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Guide to Printers and Printing

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Software

November 1999

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49004 ANGERS CEDEX 01
FRANCE

ORDER REFERENCE
86 A2 37JX 02

Printed in France

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Year 2000

The product documented in this manual is Year 2000 Ready.

Contents

About This Book

This book contains information for understanding the print process as well as providing printer configurations.

Note: You can also view the information in this book with a Version 3.2 HTML–compatible web browser.

Who Should Use This Book

This book is for system administrators and programmers to help you resolve print–related problems. Before you read this book, you should know basic operating system commands.

This book assumes you are familiar with the information and concepts presented in the following publications:

- *AIX 4.3 System User's Guide: Operating System and Devices*, 86 A2 97HX
- *AIX 4.3 System User's Guide: Communications and Networks*, 86 A2 98HX
- *AIX 4.3 Installation Guide*, 86 A2 43GX

How to Use This Book

The following overview briefly describes the contents of each chapter of the *AIX Guide to Printers and Printing*:

- Chapter 1, "Printers, Print Jobs, and Queues Overview for Users," provides overviews and some procedures related to printing files.
- Chapter 2, "Printers, Print Jobs, and Queues for System Administrators," includes information about administrative tasks related to configuring printers and spooler queues.
- Chapter 3, "Spooling Overview," contains a description of the spooler components and the interactions between those components.
- Chapter 4, "Printer, Plotter, and Spooler Subsystem Programming," contains an overview of spooler internals as well as detailed information needed to address the spooler programmatically or to modify the behavior of the spooler.
- Chapter 5, "Spooler Troubleshooting," contains some hints, tips, and procedures for troubleshooting spooler problems.

Highlighting

The following highlighting conventions are used in this book:

Bold	Identifies commands, subroutines, keywords, files, structures, directories, and other items whose names are predefined by the system. Also identifies graphical objects such as buttons, labels, and icons that the user selects.
Italics	Identifies parameters whose actual names or values are to be supplied by the user.
`Monospace`	Identifies examples of specific data values, examples of text similar to what you might see displayed, examples of portions of program code similar to what you might write as a programmer, messages from the system, or information you should actually type.

ISO 9000

ISO 9000 registered quality systems were used in the development and manufacturing of this product.

Related Publications

The following publications contain information on managing your system, the commands and files used in the operating system.

Order Number	Bibliography
86 A2 71WE	*AIX and Related Products Documentation Overview*
86 A2 99HX	*AIX 4.3 System Management Guide: Operating System and Devices*
86 A2 38JX to 86 A2 43JX	*AIX Commands Reference*
86 A2 79AP	*AIX Files Reference*

Ordering Publications

You can order publications from your sales representative or from your point of sale. To order additional copies of this book, use order number 86 A2 37JX.

Use *AIX and Related Products Documentation Overview* for information on related publications and how to obtain them.

Chapter 1. Printers, Print Jobs, and Queues Overview for Users

Depending on the printer, you can control the appearance and characteristics of the final output. The printers need not be located in the same area as the system unit and the system console. A printer can be attached directly to a local system, or a print job can be sent over a network to a remote system.

To handle print jobs with maximum efficiency, the system places each job into a queue to await printer availability. The system can save output from one or more files in the queue. As the printer produces the output from one file, the system processes the next job in the queue. This process continues until each job in the queue has been printed.

This section discusses:

Printer Terminology

The following defines terms commonly used with printing.

Print Job

A *print job* is a unit of work to be run on a printer. A print job can consist of printing one or more files, depending on how the print job is requested. The system assigns a unique job number to each job it runs.

Queue

The *queue* is where you direct a print job. It is a stanza in the /**etc**/**qconfig** file whose name is the name of the queue and points to the associated queue device. The following is a sample listing:

```
Msa1:
   device = lp0
```

Queue Device

The *queue device* is the stanza in the /**etc**/**qconfig** file that normally follows the local queue stanza. It specifies the /**dev** file (printer device) that should be printed to and the backend that should be used. Following is a sample listing:

```
lp0:
   file = /dev/lp0
   header = never
   trailer = never
   access = both
   backend = /usr/lpd/piobe
```

In the previous example, `lp0` is the device name, and the rest of the lines define how the device is used.

Note: There can be more than one queue device associated with a single queue.

qdaemon

The **qdaemon** is a process that runs in the background and controls the queues. It is generally started when the system is turned on.

Print Spooler

The *spooler* is not specifically a print job spooler. Instead, it provides a generic spooling function that can be used for queuing various types of jobs, including print jobs queued to a printer.

The spooler does not normally know what type of job it is queuing. When the system administrator defines a spooler queue, the purpose of the queue is defined by the spooler backend program that is specified for the queue. For example, if the spooler backend program is the **piobe** command (the printer I/O backend), the queue is a print queue. Likewise, if the spooler backend program is a compiler, the queue is for compile jobs. When the spooler's **qdaemon** command selects a job from a spooler queue, it runs the job by invoking the backend program specified by the system administrator when the queue was defined.

The main spooler command is the **enq** command. Although you can invoke this command directly to queue a print job, three front–end commands are defined for submitting a print job: the **lp**, **lpr**, and **qprt** commands. A print request issued by one of these commands is first passed to the **enq** program, which then places the information about the file in the queue for the **qdaemon** to process.

Real Printer

A *real printer* is the printer hardware attached to a serial or parallel port at a unique hardware device address. The printer device driver in the kernel communicates with the printer hardware and provides an interface between the printer hardware and a virtual printer, but it is not aware of the concept of virtual printers.

Local and Remote Printers

When you attach a printer to a node or host, the printer is referred to as a *local printer*. A *remote print system* allows nodes that are not directly linked to a printer to have printer access.

To use remote printing facilities, the individual nodes must be connected to a network using the Transmission Control Protocol/Internet Protocol (TCP/IP) and must support the required TCP/IP applications.

Printer Backend

The *printer backend* is a collection of programs called by the spooler's **qdaemon** command to manage a print job that is queued for printing. The printer backend performs the following functions:

- Receives from the **qdaemon** command a list of one or more files to be printed.
- Uses printer and formatting attribute values from the database, overridden by flags entered on the command line.
- Initializes the printer before printing a file.
- Runs filters as necessary to convert the print data stream to a format supported by the printer.
- Provides filters for simple formatting of ASCII documents.
- Provides support for printing national language characters.
- Passes the filtered print data stream to the printer device driver.
- Generates header and trailer pages.
- Generates multiple copies.
- Reports paper out, intervention required, and printer error conditions.
- Reports problems detected by the filters.
- Cleans up after a print job is canceled.
- Provides a print environment that a system administrator can customize to address specific printing needs.

Starting a Print Job (qprt Command)

Use the **qprt**, or **smit** commands to request a print job and specify the following:

- Name of the file to print
- Print queue name
- Number of copies to print
- Whether to make a copy of the file on the remote host
- Whether to erase the file after printing
- Whether to send notification of the job status
- Whether to send notification of the job status by the system mail
- Burst status
- User name for ”Delivery To” label
- Console acknowledgment message for remote print
- File acknowledgment message for remote print
- Priority level

Prerequisites

- For local print jobs, the printer must be physically attached to your system or, in the case of a network printer, attached and configured on the network.
- For remote print jobs, your system must be configured to communicate with the remote print server.

qprt Command

The **qprt** command creates and queues a print job to print the file you specify. If you specify more than one file, all the files together make up one print job. These files are printed in the order specified on the command line.

Before you can print a file, you must have read access to it. To remove a file after it has printed, you must have write access to the directory that contains the file.

The basic format of the **qprt** command is:

```
qprt -PQueueName FileName
```

Some useful **qprt** command flags are:

–b *Number*
Specifies the bottom margin. The bottom margin is the number of blank lines to be left at the bottom of each page.

–B *Value*
Specifies whether burst pages (continuous–form pages separated at perforations) should be printed. The *Value* variable consists of a two–character string. The first character applies to header pages. The second character applies to trailer pages. Each of the two characters can be one of the following:

a Always prints the (header or trailer) page for each file in each print job.

n Never prints the (header or trailer) page.

g Prints the (header or trailer) page once for each print job (group of files).

For example, the **–B ga** flag specifies that a header page be printed at the beginning of each print job and that a trailer page be printed after each file in each print job.

Note: In a remote print environment, the default is determined by the remote queue on the server.

–e *Option*
Specifies whether emphasized print is wanted.

+ Indicates emphasized print is wanted.

! Indicates emphasized print is not wanted.

–E *Option*
Specifies whether double–high print is wanted.

+ Indicates double–high print is wanted.

! Indicates double–high print is not wanted.

–f *FilterType*
A one–character identifier that specifies a filter through which your print file or files are to be passed before being sent to the printer. The available filter identifiers are **p**, which invokes the **pr** filter, and **n**, which processes output from the **troff** command.

–i *Number*
Causes each line to be indented the specified number of spaces. The *Number* variable must be included in the page width specified by the **–w** flag.

–K *Option*
Specifies whether condensed print is wanted.

+ Indicates condensed print is wanted.

! Indicates condensed print is not wanted.

–l *Number*
Sets the page length to the specified number of lines. If the *Number* variable is 0, page length is ignored, and the output is considered to be one continuous page. The page length includes the top and bottom margins and indicates the printable length of the paper.

–L *Option*

Specifies whether lines wider than the page width should be wrapped to the next line or truncated at the right margin.

+ Indicates that long lines should wrap to the next line.

! Indicates that long lines should not wrap but instead should be truncated at the right margin.

–N *Number*

Specifies the number of copies to be printed. If this flag is not specified, one copy is printed.

–p *Number*

Sets the pitch to *Number* characters per inch. Typical values for *Number* are 10 and 12. The actual pitch of the characters printed is also affected by the values for the **–K** (condensed) flag and the **–W** (double–wide) flag.

–P *Queue*[:*QueueDevice*]

Specifies the print queue name and the optional queue device name. If this flag is not specified, the default printer is assumed.

–Q *Value*

Specifies paper size for the print job. The *Value* for paper size is printer–dependent. Typical values are: 1 for letter–size paper, 2 for legal, and so on. Consult your printer manual for the values assigned to specific paper sizes.

–t *Number*

Specifies the top margin. The top margin is the number of blank lines to be left at the top of each page.

–w *Number*

Sets the page width to the number of characters specified by the *Number* variable. The page width must include the number of indention spaces specified with the **–i** flag.

–W *Option*

Specifies whether double–wide print is wanted.

+ Indicates double–wide print is wanted.

! Indicates double–wide print is not wanted.

–z *Value*

Rotates page printer output the number of quarter–turns clockwise as specified by the *Value* variable. The length (**–l**) and width (**–w**) values are automatically adjusted accordingly.

0 Portrait

1 Landscape right

2 Portrait upside–down

3 Landscape left.

–# Value

Specifies a special function.

j Displays the job number for the specified print job

h Queues the print job, but puts it in the **HELD** state until it is released again.

v Validates the specified printer backend flag values. This validation is useful in checking for illegal flag values at the time of submitting a print job. If the validation is not specified, an incorrect flag value will stop the print job later when the job is actually being processed.

For example, to request the `myfile` file to be printed on the first available printer configured for the default print queue using default values, type:

```
qprt myfile
```

For example, to request the file `somefile` to be printed on a specific queue using specific flag values and to validate the flag values at the time of print job submission, type:

```
qprt -f p -e + -Pfastest -# v somefile
```

This passes the `somefile` file through the **pr** filter command (the **–f p** flag) and prints it using emphasized mode (the **–e +** flag) on the first available printer configured for the queue named **fastest** (the **–Pfastest** flag).

For example, to print `myfile` on legal–size paper, type:

```
qprt -Q2 myfile
```

For example, to print three copies of each of the files `new.index.c` , `print.index.c` , and `more.c` at the print queue `Msp1` , type:

```
qprt -PMsp1 -N 3 new.index.c print.index.c more.c
```

For example, to print three copies of the concatenation of three files `new.index.c` , `print.index.c` , and `more.c` , type:

```
cat new.index.c print.index.c more.c | qprt -PMsp1 -N 3
```

Note: The AIX operating system also supports the BSD UNIX print command (**lpr**) and the System V UNIX print command (**lp**). See the **lpr** and **lp** commands in the *AIX Commands Reference* for the exact syntax.

See the **qprt** command in the *AIX Commands Reference* for the exact syntax.

smit Command

To start a job using SMIT, type:

```
smit qprt
```

Canceling a Print Job (qcan Command)

You can cancel any job in the print queue with the Web-based System Manager fast path or the **qcan** or **smit** commands. When you cancel a print job, you are prompted to provide the name of the print queue where the job resides and the job number to be canceled.

This procedure applies to both local and remote print jobs.

Prerequisites

- For local print jobs, the printer must be physically attached to your system or, in the case of a network printer, attached and configured on the network.
- For remote print jobs, your system must be configured to communicate with the remote print server.

Web-based System Manager Fast Path

To cancel a print job using the Web-based System Manager fast path, type:

```
wsm printers
```

In the Print Queues container, select the print job, then use the menus to cancel it from a print queue.

qcan Command

The **qcan** command cancels either a particular job number in a local or remote print queue, or all jobs in a local print queue. To determine the job number, type the **qchk** command.

The basic format of the **qcan** command is:

```
qcan -PQueueName -x JobNumber
```

See the **qcan** command in the *AIX Commands Reference* for the exact syntax.

For example, to cancel job number `123` on whichever printer the job is on, type:

```
qcan -x 123
```

For example, to cancel all jobs queued on printer `lp0`, type:

```
qcan -X -Plp0
```

Note: The AIX operating system also supports the BSD UNIX cancel print command (**lprm**) and the System V UNIX cancel print command (**cancel**). See the **lprm** and **cancel** commands in the *AIX Commands Reference* for more information and the exact syntax.

smit Command

To cancel a print job using SMIT, type:

```
smit qcan
```

Prioritizing a Print Job (qpri Command)

You can change the priority of a job with the Web-based System Manager fast path or the **qpri** or **smit** commands. You can only assign job priority on local queues. Higher values indicate a higher priority for the print job. The default priority is 15. The maximum priority is 20 for most users, and 30 for users with root user privilege and members of the printq group (group 9).

Note: You cannot assign priority to a remote print job.

Prerequisite

The printer must be physically attached to your system.

Web-based System Manager Fast Path

To change the priority of a queued print job using the Web-based System Manager fast path, type:

```
wsm printers
```

In the Print Queues container, select the print job, then use the menus to set the priority for that job in a local print queue.

qpri Command

The **qpri** command reassigns the priority of a print job that you submitted. If you have root user authority or belong to the printq group, you can assign priority to any job while it is in the print queue. The basic format of the **qpri** command is:

```
qpri -# JobNumber -a PriorityLevel
```

For example, to change job number `123` to priority number `18`, type:

```
qpri -# 123 -a 18
```

For example, to prioritize a local print job as it is submitted, type:

```
qprt -PQueueName -R PriorityLevel FileName
```

See the **qpri** command in the *AIX Commands Reference* for the exact syntax.

smit Command

To change the priority of a print job using SMIT, type:

```
smit qpri
```

Moving a Print Job to Another Print Queue (qmov Command)

After you have sent a print job to a print queue, you may want to move the print job to another print queue. You can move it with the Web-based System Manager fast path or with the **qmov** or **smit** commands.

Note: You cannot move a remote print job to another print queue.

Prerequisite

The printer must be physically attached to your system.

Web-based System Manager Fast Path

To move a print job to another queue using the Web-based System Manager fast path, type:

```
wsm printers
```

In the Print Queues container, select the print job, then use the menus to move it from one print queue to another.

qmov Command

The **qmov** command moves a print job to another print queue. You can either move a particular print job, or you can move all the print jobs on a specified print queue or all the print jobs sent by a specified user. To determine the print job number, type the **qchk** command.

The basic format of the **qmov** command is:

```
qmov  -mNewQueue {[ -#JobNumber ] [ -PQueue ] [ -uUser ]}
```

See the **qmov** command in the *AIX Commands Reference* for the exact syntax.

For example, to move job number `280` to print queue `hp2`, type:

```
qmov -mhp2 -#280
```

For example, to move all print jobs on print queue `hp4D` to print queue `hp2`, type:

```
qmov -mhp2 -Php4D
```

smit Command

To move a print job using SMIT, type:

```
smit qmov
```

Holding and Releasing a Print Job (qhld Command)

After you have sent a print job to a print queue, you can put the print job on hold with the Web-based System Manager fast path or with the **qhld** or **smit** commands. You can later release the print job for printing with these same commands.

