors. As a raster device, the thermal plotter has a maximum resolution of 2432 X 2432 (A-size) and 3124 X 3124 (B-size) at eight colors.

Information on the VERSATEC Versacolor plotter is available from document G-10 and from the SNS on-line files by entering:

man mfdev or *man rmdev*

Access

The VERSATEC thermal plotter is accessed with one of the following control statements:

Vector Input

UNIX

<i>mfvera</i>	A size paper
<i>mfverb</i>	B size paper

NOS

PLOT.ZVER,A	A size paper
PLOT.ZVER,B	B size paper

Raster Input

UNIX

<i>rmvera</i>	A size paper
<i>rmverb</i>	B size paper

NOS

PLOT.VERRAS,A	A size paper
PLOT.VERRAS,B	B size paper

5.1.4 IBM LASER PRINTER/PLOTTER

Description

The IBM Laser printer/plotter is a high speed laser printer capable of plotting black and white images. It has a plotting resolution of 240 X 240 dots per square inch. The laser printer uses the back side of 14.88 X 8.5 fanfold-lined listing paper. The maximum plotting area is approximately 13.88 X 7.5.

An image is created in the controller of the laser printer. The raster image is then transferred to a light sensitive, positively charged drum in the laser printer. The drum is then rotated while a laser light scans the drum neutralizing the spots where black should be and positively charging the spots where white should be. The drum is then rolled through a positively charged toner powder where powder sticks to the neutralized dots on the drum. The laser printer then places a negative charge on the paper and the positive toner powder sticks to the negative paper when the paper is passed over the drum.

Information on the laser printer is available from document G-10 and from the SNS on-line files by entering:

man mfdev

Access

The laser printer is accessed with one of the following control statements:

Vector Input

UNIX

mfibm3800

NOS

PLOT.ZLASER

5.1.5 COLOR FILM RECORDING SYSTEM

Description

The Color Film Recorders are high resolution devices capable of producing 16mm movies, 35mm slides, 4X5 negatives and 8X10 viewgraphs in color or black/white. 256 colors are available and a copy of the default color table can be obtained from OCO. Different resolutions are available depending on the format. A table giving the format and the different resolutions follows:

8 X 10 viewgraph	5120 X 4096
4 X 5 negative	5120 X 4096
35mm	4096 X 2732
16mm	1402 X 1024

Documentation for the Color Film Recording System is available from document G-10 and from the SNS on-line files by entering:

man mfdev and man rmdev

Access

The Color Film Recording System is accessed with one of the following control statements:

Vector Input

UNIX

<i>mfcel16</i>	16mm
<i>mfcel35</i>	35mm
<i>mfcel8</i>	8 X 10 viewgraph
<i>mfcel4</i>	4 X 5 negative

NOS

PLOT.CEL,16	16mm
PLOT.CEL,35	35mm
PLOT.CEL,8	8 X 10 viewgraph
PLOT.CEL,4	4 X 5 negative

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Raster Input

UNIX

<i>rmcel16</i>	16mm
<i>rmcel35</i>	35mm
<i>rmcel8</i>	8 X 10 viewgraph
<i>rmcel4</i>	4 X 5 negative

NOS

PLOT.CELRAS,16	16 mm
PLOT.CELRAS,35	35 mm
PLOT.CELRAS,8	8 X 10 viewgraph
PLOT.CELRAS,4	4 X 5 negative

5.1.6 QMS PSJET+ Laser Printer

Description

The QMS PSJET+ is a laser printer capable of plotting black and white PostScript files. It has a plotting resolution of 300 dots per inch. The PSJET+ uses state-of-the-art laser printer technology to produce 8.5 X 11 inch black and white plots.

Access

The QMS PSJET+ is available only on **Eagle** and **Mustang** and can be accessed with the following command:

```
lpr -Ppsjet+
```

5.2 Graphics Lab

The ACD Graphics Lab is located on the first floor of Building 1268A in Room 1101A. Its functions are to provide access to graphics hardware and software to users who need it, provide a facility for evaluating new graphics hardware, and to promote an environment conducive to graphics research.

The facility has microcomputers, workstations, graphics terminals, and graphics hardcopy devices. A list of the available graphics devices can be accessed on the **Eagle** and **Mustang** computer with the following command:

```
man acdlab
```

Users are invited to use the facilities in the ACD Graphics Lab whenever it is convenient. Users seeking access to the ACD Graphics Lab should call FSGB at 864-6706.

6. INFORMATION RESOURCES

The information in the preceding sections provides an overview of the computer graphics environment at Langley Research Center. There are three sources for computer graphics information: user documentation, user training, and user technical assistance.

Both printed material and on-line documentation on computer graphics are available. ACD-supplied printed material includes vendor documentation for supported software and hardware products and locally developed documentation describing LaRC implementation information. The on-line documentation is current information and is designed for quick reference. The official LaRC Central Scientific Computing Complex graphics documentation is designated as document category "G" (see "INTRODUCTION TO THE USE OF THE CENTRAL SCIENTIFIC COMPUTING COMPLEX" (A-1)). The on-line documentation should be consulted periodically to determine current status information with respect to the Langley Graphics System.

Users with graphics related problems may obtain technical assistance from the User Consultation Office (Building 1268, Room 1046, 864-6581).

The following subsections detail the available computer graphics information resources.

6.1 Graphics Documentation

The following documents are available through the Operations Control Office (OCO, ext. 864-6562) or by sending electronic mail to lionel@uxv for overnight service.

- G-1 GRAPHICS MINI MANUAL (February 1990)
- G-2 GUIDELINES IN PREPARING COMPUTER-GENERATED PLOTS FOR
NASA TECHNICAL REPORTS WITH THE LARC GRAPHICS OUTPUT
SYSTEM. (NASA TM81908 (revised), Aug. 1983)
- Describes techniques for preparing plots for publication.
- G-3 LANGLEY GRAPHICS SYSTEM (January 1983)
- Describes batch graphics usage, graphics subroutines, and ACD
Graphics Production Devices.
- G-5 DI-3000 USER'S GUIDE (Version 5)
 APPENDIX D - DI-TEXTPRO
 APPENDIX E - DI-3000 XPM
- Complete description of DI-3000 graphics system.
- G-6 (NOS) METAFILE SYSTEM USER'S GUIDE
G-6 METAFILE TRANSLATOR USER'S GUIDE
- Describes the DI-3000 Metafile system including the metafile driver,
METAFILE TRANSLATOR, and metafile structure.
- G-8 CONTOURING SYSTEM USER'S GUIDE
- Complete description of CONTOURING System subroutines and
parameters.
- G-9 (NOS) NCAR GRAPHICS SOFTWARE
G-9 NCAR GKS-COMPATIBLE GRAPHICS SYSTEM
- Complete description of the low-level system plot package and the
high-level utilities for depicting contours, surfaces, velocities, and maps
which comprise the NCAR software.
- G-10 DEVICE DRIVER GUIDES
- Describes the device specific features of a DI-3000 graphics device
driver.

- G-11 PICSURE USER'S GUIDE
 PICSURE PLUS USER'S GUIDE - PICQUICK
 PICSURE PLUS USER'S GUIDE APPENDIX C - PICTOOLS
- Provides a complete description for drawing charts and graphs with the PICSURE software.
- G-12 COMMON GRAPHICS LIBRARY (CGL) VOLUME I: LEZ USER'S GUIDE
G-13 COMMON GRAPHICS LIBRARY (CGL) VOLUME II: LOW-LEVEL
 USER'S GUIDE
- Describes use of COMMON GRAPHIC LIBRARY routines
- G-14 RASTER METAFILE AND RASTER METAFILE TRANSLATOR
- A command-driven program designed to permit reading/writing, display and manipulation of RM formatted images.
- G-15 FIGARO REFERENCE MANUAL
- Provides a functional description of FIGARO, including a detailed description of each user level subroutine.
- G-16 FIGARO TRAINING MANUAL
- Provides a step-by-step approach to learning FIGARO for beginners.