Note: You cannot hold and release remote print jobs.

Prerequisite

The printer must be physically attached to your system.

Web-based System Manager Fast Path

To hold or release a print job using the Web-based System Manager fast path, type:

```
wsm printers
```

In the Print Queues container, select the print job, then use the menus to put it on hold or to release a held job for printing.

qhld Command

The **qhld** command puts a print job on hold after you have sent it. You can either put a particular print job on hold, or you can hold all the print jobs on a specified print queue. To determine the print job number, type the **qchk** command.

The basic format of the **qhld** command is:

```
qhld [ -r ] {[ -#JobNumber ] [ -PQueue ] [ -uUser ]}
```

See the **qhld** command in the *AIX Commands Reference* for the exact syntax.

For example, to hold job number `452` on whichever print queue the job is on, type:

```
qhld -#452
```

For example, to hold all jobs queued on print queue `hp2`, type:

```
qhld -Php2
```

To release job number `452` on whichever print queue the job is on, type:

```
qhld -#452 -r
```

To release all jobs queued on print queue `hp2`, type:

```
qhld -Php2 -r
```

smit Command

To hold or release a print job using SMIT, type:

```
smit qhld
```

Checking Print Job Status (qchk Command)

You can display the current status information for specified job numbers, queues, printers, or users with the Web-based System Manager fast path or with the **qchk** or **smit** commands.

Prerequisites

- For local print jobs, the printer must be physically attached to your system or, in the case of a network printer, attached and configured on the network.
- For remote print jobs, your system must be configured to communicate with the remote print server.

Web-based System Manager Fast Path

To check the status of a print job using the Web-based System Manager fast path, type:

```
wsm printers
```

In the Print Queues container, select the print job, then use the menus to check its status.

qchk Command

The **qchk** command displays the current status information regarding specified print jobs, print queues, or users.

The basic format of the **qchk** command is:

```
qchk -P QueueName -# JobNumber -u OwnerName
```

See the **qchk** command in the *AIX Commands Reference* for the exact syntax.

For example, to display the default print queue, type:

```
qchk -q
```

For example, to display the long status of all queues until empty, while updating the screen every `5` seconds, type:

```
qchk -A -L -w 5
```

For example, to display the status for print queue `lp0`, type:

```
qchk -P lp0
```

For example, to display the status for job number `123`, type:

```
qchk -# 123
```

For example, to check the status of all jobs in all queues, type:

```
qchk -A
```

Note: The AIX operating system also supports the BSD UNIX check print queue command (**lpq**) and the System V UNIX check print queue command (**lpstat**). See the **lpq** and **lpstat** commands in the *AIX Commands Reference* for the exact syntax.

smit Command

To check a print job's status using SMIT, type:

```
smit qchk
```

Printer Status Conditions

Some of the status conditions that a print queue can have are:

DEV_BUSY Indicates that:

- More than one queue is defined to a printer device (lp0) and another queue is currently using the printer device.
- **qdaemon** attempted to use the printer port device (lp0), but another application is currently using that printer device

To recover from a **DEV_BUSY**, wait until the queue or application has released the printer device or cancel the job or process that is using the printer port.

DEV_WAIT Indicates that the queue is waiting on the printer because the printer is offline, out of paper, jammed, or the cable is loose, bad, or wired incorrectly.

To recover from a **DEV_WAIT**, correct the problem that caused it to wait. It may be easier for diagnostic testing to use the **enq** command to move all queued jobs from the **DEV_WAIT** queue to another queue that is either printing or is **DOWN**. After the problem is corrected, you can move any unprinted job back to the original queue.

A queue that is in **DEV_WAIT** for longer than a defined number of seconds will go into a **DOWN** state.

DOWN A queue will usually go into a **DOWN** state after it has been in the **DEV_WAIT** state. This situation occurs when the printer device driver cannot tell if the printer is there due to absence of correct signalling. However, some printers may not have the capability to signal the queuing system that it is offline, and instead signals that it is off. If the printer device signals or appears to be off, the queue will go into the **DOWN** state.

To recover from a **DOWN** state, correct the problem that has brought the queue down and have the system administrator bring the queue back up. The queue *must* be manually brought up before it can be used again.

HELD Specifies that a print job is held. The print job will not be processed by the spooler until it is released.

QUEUED Specifies that a print file is queued and is waiting in line to be printed.

READY Specifies that everything involved with the queue is ready to queue and print a job.

RUNNING Specifies that a print file is printing.

Formatting Files for Printing (pr Command)

The **pr** command performs simple formatting of the files you sent to be printed. You pipe the output of the **pr** command to the **qprt** command to format your text.

Some useful **pr** command flags are:

–d	Double–spaces the output.
–h *"String"*	Displays the specified string, enclosed in " " (quotes), instead of the file name as the page header. The flag and string should be separated by a space.
–l *Lines*	Overrides the 66–line default and resets the page length to the number of lines specified by the *Lines* variable. If the *Lines* value is smaller than the sum of both the header and trailer depths (in lines), the header and trailer are suppressed (as if the **–t** flag were in effect).
–m	Merges files. Standard output is formatted so the **pr** command writes one line from each file specified by a *File* variable, side by side into text columns of equal fixed widths, based on the number of column positions. This flag should not be used with the **–***Column* flag.
–n [*Width*][*Character*]	Provides line numbering based on the number of digits specified by the *Width* variable. The default is 5 digits. If the *Character* (any non–digit character) variable is specified, it is appended to the line number to separate it from what follows on the line. The default character separator is the ASCII TAB character.
–o *Offset*	Indents each line by the number of character positions specified by the *Offset* variable. The total number of character positions per line is the sum of the width and offset. The default value of *Offset* is 0.
–s*Character*	Separates columns by the single character specified by the *Character* variable instead of by the appropriate number of spaces. The default value for *Character* is an ASCII TAB character.
–t	Does not display the five–line identifying header and the five–line footer. Stops after the last line of each file without spacing to the end of the page.
–w *Width*	Sets the number of column positions per line to the value specified by the *Width* variable. The default value is 72 for equal–width multicolumn output. There is no limit otherwise. If the **–w** flag is not specified and the **–s** flag is specified, the default width is 512 column positions.
–*Column*	Sets the number of columns to the value specified by the *Column* variable. The default value is 1. This option should not be used with the **–m** flag. The **–e** and **–i** flags are assumed for multicolumn output. A text column should never exceed the length of the page (see the **–l** flag). When this flag is used with the **–t** flag, use the minimum number of lines to write the output.
+*Page*	Begins the display with the page number specified by the *Page* variable. The default value is 1.

For example, to print a file named `prog.c` with headings and page numbers on the printer, enter:

```
pr prog.c | qprt
```

This adds page headings to `prog.c` and sends it to the **qprt** command. The heading consists of the date the file was last modified, the file name, and the page number.

For example, to specify a title for a file named `prog.c`, enter:

```
pr –h "MAIN PROGRAM" prog.c | qprt
```

This prints `prog.c` with the title `MAIN PROGRAM` in place of the file name. The modification date and page number are still printed.

For example, to print a file named `word.lst` in multiple columns, enter:

```
pr -3 word.lst | qprt
```

This prints the `word.lst` file in three vertical columns.

For example, to print several files side by side on the paper:

```
pr -m -h "Members and Visitors" member.lst visitor.lst | qprt
```

This prints `member.lst` and `visitor.lst` side by side with the title `Members and Visitors`.

For example, to modify a file named `prog.c` for later use, enter:

```
pr -t -e prog.c > prog.notab.c
```

This replaces tab characters in `prog.c` with spaces and puts the result in `prog.notab.c`. Tab positions are at columns 9, 17, 25, 33, and so on. The **–e** flag tells the **pr** command to replace the tab characters; the **–t** flag suppresses the page headings.

For example, to print a file named `myfile` in two columns, in landscape, and in 7–point text, enter:

```
pr -l66 -w172 -2 myfile | qprt -z1 -p7
```

See the **pr** command in the *AIX Commands Reference* for the exact syntax.

Printing ASCII Files on a PostScript Printer

The Text Formatting System includes the enscript filter for converting ASCII print files to PostScript for printing on a PostScript printer. This filter is called by the **qprt –da** command when submitting a print job to a PostScript print queue.

Prerequisites

- The printer must be physically attached to your system.
- The printer must be configured and defined.
- The transcript portion of Text Formatting Services must be installed.

There are several flags that may be specified with the **qprt** command to customize the output when submitting ASCII files to a PostScript print queue.

–1+	Adds page headings.
–2+	Formats the output in two columns.
–3+	Prints the page headings, dates, and page numbers in a fancy style. This is sometimes referred to as ”gaudy” mode.
–4+	Prints the file, even if it contains unprintable characters.
–5+	Lists characters that are not included in a font.
–h *string*	Specifies a string to be used for page headings. If this flag is not specified, the heading consists of the file name, modification date, and page number.
–l *value*	Specifies the maximum number of lines printed per page. Depending on the point size, fewer lines per page may actually appear.
–L!	Truncates lines longer than the page width.
–p	Specifies the point size. If this flag is not specified, a point size of 10 is assumed, unless two–column rotated mode (**–2+ –z1**) is specified, in which case a value of 7 is used.
–s	Specifies the font style. If this flag is not specified, the Courier font is used. Acceptable values are: Courier–Oblique Helvetica Helvetica–Oblique Helvetica–Narrow Helvetica–Narrow–Oblique NewCenturySchlbk–Italic Optima Optima–Oblique Palatino–Roman Palatino–Italic Times–Roman Times–Italic **Note:** The PostScript printer must have access to the specified font.
–z1	Rotates the output 90 degrees (landscape mode).

For example, to send the ACSII file `myfile.ascii` to the PostScript printer named `Msps1`, enter:

```
qprt –da –PMsps1 myfile.ascii
```

For example, to send the ACSII file `myfile.ascii` to the PostScript printer named `Msps1` and print out in the Helvetica font, enter:

```
qprt –da –PMsps1 –sHelvetica myfile.ascii
```

For example, to send the ASCII file `myfile.ascii` to the PostScript printer named `Msps1` and print out in the point size 9, enter:

```
qprt –da –PMsps1 –p9 myfile.ascii
```

Command Summary for Printers, Print Jobs, and Queues

cancel

Cancels requests to a line printer.

lp

Sends requests to a line printer.

lpq

Examines the spool queue.

lpr

Enqueues print jobs.

lprm

Removes jobs from the line printer spooling queue.

lpstat

Displays line printer status information.

pr

Writes a file to standard output.

qcan

Cancels a print job.

qchk

Displays the status of a print queue.

qhld

Holds or releases a print job.

qmov

Moves a print job to another print queue.

qpri

Prioritizes a job in the print queue.

qprt

Starts a print job.

Chapter 2. Printers, Print Jobs, and Queues for System Administrators

The printer subsystem includes a spooler, real printers, virtual printers, backends, and queues. A print job can be sent to a printer attached directly to a local system, or it can be sent over a network to a remote system and printed on a printer attached to the remote system.

The system management tasks associated with printers include:

Printing Processes

The system sends codes to the printer when you print a file. Some codes print specific characters, such as **a** to **z** or **0** to **9**. Other codes print characters or files, such as underscoring certain characteristics or by adjusting the page length. Edit the file if you want to send different character codes to the printer, such as to change the word `that` to `this`. You do not have to understand the underlying codes.

To alter the way a printer works, you must understand what happens when you print a file, which options you have for sending control information to the printer, and which printer characteristics you can control.

You can use Web-based System Manager (**wsm printers** fast path), the System Manager Interface Tool (SMIT), or the **qprt** command to send a file to a printer. You can also use **wsm printers** or SMIT to cancel or prioritize a print job.

A file does not go directly to the printer. Web-based System Manager, SMIT, or the **qprt** command calls the **enq** command and places the print request in a queue. The print request stays in the queue until a printer becomes available, at which point, the **qdaemon** command runs the (printer input/output backend) **piobe** command. The **piobe** command processes the file and sends it, along with control information, to the printer. The printer receives a data stream containing the contents of the file and the control information specified with the **qprt** command.

Controlling the Printing Process

Add printer control information to the printer data stream in the following ways:

- Include printer control codes in the file.

Note: Set the print queue data stream to **passthru** (that is, **d=p**). Refer to ”Printer Colon File Conventions” , on page 4-20 for more information.

Include all printer control information that is unique to that file. For example, to underscore the title of a book or print a paragraph in bold type, insert codes that start and stop the printer control information at the correct places.

Some application programs, such as word processors, allow you to insert specific printer controls in the file. However, if the printer cannot be configured from the application program, you must use a system editor to insert printer control codes. Printer control codes are available with the printer, from the dealer where the printer was purchased, or from the printer manufacturer.

- Supply command flags with the **qprt** command.

  The Web-based System Manager fast path, **wsm printers**, the **qprt** command, or the SMIT **Start a Print Job** option recognize a number of flags that control printer operations, such as:

  – Specifying condensed, emphasized, double–wide, and double–strike printing
  – Printing in specified colors
  – Setting the margins
  – Setting the number of lines per vertical inch
  – Maintaining the horizontal position on the print line for a line feed or vertical tab control

  You can specify particular print characteristics for a single print job. For example, the **qprt** command flag for setting pitch is `-p Number`, where `Number` is the number of characters per inch. If the standard **qprt** command setting is 10 characters per inch, but you need 12 characters per inch for the `printtest` file, enter the command:

  ```
  qprt -p 12 printtest
  ```

  The flag on the command line overrides the standard **qprt** command setting for this job. The standard **qprt** command pitch setting remains 10.

- Change the standard **qprt** command settings.

  The Web-based System Manager fast path, **wsm printers**, allows you to change or show the print queue characteristics of a printer. You can also use SMIT or the **lsvirprt** command.

  Note: You must have root authority or be a member of the printq group.

  For example, to change the standard pitch to 12 characters per inch, run Devices (**wsm devices**), the **chvirprt** command, or SMIT. Select the printer from the list displayed and enter the attribute name and value, separated by the equal sign (=).

  The attribute names for the **qprt** command flags are the flag letters. You can change the standard pitch to 12 by specifying `p=12`.

Print Spooler

The *spooler* is not specifically a print job spooler but a generic spooling function that can be used for queuing various types of jobs, including print jobs queued to a printer.

The spooler does not know what type of job it is queuing. When the system administrator defines a spooler queue, the purpose of the queue is defined by the spooler backend program. For example, if the spooler backend program is the **piobe** command (the printer I/O backend), the queue is a print queue. Likewise, if the spooler backend program is a compiler, the queue is for compiler jobs. When the spooler's **qdaemon** command selects a job from a spooler queue, it runs the job by invoking the backend program.

When networks are composed of AIX machines and other types of clients and servers, not all remote print requests are supported across the network. In some instances, you may have to submit print jobs one file at a time or concatenate files before submitting them as a print job.

The main spooler command is the **enq** command. Although you can invoke this command directly to queue a print job, three front–end commands are defined for submitting a print job: the **lp**, **lpr**, and **qprt** commands. A print request issued by one of these commands is passed to the **enq** program that places the information about the file in the queue for the **qdaemon** to process. The queue is the **/var/spool/lpd/qdir** directory.

If the job is not a file (that is, pipe output of a command to **enq**), a real file is created in **/var/spool/qdaemon**, that contains the data to be printed. The information in the **/var/spool/lpd/qdir** file points to the file in **/var/spool/qdaemon**.

Real and Virtual Printers

A *real printer* is the printer hardware attached to a serial or parallel port at a unique hardware–device address. The printer device driver in the kernel communicates with the printer hardware and provides an interface between the printer hardware and a virtual printer. A real printer can be added with Web-based System Manager **wsm devices;** fast path, or using the **mkdev** command at the command line.

A *virtual printer* is a set of attributes that defines a high–level data stream (such as ASCII or PostScript) that the printer understands. This does not include information about how the printer hardware is attached to the host computer or about the protocol used for transferring bytes of data to and from the printer.

A virtual printer is associated with a print queue. You can define a print queue for each data stream the printer supports. Multiple print queues can use the same real printer.

- To add print queues, use the Web-based System Manager fast path, **wsm printers**, the SMIT **Add a Print Queue** option, or the **mkque**, **mkquedev**, and **mkvirprt** commands.
- To view a list of print queues and their associated virtual printers, use the Web-based System Manager fastpath, **wsm printers**, the SMIT **List All Print Queues** option, or the **lsvirprt** command.

When you submit a print job, a print queue must be directly or indirectly specified. To specify a specific printer for a print job, add a colon and the printer device name to the print queue name. If a printer is not specified for the print job, the spooler selects the first available printer associated with the print queue. If there are several printers associated with a print queue, any printer is used.

IBM Proprinters, for example, need only one print queue to be defined for each real printer. This is because Proprinters support only one data stream, IBM extended ASCII. The IBM 4216 Model 031 Personal Pageprinter needs multiple print queues defined. A print queue can be defined for each data stream the printer supports. A print queue can be defined for PostScript, Proprinter, HP LaserJet, and Diablo 630 emulations. All four print queues output to the same real printer, the 4216 Model 031.

Local and Remote Printers

A *local printer* is the printer attached to a node or host. A *remote printer* allows nodes that are not directly linked to a printer to have printer access.

To use remote printing facilities, the individual nodes must be connected to a network using the Transmission Control Protocol/Internet Protocol (TCP/IP) and must support the required TCP/IP applications. The **lpd** daemon controls the remote print server and any host on a network can be designated as a print server. Before a remote server can accept a print request, the **/etc/hosts.lpd** or **/etc/hosts.equiv** file must be configured to accept print requests from other nodes or hosts. Use Web-based System Manager **wsm printers** fast path, or SMIT **Manage Print Server** option to configure a print server.

Printer Backends

The *printer backend* is a collection of programs started by the spooler's **qdaemon** command to manage a print job that is queued for printing. The printer backend performs the following functions:

- Receives from the **qdaemon** command a list of one or more files to be printed.
- Uses printer and formatting attribute values from the database, overridden by any flags specified.
- Initializes the printer before printing a file.
- Provides filters for simple formatting of ASCII documents.
- Uses filters to convert the print data stream to a format supported by the printer.
- Provides support for printing national language characters.
- Passes the filtered print data stream to the printer device driver.
- Generates header and trailer pages.
- Generates multiple copies.
- Reports paper–out, intervention–required, and printer–error conditions.
- Reports problems detected by the filters.
- Cleans up after a print job is canceled.
- Provides a print environment that you can customize to address specific printing needs.

The **mkvirprt** command defines a virtual printer to the printer backend. The set of predefined attributes for the particular type of printer is copied to create a customized set of attributes. The customized attributes can be listed with the **lsvirprt** command and changed with the **chvirprt** command or, by using the Devices or SMIT **Change** / **Show Print Queue Characteristics** option. Each time the **mkvirprt** or **chvirprt** command is used, a digest utility (**piodigest** command) is automatically run to construct a memory image of the attribute values and lookup tables to be read in and used during the printing process.

The **qdaemon** command calls the **piobe** command (the Print Job Manager) and passes the flag options and the names of one or more files to be printed. The only flag options not passed are the spooler flag options removed by the **enq** command. The **qdaemon** command has already opened the printer device and redirected standard output to the printer. A status file provides communication between the **qdaemon** and the backend.

If a header page is needed, the **piobe** command retrieves a header page pipeline used to generate the header page. The header page pipeline is passed to a shell. In the pipeline, the standard output from the header page filter becomes the standard input for the formatter filter. The formatter filter processes the header page and writes the result to standard output. Standard output for the formatter filter becomes standard input for the device driver interface program that writes the filtered header page to the printer device driver.

Formatter Filters

A *formatter filter* provides the capability of either formatting the input print file or passing it through unmodified, based on an input parameter. Even if the formatter passes the input file unmodified, it still sends printer commands to initialize the printer before the input file is printed and restores the printer after printing is complete.

A formatter driver is device independent. There is a formatter for each type (or group of types) of input data. For example, there is one formatter for all the supported Proprinters.

The formatter filter is made up of two components:

- A device–independent formatter driver
- A device–dependent formatter

The formatter driver is invoked by a pipeline and is passed the name of a formatter to be driven. The formatter driver dynamically loads and links the formatter and calls the formatter's **setup** function which indicates whether data formatting or data pass–through is requested. After the formatter's **setup** function performs the necessary functions, it returns to the formatter driver. The formatter driver calls the **initialize** function. The **initialize** function outputs a string of printer commands to initialize the printer and returns to the formatter driver.

The formatter driver either calls the **passthru** function once or calls the **lineout** function for each line in the print file based on the return code from the **setup** function. If the **lineout** function is called, the formatter driver performs all vertical spacing, including line spacing, vertical tabs, form feeds, and top and bottom margins. Line spacing and vertical tabs are performed by the **lineout** function. Other vertical spacing functions are performed automatically.

When processing is complete, the formatter driver calls the **restore** function. The **restore** function outputs a string of printer commands to restore the printer to its default state, defined by the database attribute values.

For more information about how the print formatter interacts with the printer formatter subroutines, refer to the example of a print formatter, on page 4-25.

Printer Terminology

Printer/Plotter Device A special file in the **/dev** directory for the device. This file can be used by redirection (for example, `cat FileName > /dev/lp0`). Settings for the device driver can be displayed and changed using the Devices fastpath or the **lsdev** and **chdev** commands. Before printer commands can access a printer device, a print queue must be created for the device or the printer must be configured in the printer backend in **/etc/qconfig**.

Virtual Printer A combination of a specific queue and a specific queue device in the **/etc/qconfig** file. There is an associated file in the **/var/spool/lpd/pio/@local/ddi** directory that contains formatting data. When you use SMIT to add a printer, the system automatically creates the virtual printer's queue, queue device, and **/var/spool/lpd/pio/@local/ddi** file.

Use the Devices fastpath to create a queue and queue device for a printer, using the standard **piobe** backend. If you want to implement load sharing, use to add a second queue device to an existing queue. You can also use the SMIT commands.

Queue A line or list of items in the **/etc/qconfig** file where the name of the queue manually points to the associated queue device. The following is a sample listing:

```
lp0:   device = lp0
```

Normally, queues are created through Web-based System Manager.

Queue Device The queue device is the line or list of items in the /**etc**/**qconfig** file that normally follows the local queue. It specifies the /**dev** file (printer device) to print to and the backend to use. Following is a sample listing:

```
lp0:
   file = /dev/lp0
   header = never
   trailer = never
   access = both
   backend = /usr/lib/lpd/piobe
```

There can be more than one queue device associated with a single queue.

Adding a printer through the Web-based System Manager **wsm devices** fast path creates a standard queue device entry to an existing queue.

> **Note:** There will not be a file entry in the /**etc**/**qconfig** file when you are using a remote printer. The queue directs the file to the server.

qdaemon

The **qdaemon** is a process that runs in the background. When you turn the system on, the **startsrc** command starts the **qdaemon**. **startsrc** is a command to the **srcmstr** daemon that is started from /**etc**/**inittab**.

The **qdaemon** keeps track of the print requests in the /**var**/**spool**/**lpd**/**qdir** directory and ensures that the jobs are sent to the proper printer at the proper time. It also keeps track of the status of the printers and stores printer usage data for system accounting purposes (for example, **lpstat** and **enq –A** commands). This information is held in the /**var**/**spool**/**lpd**/**stat** directory.

If the **qdaemon** is stopped, it will be restarted by the **srcmstr**.

> **Note:** Do not stop the **srcmstr** process; it controls other daemons running on your system.

Initial Printer Configuration

You can use one process to configure a printer and another to add a print queue. There are several different articles that describe how to do this. The task you use depends on how your printer is attached to the system. You can also configure a printer without adding a print queue. The following describes how to do these tasks:

The ”Queuing a Print Job” and ”Removing a Print Queue” procedures can be used after configuring a print queue.

Changing the Configuration File

Both the **enq** command and **qdaemon** command read the /**etc**/**qconfig** file when they start. The **qdaemon** command starts when you start the system; the **enq** command starts each time someone requests a print job. Thus, if you change the /**etc**/**qconfig** file, the **enq** command reads the new version of the configuration file the next time it runs.

Do not edit the /**etc**/**qconfig** file while there are active jobs in any queue. Editing includes both manual editing and use of the **mkque**, **rmque**, **chque**, **mkquedev**, **rmquedev**, or **chquedev** commands. It is recommended that all changes to the /**etc**/**qconfig** file be made using these commands. However, if manual editing is desired, first issue the **enq –G** command to bring the queuing system and the **qdaemon** command down after all jobs are present. Then edit the /**etc**/**qconfig** file and restart the **qdaemon** command with the new configuration.

Configuring a Local Printer and Adding a Queue

Note: If you want to configure a printer without adding a print queue, see ”Configuring a Printer without Adding a Queue”, on page 2-11.

Prerequisites

- Read the documentation for your printer. You may need printer–specific information to connect and configure the printer.
- Review the configuration of your system. Determine to which parallel or serial port you want to connect the printer.
- You must have root authority.

Procedure

1. Connect the printer directly to the serial or parallel port on the local host:
   a. Type **shutdown** at the system prompt to halt the system.
   b. Turn off the system and any external devices.
   c. Connect the printer to the appropriate serial or parallel port.
   d. Set up your printer as described in the printer documentation.
   e. Restart the system.
2. At the system prompt, type:

```
wsm printers
```

In the Web-based System Manager Print Queues container, use the menus to complete the steps to configure a printer device and one or more print queues. You can also perform this step with the SMIT fast path `smit mkpq`.

Note: If the printer supports more than one type of print data, such as PostScript and ASCII, enter a print queue name for each print data type.

Note: Before choosing a 7–bit interface, see ”Considerations for 8–Bit Printer Attached to 7–Bit Interface”, on page 5-7.

3. After the printer and print queues are sucessfully created, their names are displayed. Be sure to note any error messages before you exit.
4. Type `wsm printers`. Use the Print Queues menus to customize the new print queue. You can also perform this step with the SMIT fast path `smit chpq`.

Configuring a Remote Printer and Adding a Queue

Prerequisites

The remote host must be configured as a print server.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

   In the Web-based System Manager Print Queues container, use the menus to complete the steps to configure a print queue for a printer attached to a remote host. You can also perform this step with the SMIT fast path `smit mkpq`.
2. After the print queues are successfully created, their names are displayed. Be sure to note any error messages before you exit.
3. Type `wsm printers`. Use the Print Queues menus to customize the new print queue. You can also perform this step with the SMIT fast path `smit chpq`.

Configuring an Xstation Printer and Adding a Print Queue

You can attach several printers and plotters to serial ports on the Xstation 130, 140 or 150, and one printer or plotter to the serial port on the Xstation 120. You can also attach printers to a parallel port. Printer queues on hosts can access the printer through the same network connection used by an Xwindow environment.

To configure a printer, ensure that your system meets the prerequisite conditions, then create a printer or plotter queue to spool to the Xstation. After you add the queue, you can submit print or plot jobs to the queue using the **qprt** command, the **lp** command, the **lpr** command, or the **enq** command.

Prerequisites

To set up a print queue, you must meet the following conditions:

- Root user permission to add the print queue.
- An Xstation that the printer is connected to.
- You may need to set up the printer. See your printer manual for instructions.
- Before you begin, you should know how to connect the printer to a parallel or serial port on the Xstation. On an Xstation 120, one serial port and one parallel port are available. On an Xstation 130, an optional serial port fan–out cable provides one additional serial port, and a IBM PS/2 Dual Async Adapter/A provides two additional serial ports. On an Xstation 140 or Xstation 150, an optional serial port fan–out cable provides one additional serial port.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

   In the Web-based System Manager Print Queues container, use the menus to complete the steps to add a print queue for a printer connected to an Xstation. You can also perform this step with the SMIT fast path `smit mkpq`.

Note: If a printer supports more than one printer language such as PostScript and PCL, each supported language is listed. Enter a queue name for each printer language for which you want to add a print queue. If you do not enter a queue name for a printer language, no queue will be added for that printer language.

2. After the print queues are successfully created, their names are displayed. Be sure to note any error messages before you exit.
3. Type `wsm printers`. Use the Print Queues menus to customize the new print queue. You can also perform this step with the SMIT fast path `smit chpq`.

Configuring a Network Printer and Adding a Queue

Prerequisites

- Read the documentation for your printer. You may need printer–specific information to connect and configure the printer.
- Read the documentation for the Hewlett–Packard JetDirect card.
- You must have root authority.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

   In the Web-based System Manager Print Queues container, use the menus to complete the steps to configure a printer attached to the network with a Hewlett–Packard JetDirect card and to add a queue. You can also perform this step with the SMIT fast path `smit mkpq`.

2. After the print queues are successfully created, their names are displayed. Be sure to note any error messages before you exit.
3. Type `wsm printers`. Use the Print Queues menus to customize the new print queue. You can also perform this step with the SMIT fast path `smit chpq`.

Configuring a Print Queue for a File in the /dev Directory

Prerequisites

- Read the documentation for your printer. You may need printer–specific information to connect and configure the printer.
- Review the configuration of your system.
- You must have root authority.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

   In the Web-based System Manager Print Queues container, use the menus to complete the steps to configure a print queue for a file in the /**dev** directory and add a queue. You can also perform this step with the SMIT fast path `smit mkpq`.

Note: If the printer supports more than one type of print data, such as PostScript and ASCII, enter a print queue name for each print data type.

2. After the print queues are successfully created, their names are displayed. Be sure to note any error messages before you exit.
3. Type `wsm printers`. Use the Print Queues menus to customize the new print queue. To use the SMIT fast path, type `smit chpq`.

Configuring a Printer Port

The following procedure describes how to configure a printer attached to the local host without adding a print queue. Use this procedure if you want to add a printer or plotter, but you do not want to spool print jobs.

Note: If you also want to add print queues when you configure your printer, refer to ”Initial Printer Configuration”, on page 2-7.

Prerequisites

The printer or plotter must be physically attached to your system to configure the printer port.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

   In the Web-based System Manager Print Queues container, use the menus to complete the steps to configure a printer attached to the local host. You can also perform this step with the SMIT fast path `smit pdp`.

2. The system displays the printer device name.

Configuring a Printer without Adding a Queue

Use the following procedure if you want to add a printer or plotter, but you do not want to spool print jobs.

Note: If you also want to add print queues when you configure your printer, refer to ”Initial Printer Configuration”, on page 2-7.

Prerequisites

The printer or plotter must be physically attached to your system to configure the printer port.

smit Command

1. At the system prompt, type:

   ```
   smit pdp
   ```

2. Select **Add a Printer**/**Plotter**.

3. Provide additional information as prompted.

qprt Command

The following describes how to queue a print job using the **qprt** command, the **enq** command, the **lp** command, or the **lpr** command. The syntax is the same for all three queuing commands, except that the **–d** flag (instead of the **–P** flag) should be specified with the **lp** command:

```
Command –PQueueName FileName
```

where:

`QueueName`	Name of the print queue.
`FileName`	Name of the file to be printed.

The following example demonstrates how to use the **qprt** command:

```
qprt –Pfastest myfile
```

Refer to the individual queuing commands for additional flags that can be specified.

Additional Queue Operations

This section describes the following procedures:

Adding a Print Queue Device

Prerequisites

To perform this task, you must have root authority.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, use the menus to select or type values for required attributes such as the name of the device, the queue where the device will be attached, and the path name for the printer backend program.

3. Provide additional information as prompted.

You can also perform this task with the following commands:

```
smit mkquedev or

mkquedev -d QueueName -q QueueName -a Attribute = Value
```

You may need to use the **–a** flag several times to fully configure a print queue device.

Adding Plotter Support with 5080

Prerequisites

- The plotter must be physically attached to your system.
- The plotter device must have already been added.

Procedure

The 5080 Attachment Adapter plotter backend is accessible with the **enq** command after you use this procedure to identify the plotters.

1. At the system prompt, type:

   ```
   smit pq_mklque
   ```

2. At the NAME of Queue to Add prompt, type:

   ```
   plta to define serial porta.
   ```

3. At the NAME of Device to Add prompt, type:

   ```
   plota to define serial port a:
   ```

4. For BACKEND PROGRAM Pathname, type:

   ```
   /usr/lib/lpd/plotgbe -gswa 9600
   ```

5. At the NAME of Queue to Add prompt, enter the following to define serial port `b`:

   ```
   pltb
   ```

6. At the NAME of Queue to Add prompt, type:

   ```
   pltb to define serial port b.
   ```

7. For BACKEND PROGRAM Pathname, type:

   ```
   /usr/lib/lpd/plotgbe -gswa 9600
   ```

8. Attach the plotter to either port `a` or port `b`.

You can also perform this task with the **mkque** and **mkquedev** commands. Additional flags are required to add plotter support.