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The following documents are available in User Consultation for reference only (ext. 46581).

NCAR CONNECTOR GRAPHICS PACKAGE USER'S GUIDE

Describes the software interface between the NCAR graphics library and DI-3000.

USER'S GUIDE TO NCAR CONTOUR PLOTTING

Through a series of increasingly complex examples, the use of the NCAR contouring routines in FORTRAN programs is illustrated. (Also exists as ICASE Internal Report. Document no. 25, Nov. 18, 1983.)

MOVIE.BYU TRAINING MANUAL

Describes the capabilities of the Brigham Young University FORTRAN programs including visual realism algorithms, model generation, and animation and movie production procedures.

LaRC MOVIE.BYU IMPLEMENTATION NOTES

Describes modifications made to MOVIE.BYU (Version 5.1) for implementation at LARC. This manual should be used in conjunction with the on-line documentation or the MOVIE.BYU Training Manual.

RASDOC

Complete description of the RASLIB subroutine library for generating digital images for display on a raster device. Includes details on movie making, image transfer, and the ACD DIGITAL DISPLAY/FILM WRITER SYSTEM.

GKS - THE GRAPHICS STANDARD

Text designed to provide the graphics community with detailed information on the GKS standard.

6.2 Assistance

6.2.1 USER CONSULTATION

The User Consultation Office staff, Building 1268, Room 1046, 804-864-6581, is ready to help you solve specific graphics problems, to recommend helpful documentation, to recommend a suitable package or subroutines for your application, to advise on how to use the package, to recommend programming techniques, etc. Consultation is available from 8:00 a.m. to 4:00 p.m. in person or by telephone. In addition, User Consultation may be contacted by sending electronic mail to:

uchelp@eagle.larc.nasa.gov
or
uchelp@voyager.larc.nasa.gov

6.2.2 ON-LINE DOCUMENTATION

On-line documentation is provided on both UNIX and NOS to assist users in accessing and exercising the various LARCGS software components. In addition to providing a quick reference to the use of individual graphics software packages, the on-line documentation identifies a collection of sample test programs and compile/load/execute procedure files. An on-line NEWS file is maintained on both subsystems to inform users of enhancements. The on-line documentation is the most up-to-date source on the status of the LARCGS.

On NOS UN=PVINFORM is a repository for on-line documentation and the other relevant graphics support files. On UNIX, *man* pages and *notes* serve a similar purpose. On both systems an on-line OVERVIEW AND STATUS document is provided as well as a document for individual software components.

The on-line documents are listed in TABLE 5.

TABLE 5: ON-LINE DOCUMENTATION

<u>ON-LINE DOCUMENT</u>	<u>NOS FILE NAME (UN=PVINFO)</u>	<u>UNIX DOCUMENTATION</u>
OVERVIEW AND STATUS	PINTRO	notes graphics
DI-3000	DINTRO	man di3load, mftran
CONTOUR	CINTRO	man di3load
NCAR	NINTRO	man ncar
MOVIEBYU	n/a	man moviebyu
RASLIB	RASDOC	man raslib
RM/RMT	n/a	man rmtran
COMMON LIBRARY	CGINTRO	man cgl
LARCGOS	LARCDOC	man larcgos
PICSURE	n/a	man picsure
FIGARO	n/a	man figaro
DI-TEXTPRO	TXTNDX	man di3load
PLOT3D/GAS/SURF	n/a	man plot3d



Report Documentation Page

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12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546-0001				14. Sponsoring Agency Code	
				15. Supplementary Notes *Computer Sciences Corporation, Hampton, VA **Unisys Corporation, Hampton, VA	
16. Abstract The intent of this report is to introduce users to the computer graphics capabilities available at the Center and to assist in their use. More specifically, the manual identifies and describes the various graphics software and hardware components, details the interfaces between these components, and provides information concerning the use of these components at LaRC.					
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