Creating a Plotter Setup File

To send plot files to the plotter, you need a special file containing the instructions for the type of pacing protocol you are using. Instructions for Xon/Xoff Pacing Protocol and Data Transmit Rate (DTR) Pacing Protocol follow:

For Xon/Xoff Pacing	For DTR Pacing
ESC.R:	ESC.R:
ESC.M2:	ESC.M2:
ESC.N2:	ESC.N2:
ESC.P1:	ESC.P3:

Each line must be entered with no spaces, ESC has the ASCII value 27. The . (period) is part of the command.

Adding a Local Printer to an Existing Queue

Prerequisites

To perform this task, you must be one of the following:

- Root
- A member of the printq group

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, use the menus to select the **local** attachment type, manufacturer, and printer model.
3. Provide additional information as prompted.

You can also perform this task with the SMIT fast path `smit mkpqprt`.

Adding an Xstation Printer to an Existing Queue

Prerequisites

To perform this task, you must be one of the following:

- Root
- A member of the printq group

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, use the menus to select the **xstation** attachment type, manufacturer, and printer model.
3. Provide additional information as prompted.

You can also perform this task with the `smit mkpqprt` command.

Adding an ASCII Terminal Printer to an Existing Queue

Prerequisites

To perform this task, you must be one of the following:

- Root
- A member of the printq group

Procedure

1. At the system prompt, type:

   ```
   smit mkpqprt
   ```

2. Select the **ascii** attachment type, manufacturer, printer model, and tty name.
3. Provide additional information as prompted.

Adding an HP JetDirect Printer to an Existing Queue

Prerequisites

To perform this task, you must be one of the following:

- Root
- A member of the printq group

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, use the menus to select the **hpJetDirect** attachment type, manufacturer, and printer model.
3. Provide additional information as prompted.

You can also perform this task with the `smit mkpqprt` fast path command.

Adding a File to an Existing Queue

Prerequisites

To perform this task, you must be one of the following:

- root
- A member of the printq group

Procedure

1. At the system prompt, type:

   ```
   smit mkpqprt
   ```

2. Select the **file** attachment type, manufacturer, and model.
3. Type the Name of existing FILE in the /dev directory. This is the file where you want print job output to be stored. The file must already exist and be located in the /**dev** directory.
4. Provide additional information as prompted.

Configuring Nonsupported Printers

A *nonsupported printer* is a device that is not supplied with the operating system.

Configuration Options

Choose one of the following methods to configure and drive a nonsupported printer:

- Configure the device as a supported printer if the nonsupported printer uses the same hardware interface (serial or parallel) and closely approximates the functions of a supported printer.
- Configure your printer as a supported printer if there are no supported printers similar to yours. Change the virtual printer characteristics to accommodate your printer.
- Use **generic** as the printer type and the appropriate interface type if you are unsure if your printer emulates a supported device. The operating system supplies two generic devices, other parallel printer (**opp**) and other serial printer (**osp**). Specify one of these devices by selecting the interface type, such as **parallel rs232**, and modify the characteristics according to the specifications in your printer manual.
- Configure your printer device driver and print queue, but set the print subsystem to pass all print requests transparently to the printer. With this configuration the application must correctly assemble the printer data stream. The print spooling subsystem is available for sharing the printer among users, but the virtual printer system does not format the printer data stream.
- If your output device has special formatting requirements, such as an electrostatic plotter that requires input as raster graphics, substitute the formatting software for the printer formatter or the printer backend program.

Customizing Nonsupported Virtual Printers

You must define a virtual printer to support the features of the nonsupported printer and the print spooling subsystem.

1. You must identify the printer data stream that best matches your printer to customize a nonsupported printer. The operating system supports the following data streams through predefined virtual printers:

asc	Extended ASCII
pcl	Hewlett–Packard LaserJet
gl	Plotter
ps	PostScript
630	Diablo 630
855	Texas Instruments 855 dot matrix printer in dp mode

2. Once you have identified the data stream used by your printer, choose either a supported printer that uses the same data stream or one of the generic printers and customize the definition for your printer.

Wiring Nonsupported Printers

You may need to adapt your nonsupported printer so that it functions properly with the AIX serial printer device driver:

1. The following chart details what the RS–232 signals mean to the serial printer device driver:

RS–232 Signal	Serial Printer Device Driver Use
FG	Frame ground. Often used as shield.
TxD —>	Used to transmit data to printer.
RxD <—	Used to Receive data from printer.
RTS <—	Held high after printer port opened. Provides host status to printer. Not used for data pacing.
CTS <—	Must be high for printer port to be opened. Used to detect that the printer is turned on.
DSR	Not used. Usually tied to DCD.
SG	Reference voltage for signals.
DCD <—	Used for data pacing when DTR is set to **yes**.
DTR —>	Held high after printer port opened. Provides host status to printer.

2. If you use FG as a cable shield, make sure that it is only connected at one end. It makes no difference which end is connected. This provides an efficient shield against electrical noise.

3. If your RTS signal is used to supply voltage to CTS on the printer port, check to see what your printer does with its RTS signal.

   Although RTS and CTS data pacing is not supported on serial printers, the device driver will block the open of the printer port until the voltage of CTS becomes high. The CTS signal is usually supplied by the RTS signal from the printer. However, some printers use the RTS signal for data pacing. These printers drop RTS when they want the system to stop sending data. Since the queuing system always needs the port opened to check for status, if the printer drops the RTS signal, the port closes and the queue goes down.

4. Some printers require that you raise the voltage of DCD and DSR or CTS on the printer side. There are several methods for raising the voltage:

   – Use DTR or RTS on the computer side to supply the voltage.

     OR

   – Obtain the voltage from the printer side.

Printing with Terminal–Attached Printers

Many asynchronous ASCII terminals have an auxiliary (AUX) port that can be used to connect a printer. Terminal–attached printing is supported for terminals attached directly to a host machine or attached remotely by modem to a host machine.

This section discusses configuration, maintenance, and problem determination for terminal–attached printers as well as the following topics:

- Supported hardware
- Installing a terminal–attached printer
- Terminfo database
- Printer backend commands

Supported Hardware

The following hardware is supported for terminal–attached printing.

- Cables
  - RS–232
  - RS–422
- Terminal Devices
  - IBM 3151, 3161, 3162, 3163, 3164
  - DEC VT100, VT220, VT320, VT330
  - WYSE 30, 50, 60, 350
- Printers
  - IBM 2380 Personal Printer II
  - IBM 2381 Personal Printer II
  - IBM 2390 Personal Printer II
  - IBM 2391 Personal Printer II
  - IBM 2380 Personal Printer II (Model 2)
  - IBM 2381 Personal Printer II (Model 2)
  - IBM 2390 Personal Printer II (Model 2)
  - IBM 2391 Personal Printer II (Model 2)
  - IBM 3112 Page Printer
  - IBM 3116 Page Printer
  - IBM 3130 LaserPrinter
  - IBM 4019 LaserPrinter
  - IBM 4029 LaserPrinter
  - IBM 4037 LaserPrinter
  - IBM 4039 LaserPrinter
  - IBM 4076 InkJet Printer
  - IBM 4201 Model 3 Proprinter III
  - IBM 4202 Model 3 Proprinter III XL
  - IBM 4207 Model 2 Proprinter X24E

- IBM 4208 Model 2 Proprinter XL24E
- IBM 4247 Printer
- IBM 5204 Quickwriter
- IBM 6400 Printer
- IBM InfoPrint 40 Printer
- IBM Network Color Printer
- IBM Network Printer 12
- IBM Network Printer 17
- IBM Network Printer 24
- Hewlett–Packard 2500C Color Printer
- Hewlett–Packard LaserJet II
- Hewlett–Packard LaserJet III
- Hewlett Packard LaserJet IIISi
- Hewlett–Packard LaserJet 4
- Hewlett Packard LaserJet 4Si
- Hewlett Packard LaserJet 4 Plus
- Hewlett Packard LaserJet 4V
- Hewlett–Packard LaserJet 5000 D640 Printer
- Hewlett Packard LaserJet 5Si/5Si MX
- Hewlett Packard LaserJet 5Si Mopier
- Hewlett–Packard LaserJet 8100 Printer
- Hewlett Packard LaserJet Color
- Hewlett–Packard Color LaserJet 4500
- Lexmark Optra LaserPrinter
- Lexmark Optra E310 Laser Printer
- Lexmark Optra M410 Laser Printer
- Lexmark Optra Se Laser Printer
- Lexmark Optra T Laser Printer Family
- Lexmark Optra W810 Laser Printer
- Lexmark Optra Plus LaserPrinter
- Lexmark Optra C Color LaserPrinter
- Lexmark Optra E LaserPrinter
- Lexmark Optra N LaserPrinter
- Lexmark ExecJet IIc
- Lexmark ValueWriter 600
- Lexmark 2380 Plus Printer (Model 3)
- Lexmark 2381 Plus Printer (Model 3)
- Lexmark 2390 Plus Printer (Model 3)
- Lexmark 2391 Plus Printer (Model 3)

  - Lexmark 4039 Plus LaserPrinter
  - Lexmark 4079 Color JetPrinter Plus
  - Lexmark 4227 Forms Printer
- Asynchronous Communications Adapters
  - Native serial port controller
  - 8–port controller
  - 16–port controller
  - 64–port controller
  - 128–port controller
  - Third–party controller

  Note: Third–party asynchronous controllers are also supported. When AIX detects that an ASCII terminal was configured with a third–party controller, the terminal–attached printer will be configured as thoug h it was connected to the native port controller. See ”Native, 8–Port, 16–Port, and Third–party Controllers”, on page 2-27 for more information.

Installing a Terminal–Attached Printer

To install a new terminal–attached printer and configure it into the print spooling subsystem, you must:

- Install the physical ASCII terminal (tty) device and connect it to the system.
- Configure a tty device driver for the ASCII terminal.
- Connect the serial printer to the AUX or PRINT port of your ASCII terminal.
- Configure a virtual printer and print queue.

Installing the Physical ASCII Terminal

1. Review all relevant installation planning information and the terminal’s documentation to ensure that you have the components required for installation.
2. Review your system’s configuration and select the serial port.
3. Ensure that the communications port is not in use.
4. Connect the terminal to the serial communications port. Be sure to use proper cabling. Consult your documentation for cabling instructions.
5. Configure the terminal according to the documentation provided with it. Be sure to record the settings you choose for baud rate, stop bits, bits per character, and flow control. You will need this information to configure the AIX tty device driver.

Configuring the Terminal Device Driver (tty)

1. Log on as the root user.
2. At the system prompt type:

   Devices

   In the Web-based System Manager Devices container, use the menus to complete the steps to configure the terminal device driver.
3. Select the **Add a TTY** option and the tty type.
4. Provide additional information as prompted such as the configuration settings you made on your terminal at installation. If you are not sure of the port number IDs, press the **F4** key to display a list of available I Ds. Be sure to enter the correct TERMINAL type. When you have entered all configuration information, press Enter.

You can also perform this task with the SMIT fastpath `smit tty` .

Verifying Terminal Output

After you have configured the terminal device, enter the following to verify that the terminal is working and send output directly to the terminal screen:

```
cat /etc/qconfig > /dev/ttynn
```

where `nn` is the appropriate tty device number. The contents of the **/etc/qconfig** file should appear on the terminal screen.

Installing the Physical Printer

1. Review all relevant installation planning information and the printer's documentation to ensure that you have the required components and information to install the printer.
2. Review the terminal documentation for information on connecting printers to the auxiliary port.
3. Verify that the AUX port on the terminal is configured with the same settings as your printer such as baud rate, parity, data bits, stop bits, and XON/XOFF.
   - For information about setting values for the AUX port, consult your terminal documentation.
   - For information about configuring the printer's serial interface, consult your printer documentation.
4. Connect the printer to the terminal's AUX port. Be sure to use the proper cabling. Consult your documentation for cabling instructions.

Configuring a Virtual Printer and Print Queue

Perform the following steps to configure your terminal–attached printer into the print spooling subsystem.

1. At the system prompt, type:

   Devices

   In the Web-based System Manager Devices container, use the menus to complete the steps to configure a virtual printer and print queue.
2. Select the **ascii** attachment type, manufacturer, and printer model.
3. Provide additional information as prompted.

You can also perform this procedure with the **/usr/lib/lpd/pio/etc/piomkpq** command or with the SMIT fastpath `smit mkpq` .

Modem Connections

Terminal–attached printing can also be supported by establishing a queue for a modem line instead of creating the queue for a specific terminal. Since the terminal type of a dial–in terminal cannot be guaranteed, set t he **PIOTERM** environment variable to the terminal type of the dial–in terminal by entering the following command:

```
export PIOTERM=Dialin-Terminal-Type
```

Commands and Control Sequences

Terminfo Database

The terminfo database contains the capabilities and special features of a terminal device, such as cursor positioning, initialization sequences, and key sequences that control specific terminal operations. For supporte d terminals, the control sequence values are predefined in the terminfo database. The control sequences that allow access to the AUX port are:

mc5=*Value*	Instructs the terminal to send all data to the AUX port (Printer ON).
mc4=*Value*	Restores output to the terminal (Printer OFF).

The control sequence values are terminal specific. For example, the printer command sequences for an IBM 3151 terminal are:

```
mc5=^P^R
mc4=^P^T
```

In this example, `^P^R` refers to the Ctrl–P Ctrl–R key sequence.

Adding Support for Nonsupported Terminals

The control sequences must be added to the terminfo database in the **/usr/share/lib/terminfo** directory. To add the control sequence values for your terminal, edit the appropriate ***.ti** file. Then compile th e file using the **tic** command. Refer to the documentation supplied with your terminal for more information about control sequence values.

The *virtual printer database* is a series of files that describe the way print requests should be processed, such as the data stream to be delivered to the printer. User–configurable attributes specific to terminal–at tached printers are defined in the virtual printer database and are based upon the asynchronous communications adapter being used.

The *virtual printer attributes* are defined when the virtual printer is configured. The naming convention for attributes unique to terminal–attached printers is **y**N, where N is an integer greater than or equal t o 0. The value of **y0** is reserved. It designates that the virtual printer queue is configured for a terminal–attached printer and contains the hardware line discipline for the terminal port. The sections that follow detail the adapter–specific virtu al printer attributes for terminal–attached printers.

To change the attribute values on an existing virtual printer, use the Web-based System Manager Devices fast path. You can also use the `smit ps_lsvirprt` fast path command.

Native, 8–Port, 16–Port, and Third–party Controllers

Native port (S1 or S2), 8–port and 16–port controllers do not provide hardware support for terminal–attached printers and the hardware support for third–party controllers is unknown . As a result, print files must be split into small data blocks. The **mc5** control sequence precedes each data block, which is in turn followed by the **mc4** control sequence. When the terminal receives the **mc5** control sequence, all subseq uent data is routed to the AUX port until an **mc4** control sequence is received.

Data blocks sent to the terminal must be kept relatively small. Sending too many characters to the tty at once may cause output to the printer to be mixed with the echo of what is typed during the sending operation. A delay time between data block transmissions must also be established to minimize data reception errors.

Native port, 8–port, 16–port, and third–party controllers have the following virtual printer attributes for specifying block size and delay value:

y1 Indicates the maximum number of characters in a data block.

y2 Indicates the number of microseconds to delay between data block transmissions.

64–Port Controller

The 64–port controller provides hardware support for terminal–attached printers. The 64–port controller has the following virtual printer attribute:

y1 Sets the priority with which printing will be done over terminal activity. The larger the number, the greater the priority the printer has over the terminal.

128–Port Controller

The 128–port controller also provides hardware support for terminal–attached printers. The 128–port controller has the following virtual printer attributes:

y1 Sets the maximum characters per second (CPS) rate at which characters are sent to the print device. The rate should be just below the average print speed for your printer. Consult your printer's documentation for print speed.

y2 Sets the maximum number of print characters the device driver places in the output queue. Reducing this number increases system overhead. Increasing this number delays operator keystroke echo times when the terminal–attached printer is in use.

y3 Sets the device driver estimate of the size of the terminal–attached printer's input buffer. After a period of inactivity, the driver bursts the designated number of characters to the printer. Consult your printer's documentation for input buff er size.

Printer Backend Commands

The **piobe** command is the normal backend program run by the print spooling subsystem when printing to a locally attached printer device. The **piobe** comm and is started via the **qdaemon** process. It determines the data stream it is going to create by reading a flag or querying the virtual printer database. The **piobe** process then passes the print file through a pipeline of appropriate filters so that it generates the correct data stream. At the end of this pipeline, the filtered file is passed to the **pioout** device driver interface program.

The **pioout** command is invoked in a pipeline by the **piobe** command. For locally attached printers, the **pioout** command sends the print file to the appro priate printer device driver (for example, /**dev**/**lp1**). However, for terminal–attached printers, the print files are sent to the printer via the tty device driver (for example, /**dev**/**tty0**), after being modified by data gathered from the terminf o and virtual printer databases. The terminfo database is queried for the **mc5** and **mc4** terminal control attributes. The virtual printer database is queried for the asynchronous controller–specific attributes.

Terminal–Attached Printing Limitations

1. Only ASCII data should be sent to the printer. Binary data may inadvertently lock the terminal or cause printing to cease prematurely.
2. Printer status messages, such as out of paper and printer offline, are not supported.

Configuring a Printer for an ASCII Display Terminal

Prerequisites

- You must have connected a serial printer to the AUX or PRINT port on your ASCII terminal. Refer to the terminal documentation for cabling instructions.
- The tty device for the ASCII terminal must be defined. See ”Adding or changing a TTY from the command line” in *AIX 4.3 System Management Guide: Communications and Networks* for more information.
- The printer must be online.
- Verify that the AUX port on the terminal is configured with the same settings as your printer. To do this, consult your terminal documentation for information about setting values for the AUX port. Consult your printer documentation for information about configuring the printer serial interface.
- You must have root user authority.

Procedure

1. At the system prompt, type:

   ```
   smit mkpq
   ```

2. Select the **ascii** attachment type, manufacturer, and printer model.
3. Provide additional information as prompted.

You can also perform this task with the **/usr/lib/lpd/pio/etc/piomkpq** command.

Listing Print Queues and Print Queue Devices

The following procedures apply to both local and remote print queues and print queue devices.

Prerequisites

- The printer devices must be attached to your system for local print queues and print queue devices.
- Your system must be configured to communicate with a remote host for remote print queues and print queue devices.

Listing Print Queues

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, use the menus to complete the steps to list print queues.

You can also perform this task with the `lsallq` command or with the SMIT fast path `smit lspq`.

Listing Print Queue Devices

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, use the menus to complete the steps to list print queue devices.

You can also perform this task with the `lsallqdev -q QueueName` command or with the SMIT fast path `smit lsallqdev`.

Showing Status of Print Queues

Use the Web-based System Manager to perform this task.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Printers container, choose the Queue Status icon. From the **Selected** menu choose **Properties**. Select the ”General” tab within the ”Printer Properties” dialog. Information pertaining to status of print queues will appear in the ”Print Queue Properties” dialog.

3. You can also perform this task with the `enq -e ”$@”` command or with the SMIT fast path `smit qstatus` .

Starting and Stopping a Print Queue

Prerequisites

To perform these tasks, you must have root authority.

Starting a Queue

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, select the queue or device that you want to start.
3. Select **Start all Devices for Queue** to start a queue. Select **Start a Specific Device** to start a device.

You can also perform this task with the following commands:

```
smit qstart
```

OR

```
qadm -U QueueName
```

Stopping a Queue

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, select the queue or device that you want to stop.
3. Select **Stop all Devices for Queue** to stop a queue. Select **Stop a Specific Device** to stop a device.

You can also perform this task with the following commands:

```
smit qstop
```

OR

```
qadm -D QueueName
```

Setting the Default Print Queue

Prerequisites

To perform this task, you must be one of the following:

- root
- A member of the printq group

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, select a computer object.
3. Select a queue from the Selected menu.

You can also perform this task with the SMIT fast path `smit qdefault`.

Holding and Releasing a Print Job (qhld Command)

Prerequisites

To hold or release a print job, you must be one of the following:

- Print job owner
- root
- A member of the printq group

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, use the menus to complete the steps to hold a print job or to release a print job currently on hold.

You can also hold a print job using the following commands:

```
smit qhld
```

OR

```
qhld -# JobNumber
```

OR

```
qhld -P Queue
```

OR

```
qhld -u User
```

You can release a print job using the following commands:

```
qhld -r -# Jobnumber
```

OR

```
qhld -r -P Queue
```

OR

```
qhld -r -u User
```

Moving a Job between Queues

Prerequisites

To perform this task, you must be one of the following:

- The print job owner
- root
- A member of the printq group.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, select the job you want to move.
3. Select **Destination Queue**.

You can also perform this procedure with the following commands:

```
smit qmov
```

OR

```
qmov -m DestinationQueue -# JobNumber
```

OR

```
qmov -m DestinationQueue -P Queue
```

OR

```
qmov -m DestinationQueue -u User
```

Scheduling Print Jobs

Use the SMIT fast path to perform the following tasks.

Prerequisites

Your root user login name must be included in the **/var/adm/cron/at.allow** file or you must have root user authority.

Listing All Scheduled Print Jobs

At the prompt, type:

```
smit lsat
```

This command displays a list of all the print jobs you have scheduled. If you have root user authority, the command lists all currently scheduled print jobs.

Scheduling Print Jobs

1. At the prompt, type:

   ```
   smit sjat
   ```

2. Select or type the appropriate date and time fields.
3. Provide additional information as prompted.

Removing a Scheduled Job

At the prompt, type:

```
smit rmat
```

Select **List** to delete the job number.

Changing or Showing Queue Characteristics

The following procedures apply to both local and remote print queues and print queue devices.

Prerequisites

- For local print queues, the printer must be physically attached to your system.
- For remote print queues, your system must be configured to communicate with the remote print server.
- To change queue or queue device characteristics, you must have root authority.

Change or Show Print Queue Characteristics

1. At the system prompt, type:

   ```
   wsm devices
   ```

2. In the Web-based System Manager Devices container, select **Queue**, **Print Processor**, or **Print Destination**.
3. Select **Properties**.
4. View or change the desired attributes.

You can also perform this procedure with the **chque**, **chquedev**, **lsvirprt**, and **chvirprt** commands or with the SMIT fast path `smit chpq`.

Specifying Paper Size

Prerequisites

To perform this task, the print queue must already be configured.

Procedure

1. Load paper in the paper tray.
2. Refer to your printer documentation for information about specifying the paper size, then use the operator panel buttons to enter the paper size.
3. At the system prompt, type:

   ```
   wsm printers
   ```

4. In the Web-based System Manager Printers container, double click on the printer icon. From the **Selected** menu choose **Properties**. Information pertaining to paper size will be displayed in the ”Printer Properties Setup” dialog.

   You can also perform this task with the `pioevattr -q ”$[Queue]” -d ”$[Printer]”` command or with the SMIT fast path `smit chpq` .

Changing or Showing Printer Connection Characteristics

Prerequisites

To perform this task, you must be one of the following:

- root
- A member of the printq group

Procedure

1. At the system prompt, type:

   ```
   wsm devices
   ```

2. In the Web-based System Manager Devices container, double–click on a computer object to open its Properties. Information such as device name, type, interface type, and status display.

You can also perform this task with the SMIT fast path `smit chprtcom`.

Changing / Showing Pre–Processing Filters

This procedure describes how to change or show the command strings that you can run to pre–process print files. A *pre–processing filter* consists of a command string that you pass to a Korn shell to filter a file before it prints. There are pre–processing filters for each of the values that can be specified with the **qprt** command **–f** flag or with the **lpr** command **FilterOption** flags.

Prerequisites

To change or show pre–processing filters, you must be one of the following:

- root
- A member of the printq group.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Printers container, double click on the ”Print Processor icon. From the **Selected** menu choose **Properties**. Information on changing/showing pre–processing filters will be displayed in the ”Layout” tab of the ”Print Processing Properties” dialog.

   You can also perform this task with the SMIT fast path `smit pqfilters` .

Deleting a Print Queue

The following procedures apply to both local and remote print queues.

Prerequisites

- For local print queues, the printer must be physically attached to your system.
- For remote print queues, your system must be configured to communicate with the remote print server.
- To delete a queue or queue device, you must have root authority.

Procedure

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, select **Queue**, **Print Processor**, or **Destination**.

   If you select a queue, all copies of devices for that printer are removed. If you select a print processor or destination, only that print processor or destination is removed.

You can also use the **rmque**, **rmquedev**, and **rmvirprt** commands or the SMIT fast path **smit rmpq** to perform this task.

Note: If the selected queue has only one printer, the queue and its printer are removed. If the queue has more than one printer, only the selected printer is removed.

Listing All Supported and Defined Printers

Prerequisites

None.

List All Supported Printers

At the system prompt, type:

```
wsm printers
```

then press Enter to open Web-based System Manager Print Queues. You can also use the `smit lssprt` fast path command.

Output similar to the following is displayed:

```
bull1021    parallel Bull Compuprint Page Master 1021
.
.
.
ibm2380     parallel IBM 2380 Personal Printer II
ibm2380     rs232    IBM 2380 Personal Printer II
ibm2380     rs422    IBM 2380 Personal Printer II
.
.
.
opp      parallel Other parallel printer
osp      rs232    Other serial printer
osp      rs422    Other serial printer
```

List All Defined Printers

At the system prompt, type:

```
wsm printers
```

then press Enter to open Web-based System Manager Print Queues. You can also use the `smit lsdprt` fast path command.

Output similar to the following is displayed:

```
lp0  Available  00-04-01-06  Other serial printer
lp1  Available  00-04-01-07  Other serial printer
lp2  Available  00-00-0P-00  Other parallel printer
```

Moving a Printer to Another Port

Prerequisites

- The printer must be physically attached to your system.
- You must have root authority.
- You must have previously defined and configured a printer port.

Procedure

1. At the system prompt, type:

   ```
   wsm devices
   ```

2. In the Web-based System Manager Devices container, select the printer object you want to move.
3. Select **Move To...** from the Selected menu.

Changing or Showing Printer Characteristics

Prerequisite

A printer must have been added.

Procedure

1. At the system prompt, type:

   ```
   wsm devices
   ```

2. In the Web-based System Manager Devices container, double–click on the printer object.

Note: If the printer has a print queue, or if the printer is attached to a serial port on an Xstation, you can change the printer connection characteristics with the **wsm devices** fast path or the **chprtcom** commands.

You can also perform this task with the SMIT fast path `smit chgprt`.

Deleting a Printer

This procedure removes a printer from the system. Deleting a printer does not remove any print queues that send print jobs to that printer. See if you want to also delete the print queues.

Prerequisites

- A printer must have been added.
- You must have root authority.

Procedure

1. At the system prompt, type:

   ```
   wsm devices
   ```

2. In the Web-based System Manager Devices container, use select the printer object you want to delete.
3. Select **Delete** from the Selected menu.

You can also perform this task with the SMIT fast path **smit rmprt**.

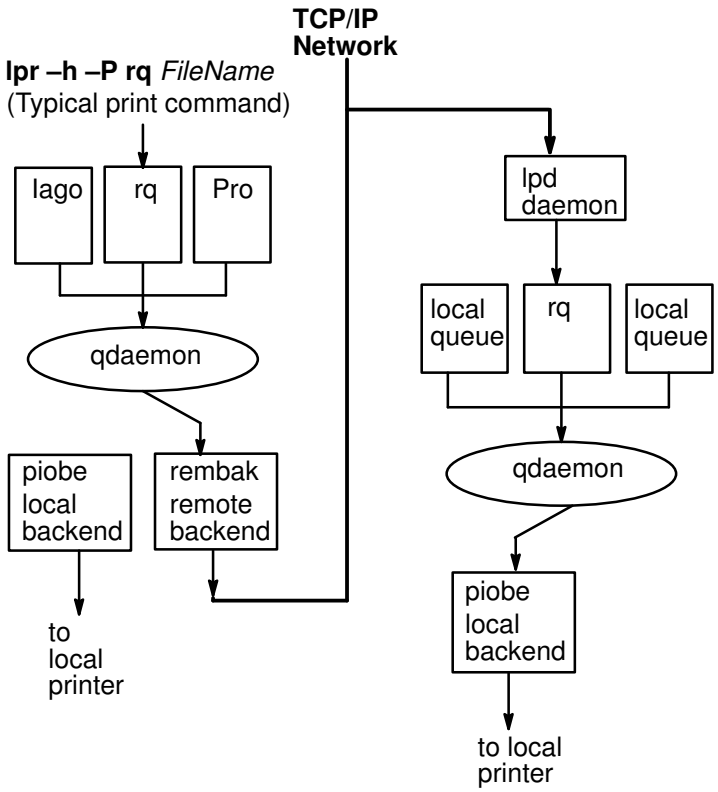
Remote Printing Overview

Remote printing allows different computers to share printers. To use remote printing facilities, the computers must be connected via the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol and must support the required TCP/IP applications, such as the **lpd** daemon.

A remote print request is queued in the same manner as a local print request:

- A front–end print command such as **qprt**, **lpr**, or **enq** initiates the request to the appropriate queue on the local system.
- The **qdaemon** on the local system processes the request as it would any locally queued job, with one exception. The **qdaemon** passes the request to the **rembak** backend program rather than the **piobe** backend.
- The **rembak** program transmits the print job to a remote server via the TCP/IP network.
- On the remote server the **lpd** daemon monitors port 515 for remote print requests.
- When the **lpd** receives a remote print request, it places the job in the appropriate local queue.
- The print request is then processed by the **qdaemon** on the print server.
- The **qdaemon** passes the request to the **piobe** backend on the print server.
- The **piobe** backend formats the data stream for printing on the specified printer.

The following figure shows how remote printing requests are handled:



Flow of a Remote Print Request

The following sections discuss how to configure, use and manage a remote printing environment:

- The **rembak** Program
- The **lpd** daemon

rembak Program

The local queue set up to serve remote print requests must be configured to use **rembak**, the remote print backend command. When you set up the queue, the system prompts for a backend program path name. The entry at this prompt tells the **qdaemon** command which backend program to use to process print requests. To set up a queue to handle remote print requests, type `/usr/lpd/rembak`.

The **rembak** command also processes status requests, job cancel requests, and requests to kill a remote queuing system. Status requests such as **qchk –A** or **lpstat** query the status of local print queues and devices by analyzing the **qconfig** file and the local print spooling subsystem status files.

In a remote print environment, the **qchk –A** and **lpstat** commands use the **rembak** program to request queue status information from the print servers. The output of a queue status command shows two entries for each remote queue. The first entry is the status of the local queue to which remote jobs are sent. The second entry shows the status of the queue on the remote print server where the jobs are printed. In the following example, the queue name `rq` was used for both the queue on the local system and the queue on the remote print server:

```
Queue Dev   Status  Job Files              User       PP  %  Blks Cp
----- ---   ------  --- ---------------    ---------- --- -- ---- --
Iago  Iago  RUNNING 284 mileaf             ann@arctur 15  13  1   1
Pro   asc   READY
bsh   bshde READY
ps    ps    READY
rq    rqd   READY
rq    ps1   RUNNING 297 .deskprint/dsktop sarah@alde 60  22  1   1
            QUEUED  298 .deskprint/howtol sarah@alde     60  1   2
```

As the preceding example shows, any print jobs currently running or queued show up in the remote print server entry for the queue.

The **rembak** program also sends requests to cancel print jobs to the remote print servers. Each print job is assigned a number. As shown in the previous example, print queue status requests display the job numbers for currently queued or running print requests. To cancel a job on a remote queue, use the same commands used to cancel local print jobs. For example, to cancel job `298` from the queue `rq`, use the Web-based System Manager **wsm printers** fast path or one of the following commands:

```
qcan -Prq -x298
```

OR

```
lprm -Prq 298
```

lpd daemon

Although local and remote print jobs are submitted with the same commands, they are processed differently. Once a print job has been transmitted to a remote host, it is no longer managed by the local print spooling subsystem.

The **lpd** daemon is part of the TCP/IP system group. Any host on a TCP/IP network can run the **lpd** daemon, and any host can send print requests to any other host on the network (if the host is currently running **lpd**). As a security measure, the **lpd** daemon forks a child process that checks each remote print request against two database files: the /**etc**/**hosts.equiv** file and the /**etc**/**hosts.lpd** file. If the name of the host submitting the print request is not in the /**etc**/**hosts.lpd** file, the print request is rejected.

Note: The **/etc/hosts.equiv** file defines which computers on a network are allowed to execute certain commands on a local host without supplying a password. The **/etc/hosts.lpd** file defines which computers on a network are allowed to execute print commands on a local host without supplying a password.

The **lpd** daemon on the remote print server monitors port 515 for print requests. When the **lpd** daemon receives a print request from a valid host, it places the request in the specified queue. The **lpd** daemon places files specified in print requests in the directory **/var/spool/lpd**. The print request is then managed by the **qdaemon** and the appropriate backend (usually **piobe**) on the remote server.

The **/etc/locks/lpd** file contains the process ID of the currently running instance of the **lpd** daemon. If a machine running the **lpd** daemon becomes inoperable, the ID for the **lpd** daemon may have to be removed before the system is restarted. The error messages `lpd: lock file` or `duplicate daemon` indicate that the ID must be removed.

Controlling the lpd Daemon

Controlling the **lpd** daemon includes starting and stopping the **lpd** subsystem and changing the characteristics of the **lpd** subsystem. Use the Web-based System Manager **wsm printers** fast path or the SMIT or System Resource Controller (SRC) commands to control the **lpd** daemon.

There are three ways to start the **lpd** daemon. If it is not currently running, you can start the daemon at any time. You also have the option of having the **lpd** daemon start at system restart or to have it start both at the current time and at system restart. The same options are available to stop the **lpd** daemon: stop now, stop at system restart, or stop both now and at system restart. You can run the **lpd** daemon with DEBUG, with SYSLOG, with both DEBUG and SYSLOG, or with neither.

To control the **lpd** daemon with Web-based System Manager, type `wsm printers` , then select the desired options from the Print Queues container menus. To control the **lpd** daemon with SMIT,type `smit lpd`, then select the desired options from the SMIT menus. To control the **lpd** daemon with the SRC, use the following SRC commands:

startsrc	Starts a subsystem, group of subsystems, or a subserver.
stopsrc	Stops a subsystem, group of subsystems, or a subserver.
lssrc	Gets the status of a subsystem, group of subsystems, or a subserver.
refresh	Causes the subsystem or group of subsystems to reread the appropriate configuration file.
traceson	Enables tracing of a subsystem, group of subsystems, or a subserver.
tracesoff	Disables tracing of a subsystem, group of subsystems, or a subserver.

Managing and Using Remote Printers and Queues

In order to print to a remote system, you must set up a remote queue on the local system. This process involves tasks such as naming a queue and a queue device on the local host, and indicating the name of the remote host and the queue on the remote host to which print jobs are sent.

You can set up a remote queue with the Web-based System Manager **wsm printers** fast path. You can also use the **smit mkrque** command. For more information, see ”Adding a Print Queue Device”, on page 2-13 .

> **Note:** The queue on the remote host designated to receive remote print requests must be an active queue.

To start the remote queue, type `wsm printers` , then select the name of the queue and queue device you configured for remote printing. You can also use `smit qstart` to perform this task.

Remote Printing and the qconfig File

The **qconfig** file contains stanzas that define queue devices. For a remote printer, some of the field values in the device stanza differ from those for a local printer. The following table lists the fields which have particular significance for remote printers. The table also shows sample values or default values for these fields.

host	sys2	The name of the remote host (print server) where jobs will be printed.
rq	q2	The name of the remote queue on which jobs will be printed.
s_statfilter	**/usr/lpd/aixshort**	The filter used to translate remote queue status information into a short form for queue status requests such as **qchk**. This is the default value when the remote print server is another AIX system.
	/usr/lpd/bsdshort	The filter used to translate BSD **lpq** command output (short form) when the remote print server is a BSD system.
	/usr/lpd/attshort	The filter used to translate ATT **lpstat** command output (short form) when the remote print server is an ATT system.
	/usr/lpd/aixv2short	The filter used to translate the AIX 2.2.1 **print –q** command output (short form) when the print server is an RT running AIX 2.2.1.
l_statfilter	**/usr/lpd/aixlong**	The filter used to translate remote queue status information into a long form for queue status requests such as **qchk**. This is the default value when the remote print server is another AIX system.
	/usr/lpd/bsdlong	The filter used to translate BSD **lpq** command output (long form) when the remote print server is a BSD system.
	/usr/lpd/attlong	The filter used to translate ATT **lpstat** command output (long form) when the remote print server is an ATT system.
	/usr/lpd/aixv2long	The filter used to translate the AIX 2.2.1 **print –q** command output (long form) when the print server is an RT running AIX 2.2.1.

Configuring a Remote Host as a Print Server

The host to be used as a print server must be configured to accept remote print requests. A host must be listed in the /**etc**/**hosts.lpd** file on the print server to have permission to print. To add a print queue host name to the /**etc**/**hosts.lpd** file using the Web-based System Manager fast path:

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Print Queues container, select a computer object.

3. Select **Properties** from the Selected menu.

4. To add the host name to the /**etc**/**hosts.lpd** file, open and edit the Host Access list.

You can also perform this task with the `smit mkhostslpd` fast path.

A print request sent from a host not defined in the print server's /**etc**/**hosts.lpd** file will be rejected. The system displays an error message indicating that the host does not have line printer access.

A host acting as a print server must also have its **lpd** process running to service print requests. The SRC command **lssrc –s lpd** shows the status of the **lpd** daemon. If it is not active, use the **wsm printers** fast path or the **startsrc** command to start the **lpd** daemon.

Using Remote Printers and Queues

No special commands are required to print to a remote host. Use any print command that allows you to specify a queue. The **lpr**, **qprt**, and **enq** commands are examples of print commands. Use the appropriate flags and options to tailor the print request, including the flag that specifies the queue. Use the name of the remote queue on your host.

You can also send a remote print request with the `smit qprt` fast path.

Queue status commands, such as **qchk** or **lpstat**, display information for both local and remote print queues. The **smit qchk** command displays a menu that allows you to choose the type of queue status information you want from both local and remote queues.

To cancel a print job in a remote queue, use the Web-based System Manager fast path (**wsm printers**), the **qcan** command, or the **lprm** command. You can also use the `smit qcan` fast path.

Using Remote Host Access for Printing

Prerequisites

- Your system must be configured to communicate as a remote print server.
- The **lpd** daemon must be installed on your system.
- To add a remote host, you must understand naming conventions for TCP/IP.

Listing All Remote Hosts

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Print Queues container, select a computer object.
3. Select **Properties** from the Selected menu to view a list of remote print server hosts.

For detailed information or assistance, see the online help.

You can also perform this task with the following commands:

```
ruser -sPOR
smit lshostslpd
```

Adding a Remote Host

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, select **New queue and printer** from the Printers menu.
3. Use the menus or provide additional information as prompted to complete the steps for adding a remote host.

For detailed information or assistance, see the online help.

You can also perform this task with the following commands:

```
ruser -a -p HostNameOR
smit mkhostslpd
```

Deleting a Remote Host

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Web-based System Manager Print Queues container, select the host you want to delete.
3. Use the menus or provide additional information as prompted to complete the steps for deleting a remote host.

For detailed information or assistance, see the online help.

You can also perform this task with the following commands:

```
smit rmhostslpdOR
ruser -d -p HostName
```

Using the lpd Remote Subsystem

Prerequisites

- Your system must be configured to communicate with a remote print server.
- To start or stop the lpd remote subsystem, you must have root authority.

Start the lpd Remote Subsystem

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Print Queues container, select a computer object.
3. Select **Properties** from the Selected menu.
4. Select **Start lpd daemon**.

For detailed information or assistance, see the online help.

You can also perform this task with the following commands:

- To start the lpd remote subsystem with the SMIT fast path:

  ```
  smit mkitab_lpd
  ```

- To start the lpd remote subsystem now:

  ```
  startsrc -c
  ```

- To start the lpd remote subsystem at the next system restart:

  ```
  mkitab "lpd:2:once:startsrc -c lpd"
  ```

- To start the lpd remote subsystem both now and at the next system restart:

  ```
  startsrc -c; mkitab "lpd:2:once:startsrc -c lpd"
  ```

Stop the lpd Remote Subsystem

1. At the system prompt, type:

   ```
   wsm printers
   ```

2. In the Print Queues container, select a computer object.
3. Select **Properties** from the Selected menu.
4. Select **Stop lpd daemon**.

for detailed information or assistance, see the online help.

You can also perform this task with the following commands:

- To stop the lpd remote subsystem with the SMIT fast path:

  ```
  smit rmitab_lpd
  ```

- To stop the lpd remote subsystem now:

  ```
  stopsrc -c -s lpd
  ```

- To stop the lpd remote subsystem at the next system restart:

  ```
  rmtab "lpd"
  ```

- To stop the lpd remote subsystem both now and at the next system restart:

  ```
  stopsrc -c -s lpd; rmtab "lpd"
  ```

Showing Status of Printer Server Subsystem

Use the SMIT fast path to perform this task.

Procedure

1. At the system prompt, type:

   ```
   smit server
   ```

2. Select **Show Status of the Print Server Subsystem**.

Printer Queuing System Status Conditions

If a printer/device is added as a tty device, the queuing system looks for carrier detect (CD) to recognize the printer. If the device is an LP device, the queuing system uses CTS to detect the printer.

Following is a list of print queue status conditions:

DEV_BUSY Identifies that:

- More than one queue is defined to a printer device (lp0), and another queue is currently using the printer device.
- **qdaemon** attempted to use the printer port device (lp0), and another application is currently using that printer device.

Normal recovery: To recover from a **DEV_BUSY**, wait until the queue or application has released the printer device, or kill the job or process that is using the printer port.

DEV_WAIT Indicates that the queue is waiting for the printer because the printer is offline, out of paper, jammed, or the cable is loose, bad, or wired incorrectly.

Normal Recovery: To recover from a **DEV_WAIT**, you must correct the problem that caused it to wait. Check to see if the printer is offline, out of paper, jammed, or loosely cabled. It may be easier for diagnostic testing to use the **enq** command to move all queued jobs from the **DEV_WAIT** queue to another queue that is either printing or is **DOWN**. After the problem is corrected, you can move any unprinted jobs back to the original queue.

DEV_WAIT can also be caused by improper flow control to the printer, particularly when using XON/XOFF software control. Use SMIT to see if you are using the proper flow control (XON/XOFF or DTR pacing).

Bad or improperly wired cabling can cause a **DEV_WAIT** situation. Usually, you cannot recover from this situation except by replacing the cable.

A queue that is in **DEV_WAIT** for longer than **TIMEOUT** seconds goes into a **DOWN** state. See **DOWN** for more information on the **TIMEOUT** value and the **DOWN** state.

DOWN Specifies that the device driver cannot communicate with the printer (CD or CTS dropped or is low) after **TIMEOUT** seconds. The **TIMEOUT** value indicates the amount of time, in seconds, that the queuing system waits for a printer operation to complete. You can set this value using SMIT.

A queue usually goes into the **DOWN** state after it has been in the **DEV_WAIT** state. If a queue goes directly into the **DOWN** state, either the **TIMEOUT** value is too small or there are cabling problems. Usually, this situation occurs when the printer device driver cannot tell if the printer is there due to the absence of correct signaling. However, some printers cannot signal the queuing system that they are only offline. These printers signal that they are off; they drop CTS (if an lp) or drop CD (if a tty).

If the printer device is off, the queue goes into the **DOWN** state. The system administrator can bring a queue to the **DOWN** state for maintenance with the queuing commands (**qadm**, **disable**, **enq**, and others).

Normal recovery: Correct the problem that brought the queue down and bring the queue back up using the **qadm**, **enable**, or **enq** commands with appropriate flags. The queue *must* be manually brought up before it can be used again.

HELD Specifies that the job is held and will not be put on the queue until it is released using the **qhld** or **enq** commands

OPR_WAIT Specifies that the backend program is waiting for the operator to perform a task such as loading paper. This is usually software–related.

Normal Recovery: To recover from an **OPR_WAIT** state, respond appropriately to the request that is made by the queuing system.

QUEUED Specifies that a print file is queued and is waiting in line to be printed.

READY Specifies that everything involved with the queue is ready to queue and print a job.

RUNNING Specifies that a print file is printing.

UNKNOWN Specifies that a user created a queue on a device file that another queue is using and that its status is **DEV_WAIT**. The queue cannot get a status from the printer device (lp0) when it is on hold (**DEV_WAIT**).

Normal recovery: To correct this, bring down the other queue or fix the problem with the printer. Bring the new queue down and back up so the queue registers as **READY**.

The following status conditions apply to remote queues:

CONNECT Specifies that the backend is trying to connect to the remote host.

GET_HOST Specifies that the backend is getting the host to which the print job will be sent.

INITING Specifies that the backend is in the process of establishing a connection to the network.

SENDING Specifies that the backend is sending the print job to the remote host.

Chapter 3. Spooler Overview

The job of the spooler, also called the queuing system, is to manage printer use, especially on systems that have more than one printer. When you submit a print job to the spooler, you can continue to use your workstation. This section discusses:

Spooler Introduction

This section provides an overview of the spooler mechanisms used by Version 3.2.5 and AIX Version 4. Because the backend **piobe**, used to process print jobs on local queues, is the most commonly used and possibly the most complex backend shipped with the AIX operating system, it is used as the primary example in this section. Using **piobe** in this fashion will allow a better development of AIX spooler concepts. Appropriate notes indicate significant differences between Version 3.2.5 and AIX Version 4.

This section should give the reader a solid impression of the spooler as a real process that has a beginning, discrete points in between (no black boxes), and an ending. If you learn to treat the spooler as a series of components that interact with one another in ways completely dependent upon how a specific queue is configured, three useful events can occur:

- Problem determination and resolution can become easier.
- Bending the spooler to your specific business needs can become easier.
- You might see opportunities for spooler modification that you hadn't considered.

Spooler Terminology

The following terms relate to the spooler overview.

Spooler

The AIX spooler is a collection of programs, configuration files, and data files that provide the following functions or services:

- Provides for the construction of queues, which are software entities whose function is to process jobs in specific ways
- Allows users to submit jobs (usually but not always printer jobs) to a queue for processing.
- Provides serial access through a queue to a device (such as a real printer), or to a program (such as a compiler), avoiding simultaneous use of a single device or program by multiple users
- Allows users to query the status of queues through status files
- Allows users to control the availability of queues and the status of jobs
- Performs extensive manipulation of print job data stream
- Offers a wide–range of delivery mechanisms for the processed job

Local and Remote Spooler Queues and Spooler Devices

A *queue* is an ordered list of requests for a specific device. A *device* is something that can handle requests one at a time, such as a printer. Each queue must be serviced by at least one device; often it can be serviced by multiple devices.

Real (physical) and Virtual Printers

A real (physical) printer is the printer hardware attached to the system via a serial or parallel port, or through a network connection such as a network terminal server. When the real printer is attached via a serial or parallel port local to the system, the printer device driver in the kernel communicates with the printer hardware and provides an interface between the printer hardware and a virtual printer.

A *virtual printer* is a set of attributes and their associated values that define a high–level data stream (such as ASCII or Postscript) and the methods for processing that data stream. This does not include information about how the real printer is attached to the host computer or about the protocol used for transferring bytes of data to and from the real printer. The **piobe** backend uses information stored in the virtual printer definition to control print job processing. The physical storage medium of the sets of attributes and their associated values is called a *printer colon file*.

Local and Remote Printers

A local printer is a real printer attached to a local host, for which there is a local queue. All jobs submitted to this queue are processed and printed on the host on which the queue exists. A remote printer is a real printer attached to a remote host. The queue for a remote printer specifies a backend whose function is to send the spooled job from the local host across the network to the remote host. All jobs submitted to this queue, on the local host, are sent across the network to the remote host where they are processed and printed.

Spooler Backends

A spooler backend is a collection of programs (a pipeline) started by the spooler's **qdaemon** command to manage a spooler job that is queued for processing. When the backend is for a print queue, the spooler backend typically performs the following functions:

- Receives from the **qdaemon** command a list of one or more jobs to be processed.

- For print jobs, uses printer and formatting attributes from the database, overridden by any flags specified on the command line.
- Initializes the printer before processing a print job.
- Provides filters for simple formatting of ASCII documents.
- Uses filters to convert print job data stream to a format supported by the printer.
- Provides support for printing national language characters.
- Passes the filtered data stream of a print job to the printer device driver.
- Generates header and trailer pages for print jobs, if requested.
- Generates multiple copies of print jobs, if requested.
- Reports paper–out, intervention–required, and printer–error conditions.
- Reports problems detected by the filters.
- Cleans up after a job is cancelled.
- For print jobs, provides an environment that you can customize to address specific printing needs.

You typically do not run printer backend programs directly, although backends such as compilers can clearly be run directly from the command line. The **qdaemon** runs the backend, sending it the names of files and any job control flags that you specify. The backend communicates with the **qdaemon** through a status file in the /**var**/**spool**/**lpd**/**stat** directory. You can use a queue status query command such as **qchk** or **lpstat** to display status information, including, in the case of a print job, the printer status, the number of pages printed, and the percentage of the job that is finished.

In AIX, **piobe** is the standard spooler backend for processing local print jobs.

Formatter Filters

A *formatter filter* is part of the pipeline created and executed by the default backend for local printer queues, **piobe**. A formatter filter provides the capability of either formatting an input file or passing it through unmodified, based on an input parameter. Even if the formatter passes the input file unmodified, it still sends printer commands to initialize the printer before the input file is printed and restores the printer to its original state after printing is complete.

It is the formatter filter that has the capability of using a virtual printer's colon file to perform extensive manipulation of a spooler print job.

Spooler Job

A *spooler job* is any job that a user submits to the spooler. All job submission commands must end with the names of one or more files that require processing. You cannot, for instance, pass a keyword to a backend and have the keyword control the function that backend will perform; the submitted job must exist in the file system.

The spooler will accept many types of jobs. It is the responsibility of the system administrator to ensure that the backend for a given queue is capable of processing any job submitted to that queue.

Printer job types include:

- ASCII
- Postscript
- PCL
- HPGL
- GL

- Diablo 630
- ditroff

Printer Devices

A printer/plotter device is a special file in the /**dev**/**directory** for a real printer. This file can be used by redirection (for example, **cat FileName > /dev/lp0**) or by user–written, compiled programs. Settings for this device driver can be displayed and changed using the **splp** command. Before any of the spooler commands can access a printer device, a print queue must be created for the device.

qdaemon

The **qdaemon** is a process that runs in the background under the auspices of the **srcmstr** process. When you turn your system on, the **startsrc** command starts the **qdaemon**. While the **qdaemon** can be started by the **startsrc** command or stopped by the **stopsrc** command, the **qdaemon** supports only signal communications and thus cannot be queried by the **lssrc** command.

The **qdaemon** tracks both job requests and the resources necessary to complete the jobs, where the resources may be a real printer, some other real device, or even a file. The **qdaemon** maintains queues of outstanding requests and sends them to the proper device at the proper time. The **qdaemon** also records printer usage data for system accounting purposes. It is the **qdaemon** that sets the backend for a spooler queue into execution.

If the **qdaemon** is aborted, it will be restarted by **srcmstr**.

> **Note:** Please do not attempt to stop the **srcmstr** daemon; it controls other daemons running on your system.

The Generic AIX Spooler

The AIX Version 3 and Version 4 spooler is not specifically a print job spooler but a generic spooling system that can be used for queuing various types of jobs, including print jobs queued to a printer queue.

The spooler does not know what type of job it is queuing. When a queue is created, the function of the queue is defined by the spooler backend for that queue. For example, if a queue is created and the queue backend is set up to be **piobe** (the default printer I/O backend for local printer queues), the queue is a print queue. Likewise, if the queue backend is set up to be **cc** (or any other compiler), the queue is for compiler jobs. When the spooler's **qdaemon** component selects a job from a queue, it processes the job by invoking the queue's backend.

This section views the spooler as a generic spooling system with an entry point, an exit point, and points in–between. Jobs submitted to the spooler enter the system (job submission), travel along a predictable path from point to point (job processing), and then exit the system (job delivery and cleanup). Understanding the flow of the job through the system is crucial to both configuring queues to execute complicated tasks and to effective problem determination and resolution. The following sections describe this job flow in greater detail, making special note when the queue is a print queue.

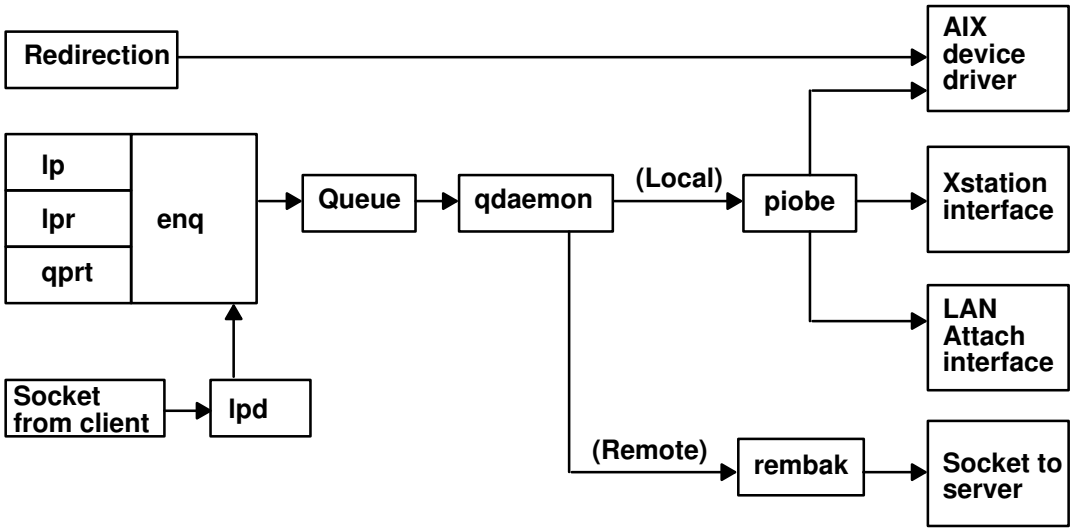
Spooler Parts

The AIX spooler can be viewed as a process or a subsystem with a beginning, points–in–between, and an ending. To accomplish its tasks, the AIX spooler has four basic parts:

1. The **enq** command is the true entry point to the spooler, and as such is the beginning of any spooler activity. This command accepts requests for job processing.
2. The **qdaemon** is responsible for accepting and tracking all jobs submitted to the spooler by the **enq** command. It is also responsible, once all the necessary resources are available, for allowing a queue backend to process a job. The **qdaemon** is one of the points–in–between in the spooler process.
3. The spooler backend is a collection of programs invoked by the spooler's **qdaemon** command to process a job in some queue. The backend sends output to a specific device, such as a printer. When the backend is **piobe**, it involves a formatter filter, which in turn involves a printer colon file. The backend is one of the points–in–between as well as the ending, since the backend contains the specific process that will deliver the processed job to its final destination.
4. The configuration file, /**etc**/**qconfig**, describes the configuration of available queues and devices. Both the **enq** command and the **qdaemon** command refer to the configuration file. This configuration file is considered as conceptually important as the other three spooler parts due to its critical value to the correct operation of the AIX spooler as a whole.

Spooler Data Flow Part I

The general flow of a job through the AIX Spooler is depicted in the Printing with AIX Operating System figure.



Printing with AIX Operating System

There are four commands that can be used to submit a job to the AIX spooler. These are **lp**, **lpr**, **qprt**, and **enq**. Each of these commands has a specific UNIX origin; **lp** originated with AT&T System V, **lpr** originated with BSD, and both **qprt** and **enq** originated with AIX.

While a user can use any one of these four commands to submit a job to the spooler, the true entry point to the spooler is the **enq** command. All of **lp**, **lpr**, and **qprt** are front ends to **enq**. **lp**, **lpr**, and **qprt** all parse their arguments and compose a call to **enq**. The front ends differ from one another in the way each one behaves and in the number and types of flags each one accepts.

When a job is submitted to the spooler, **enq** processes the job request. If the job request is valid, which basically means that the command syntax was correct, the job is placed upon a queue. **enq** creates a job description file (JDF) and notifies the **qdaemon** of the existence of the new JDF.

The **qdaemon** reads each new JDF and reads the job parameters specified by the JDF into an internal data structure that it maintains to track job requests. The **qdaemon** uses queue status information to keep track of the status of each queue and, when circumstances are right, will invoke the backend for the queue to process the job.

The backend for a queue determines precisely how a job placed on that queue will be processed. The commands that allow users to submit jobs to the spooler can specify flags requesting certain treatment of the job, the **qdaemon** can determine which job gets processed when (shortest–job–next or first–come–first–served), but the backend is the process that actually does all the work as far as processing the job is concerned. (A systems administrator can read the stanzas in /**etc**/**qconfig** and quickly determine the function of a given queue simply by examining the backend.)

In the Printing with AIX Operating System figure , on page 0 , the two most common backends scenarios are shown: a local printer queue and a remote printer queue. The local queue uses **piobe** (Printer Input/Output BackEnd) as a backend. The remote printer queue uses **rembak** (REMote BAcKend) as a backend.

piobe, like all backends, is invoked by the **qdaemon**. **piobe** sets up and controls a series of programs (a pipeline) that can not only perform extensive manipulation of a print job but

can also send an extensive amount of control data to a printer, for instance to initialize the printer to a specific mode before the processed job is delivered to the printer. It is **piobe** that makes the initial use of the data stored in printer colon files. The last program in the pipeline set up and controlled by **piobe** is responsible for the physical delivery of the byte stream generated earlier in the pipeline. In the context of a local queue, this program opens a device driver which will deliver the byte stream to a locally attached printer (attached serial or parallel), to an Xstation–attached printer, or to a network–attached printer.

rembak is a common backend when the remote printer queue simply points to a queue on another host, better known as a print server. While **piobe** can perform extensive manipulation of a print job, **rembak** just transfers jobs across TCP/IP networks to print servers. As the Printing with AIX Operating System figure depicts, if the print server is another AIX–based machine, **rembak** transfers the job across the network to the **lpd** process, which in turn invokes **enq**, which creates a JDF, and so on as described above.

Spooler Data Flow Part II

The commands **lp**, **lpr**, **qprt**, and **enq** can be used to submit a job to the spooler for processing. The **enq** command is the true entry point to the spooler; **lp**, **lpr**, and **qprt** all parse their own arguments and compose a call to **enq**. This can be demonstrated by executing the following steps as the root user at a shell prompt:

1. Type **mount /bin/echo /bin/enq** and press Enter.
2. Type **qprt –Pasc –fp –z1 –p12 –s courier –C –N 3 /etc/motd** and press Enter.
3. Type **umount /bin/enq** and press Enter.

The **qprt** command in step 2 attempts to submit a print job to the spooler and have it placed on the queue named **asc**, requesting three copies of the message–of–the–day in a 12–point Courier font rotated 90 degrees. **qprt** parses its command line arguments and builds an argument vector to pass to **enq**. When the **qprt** command tries to invoke **enq** with the argument vector, it instead invokes the **echo** command, which is mounted over the **enq** command. Thus the argument vector generated by the **qprt** command is passed to the **echo** command, which in turn simply echoes the argument vector to your display. This procedure will work with **lp** and **lpr** as well. Aside from demonstrating that **qprt** really is a front end to **enq**, this technique is also useful when you are trying to figure out how to get unsupported flags into the spooler. But more on that later.

Execution of the **qprt** command in step number 2 should cause the following output to be written to the display element specified by your **TERM** environment variable:

```
–P asc –o –o –f –o p –z –o 1 –o –p –o 12 –o –s courier –C –N 3
/etc/motd
```

This is the argument vector generated by this specific instance of the **qprt** command. If **echo** had not been mounted over **enq**, the following job submission command would have been executed:

```
enq –P asc –o –f –o p –o –z –o 1 –o –p –o 12 –o –s courier –C –N
3 /etc/motd
```

A job submission command must end with the name of one or more real files that exist in a file system accessible by the AIX operating system. This is true even when the queue is set up to handle jobs other than print jobs.

> **Note:** It is quite important to be sure you execute step 3, otherwise the spooler will be disabled.

When the **enq** command is executed, either directly or by **lp**, **lpr**, or **qprt**, it assigns a job number to the job. By default, **lp** will return the job number. **lpr** and **qprt** will not return the job number unless you specifically request it with a flag.

enq create a JDF and places it in **/var/spool/lpd/qdir**. In the later 3.2.x version of AIX, **enq** writes the name of the JDF to a message queue and signals the **qdaemon** (by sending it a SIGUSR2) that a new JDF exists. The **qdaemon** then reads the name of the JDF from the message queue, accesses the JDF directly, and reads the data contained in the JDF into an internal data structure it maintains to track all the jobs currently in the spooler. At this point in time, the job has been accepted by the spooler.

A JDF is created for all spooling system operations other than a queue status query; the structure of a JDF differs between print requests versus job cancellation requests versus queue control requests, and so on, but a JDF is created nevertheless. Commands with the same function as **lpstat** still call **enq** to do their work, but neither is a JDF created nor is the **qdaemon** involved.

In all versions of AIX prior to Version 4, the **qdaemon** assigns the job a job number when it accesses the JDF and reads its contents into the aforementioned internal data structure. In Version 4, the job number is assigned by **enq**. This change was made so **lp** would be compliant with industry standards (**lp** is supposed to return a job number when the job is submitted, regardless of whether or not the **qdaemon** accepts the job). This means two things. The first is that the job number of `NEW` should no longer be seen in Version 4, as the job number `NEW` only appeared after **enq** had created the JDF but before the **qdaemon** had accessed the JDF and assigned a job number. The second is that the existence or absence of a job number can no longer be used to determine if the job has been accepted by the qdaemon.

When the **qdaemon** determines that the device upon which the job is queued is available, the **qdaemon** invokes the backend for the queue, passing it arguments specified by the JDF. The backend processes the job.

Overview of Backend Processing

The backend for a queue is begun by **qdaemon**; the **qdaemon** determines that a job's turn to be processed has arrived, sets up an execution environment for the queue backend, constructs an argument vector for the backend, and, via fork() and exec(), causes the backend to begin execution.

The number of simultaneous instances of the backend is controlled by the presence or absence of the *file* parameter in the stanza for this queue in the /**etc**/**qconfig** configuration file. If the *file* parameter is present, then only one instance of the backend can exist *for this queue*; This is because the qdaemon will only attempt to set the execution environment for the backend when it has determined that the job can be processed. Part of setting the backend's execution environment involves opening stdout of the backend onto the file or device specified by the *file* parameter. If the **qdaemon** has already performed this action for a previous job, and that job is still executing, then the **qdaemon** cannot get a lock on the file or device specified by the *file* parameter and hence cannot open stdout of the backend onto that file or device. Thus the **qdaemon** holds the job in the queue and waits for the previous job to complete execution and release the file or device. This is how the spooling system provides and controls serial access to a device.

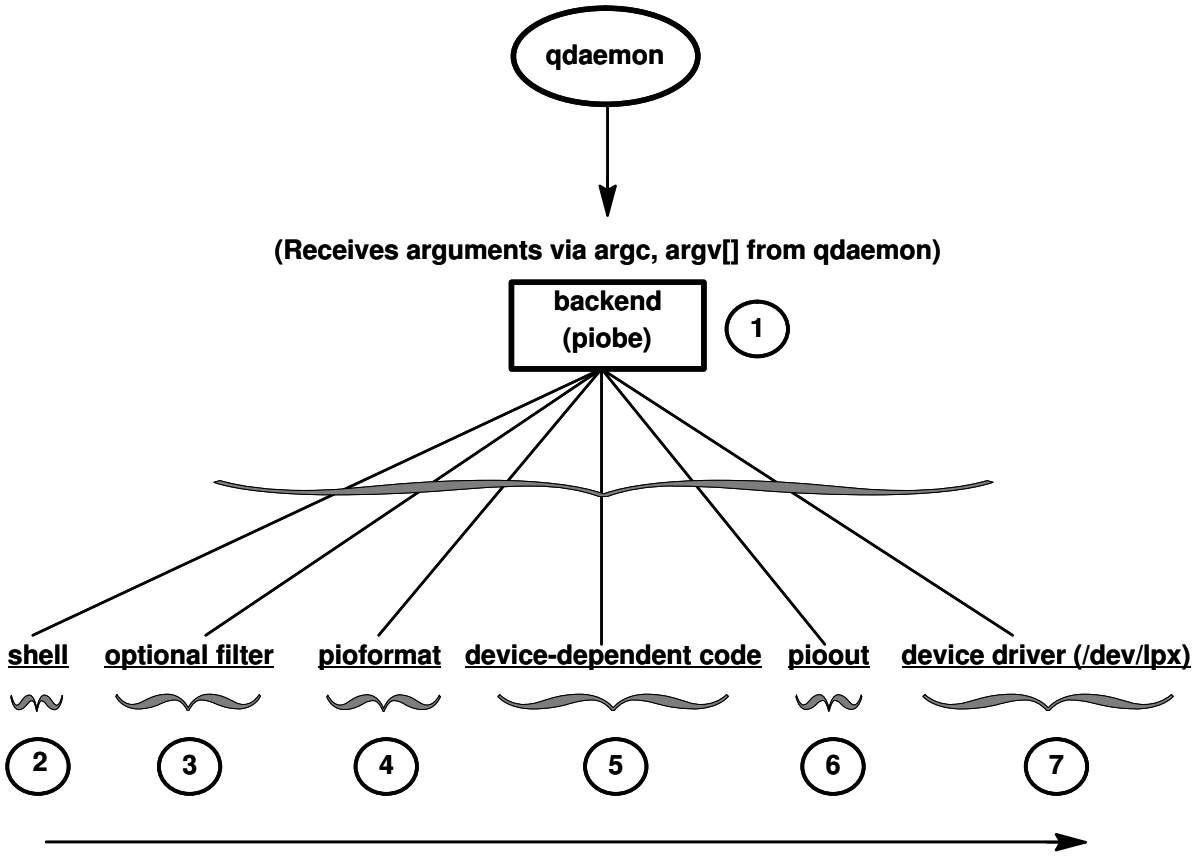
If the *file* parameter is absent or set to a value of FALSE, the **qdaemon** opens stdout of the backend onto /**dev**/**null** and executes the job immediately. In this situation there is no clear file or device to which serial access should be provided, so jobs will not stack up on the queue. Jobs submitted to this queue will be processed just as fast as the **qdaemon** can set up the execution environment. The absence of the *file* parameter effectively disables serial access to any local file or device.

A meaningful and common example of a queue lacking the *file* parameter is a remote printer queue. In this situation, the resource to which serial access should be provided actually exists on another host; there is no reason for the local queue to attempt any type of control. The backend for this type of queue, by default the **rembak** program under AIX, simply sends the job across the network to the remote queue and lets it handle the serial access control.

The default backend for a local print queue under AIX is **piobe**. Multiple queues can all specify the same backend. In this situation, multiple simultaneous instances of **piobe** can exist; each queue that specifies **piobe** as its backend can potentially generate an instance of **piobe**. However if two or more queues also specify the same value for the *file* parameter, the serial access restriction is applied. The **qdaemon** will not be able to acquire a lock on the specified file or device if the **qdaemon** has already acquired the lock for another instance of **piobe**. A queue that cannot process a job because of this restriction will show a queue status of **DEV_BUSY**. The status will change to **RUNNING** as soon as the **qdaemon** can acquire a lock on the file specified by the *file* parameter.

After a job has been submitted to the spooler for processing and after the **qdaemon** has accepted the job and determined that its turn to be processed has arrived, the backend for the queue is invoked. **piobe** uses a shell to construct and manage a pipeline of filters to process the job.

The Data stream Flow for Common Print Jobs figure depicts the flow of a job through this pipeline of filters.



Data stream Flow for Common Print Jobs

See the area labeled 1 in the data stream Flow for Common Print Jobs figure.

When the device upon which the job is queued becomes available, the **qdaemon** invokes the backend for the queue. In the AIX world, the backend is commonly **piobe**. The **qdaemon** invokes **piobe** and passes it arguments in the normal C programming language fashion, using argc and argv[].

For instance, using the command in step 2 from ”Spooler Data Flow Part II”, on page 3-10 :

```
qprt -Pasc -z1 -fp -p12 -s courier -C -N3 /etc/motd
```

piobe is passed the following arguments:

- argc = 10
- argv[0] = /usr/lib/lpd/piobe
- argv[1] = –f
- argv[2] = p
- argv[3] = –z
- argv[4] = 1
- argv[5] = –p
- argv[6] = 12
- argv[7] = –s
- argv[8] = courier
- argv[9] = /etc/motd

argv[0] is the name of the backend itself, as usual. Note that the **–Pasc**, which specifies the queue name, was parsed out of the original argument vector, as were the **–C** and –**N3** flags and arguments.

See the area labeled 2 in the Data stream Flow for Common Print Jobs figure, on page 3-13.

piobe uses the argv[] values to construct a pipeline of filters that must be executed to process the job as requested. After determining the structure of the pipeline, **piobe** passes the structure to a shell for realization. If the *file* parameter in the /**etc**/**qconfig** entry for this queue exists, **piobe** will open the stdout of the last process in the pipeline onto the value specified by the *file* parameter. The last process in the pipeline is not prevented from re–opening stdout onto some other file or device.

Note the parent–child relationship amongst these processes, which is not apparent from the figure:

- **qdaemon** is the parent of **piobe**.
- **piobe** is the parent of the shell.
- The shell is the parent of **pioout**, the last process in the pipeline before the device driver is accessed. **pioout** is called the *Interface Program for Use With the Device Driver* or the *device driver interface program*.
- **pioout** is the parent of **pioformat**.
- **pioformat** dynamically loads and links the device–dependent code at runtime; hence the device–dependent code does not appear as a process in the operating system's process table.
- **pioformat** is the parent of the optional filter (if it exists), such as the **pr** filter.

See the area labeled 3 in the data stream Flow for Common Print Jobs figure, on page 3-13.

An optional filter, such as **pr**, can be specified on the command–line (or hard–coded in the colon file) to perform pre–filtering on the job before **pioformat** processes it.

See the area labeled 4 in the Data stream Flow for Common Print Jobs figure, on page 3-13.

pioformat is known as a device–independent formatter driver. It will dynamically load, link, and drive various device–dependent formatters to process jobs of a specific data stream type (for example, Postscript, ASCII, GL, or PCL).

See the area labeled 5 in the Data stream Flow for Common Print Jobs figure, on page 3-13.

Device–dependent code is designed to handle the unique properties of combinations of specific data streams and physical printers. Because combinations of data stream types and printers can be grouped into classes with common attributes, there are currently less than 20 device–dependent modules. These modules are loaded, linked, and driven by **pioformat** at runtime.

See the area labeled 6 in the Data stream Flow for Common Print Jobs figure, on page 3-13.

pioout is the end of the job–processing pipeline, and is called the *device driver interface program*. The function of **pioout** is to take the processed data stream and deliver it to the device for which it was intended, generally a printer. In the typical local print queue environment, it is **pioout** that has its stdout opened onto the character special file in the /**dev** directory, as specified by the *file* parameter in /**etc**/**qconfig**.

See the area labeled 7 in the Data stream Flow for Common Print Jobs figure, on page 3-13.

This is the character special file in the /**dev** directory that provides access to the device driver for the printer hardware.

Virtual Printers and Formatter Filters

When the spooler queue backend is **piobe**, the *formatter filter* is normally the next–to–last process in the pipeline of filters processing the print job. The formatter filter is composed of two pieces of code.

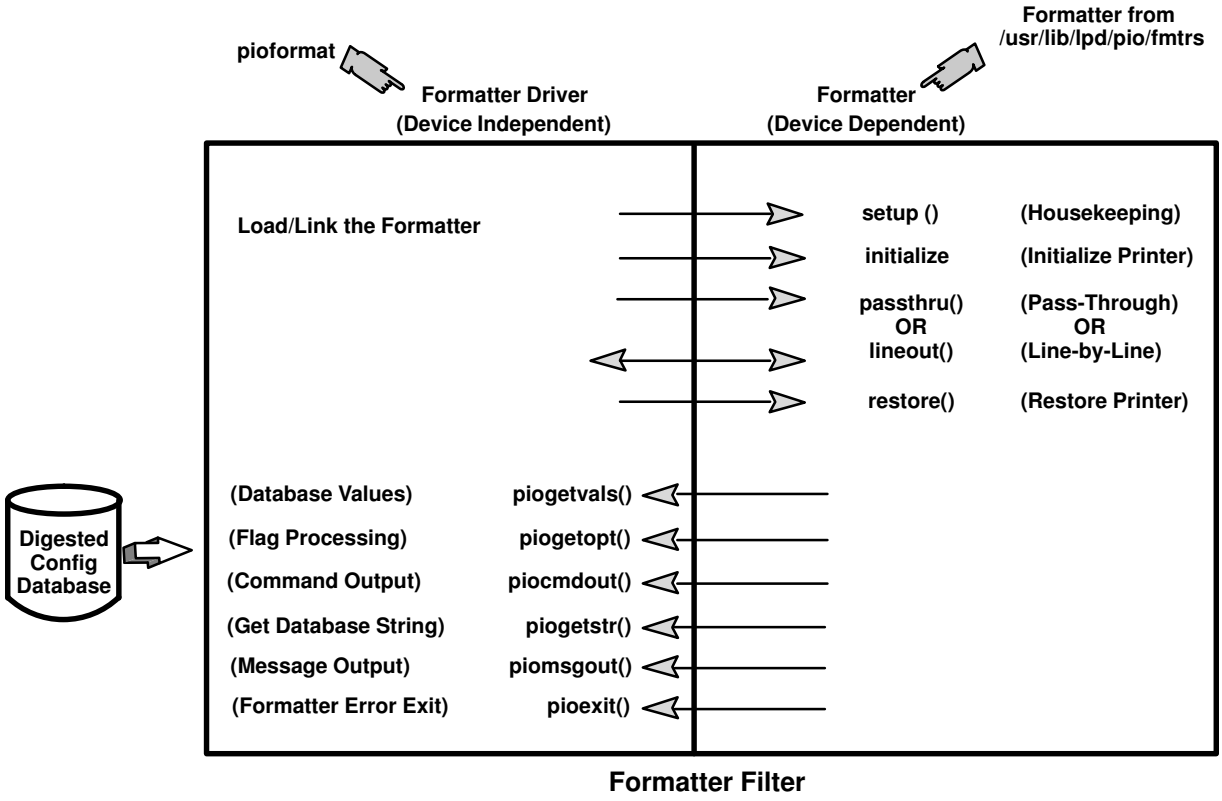
A formatter filter provides the capability of either formatting the input print file or passing it through unmodified, based on an input parameter. Even if the formatter passes the input file unmodified, it still sends printer commands to initialize the printer before the input file is printed and restores the printer after printing is complete.

The formatter filter is made up of two components:

- A device–independent formatter driver
- A device–dependent formatter

The first is the device–independent formatter driver, **pioformat**. The second is a device–dependent formatter, of which there are less than 20. Code is device–independent when its execution is in no way dependent upon specific hardware, such as a certain physical printer. Similarly, code is device–dependent when its execution is dependent upon specific hardware, again such as a certain printer. In the AIX spooler's formatter filter, it is the device–dependent formatter that contains code designed to handle all of the properties of a particular physical printer or class of printers, including supported data stream, escape sequences, and control codes unique to that printer or printer class.

The device–independent **pioformat** is called a *formatter driver* because that it precisely what it does. When **pioformat** is set into execution, it expects several arguments. One of these arguments is the full path name to a device–dependent formatter. At runtime, **pioformat** dynamically loads, links, and drives the device–dependent formatter. The Formatter Filter figure, on page 3-15 depicts this relationship.



Formatter Filter

The **pioformat** command expects to be able to call, if necessary, five subroutines; **pioformat** by itself does not contain these subroutines. The subroutines exist in the device–dependent formatter and are supplied to **pioformat** at runtime when the loading and linking of the device–dependent formatter by **pioformat** occurs.

The formatter driver is invoked by a pipeline and is passed the name of a formatter to be driven. The formatter driver dynamically loads and links the formatter and calls the formatter's **setup** function which indicates whether data formatting or data pass–through is requested. After the formatter's **setup** function performs the necessary functions, it returns to the formatter driver. The formatter driver calls the **initialize** function. The **initialize** function outputs a string of printer commands to initialize the printer and returns to the formatter driver.

The formatter driver either calls the **passthru** function once or calls the **lineout** function for each line in the print file based on the return code from the **setup** function. If the **lineout** function is called, the formatter driver performs all vertical spacing, including line spacing, vertical tabs, form feeds, and top and bottom margins. Line spacing and vertical tabs are performed by the **lineout** function. Other vertical spacing functions are performed automatically.

When processing is complete, the formatter driver calls the **restore** function. The **restore** function outputs a string of printer commands to restore the printer to its default state, defined by the database attribute values.

For more information about how the print formatter interacts with the printer formatter subroutines, refer to the example of a print formatter, on page 4-25 .

/etc/qconfig, the Spooler Configuration File

/etc/qconfig File Structure

/etc/qconfig is the most important file in the spooler domain, for these reasons:

- It contains the definition of every queue known to the spooler.
- A system administrator can read this file and discern the function of each queue.
- Although it is not recommended, this file can be edited to modify spooler queues without halting the spooler.

/etc/qconfig describes all of the queues defined to the AIX operating system; a queue is a named, ordered list of requests for a specific device. A device is something (either hardware or software) than can handle those requests one at a time. The queue provides serial access to the device. Each queue must be serviced by at least one device; often it can be handled by more than one device.

The **qdaemon** reads the ASCII version of **/etc/qconfig** and creates a binary version, **/etc/qconfig.bin**. **/etc/qconfig** must adhere to a specific structured format in order for the **qdaemon** to be able to parse it. This format is detailed in the **/etc/qconfig** *File Structure* examples below.

```
                Local Queue
queue_name:
        device = device_name
        up = TRUE or FALSE
        discipline = fcfs or sjn
device_name:
        file = physical_device_name or FALSE
        header = always or group or never
        trailer = always or group or never
        access = both or write
        backend = full_path_name_to_backend_program

                Remote Queue
queue_name:
        device = device_name
        up = TRUE or FALSE
        host = remote_hostname
        s_statfilter = full_path_to_short_filter
        l_statfilter = full_path_to_long_filter
        rq = remote_queue_name
device_name:
        backend = full_path_name_to_backend_program
```

/etc/qconfig is composed of text blocks referred to as stanzas. Each queue is represented by a pair of stanzas. The first stanza in a pair is referred to as the queue stanza; the second stanza in a pair is referred to as the device stanza. Stanzas are composed of parameters and parameter values that describe the queue's properties and function.

When the **qdaemon** parses the ASCII version of **/etc/qconfig**, the first non–commented line it identifies must be a word followed by a colon; this line represents the beginning of the queue stanza. This word is the name of a queue to which a user can submit jobs. There must be one or more lines indented by tabs following this line. One of these lines must be **device =** *device_name*. The value of the **device** parameter is a link from the queue stanza to the device stanza; this parameter has no other function. When a queue is initially setup, the operating system will frequently use the name of a printer, such as `lp1` , as the value of the **device** parameter. While the queue may actually be setup to use `lp1` , the use of `lp1` as the value of the **device** parameter only means that the device stanza will be named `lp1` . This is not related to the fact that there is a real printer known to the operating system as `lp1` .

Following the tab–indented lines, the qdaemon must find the word that is the value of the **device** parameter followed by a colon; this line represents the beginning of the device stanza. This word, which a user normally does not need to know, is the name of a device to which the corresponding queue stanza provides serial access. There must be one or more lines indented by tabs following this line. One of these lines must be **backend =** *full_path_name_to_backend*. In a local spooling environment, there are two parameters of critical importance in this stanza.

The *file* parameter specifies the real device to which the queue provides serial access. It is important to note that jobs submitted to the spooling system are queued upon this device. If a queue is setup to use a printer known to the operating system as `lp1` , then the value of the *file* parameter would be /**dev**/**lp1**. The operating system routines that create queues use the name of the real device as the name of the device stanza by default, and this is why there is some confusion as to the meaning of the **device** parameter.

The **backend** parameter specifies the full path to the program that will process the job submitted to the spooling system, once the **qdaemon** determines that the job's turn to be processed has arrived.

Spooler Queues, Virtual Printers, and Physical Printers

The *Four Queues – Four Virtual Printers – One Physical Printer* example depicts an instance of /**etc**/**qconfig** that defines four queues on a single physical printer, in this case /**dev**/**lp1**. Notice that all four pairs of stanzas use the string `lp1` to connect a queue stanza to a device stanza. It is the **file** parameter in each device stanza that specifies that the printer known to the AIX operating system as **lp1**, and whose device driver entry point is /**dev**/**lp1**, is the actual physical destination of any jobs submitted to any of these queues. When these queues were defined, via **smit**, the command that actually creates the queue definition needed a string to connect the two halves of each stanza pair. Since the physical printer at hand was `lp1` , the string `lp1` was used as the both the value of the **device** parameter in each queue stanza and as the name of each device stanza. This format is detailed in the /**etc**/**qconfig** *File Structure* examples below.

```
asc:
        device = lp1
lp1:
        file = /dev/lp1
        header = never
        trailer = never
        access = both
        backend = /usr/lib/lpd/piob

gl:
        device = lp1
lp1:
        file = /dev/lp1
        header = never
        trailer = never
        access = both
        backend = /usr/lib/lpd/piobe

pcl:
        device = lp1
lp1:
        file = /dev/lp1
        header = never
        trailer = never
        access = both
        backend = /usr/lib/lpd/piobe
```

```
ps:
        device = lp1
lp1:
        file = /dev/lp1
        header = never
        trailer = never
        access = both
        backend = /usr/lib/lpd/piobe
```

Each of these stanza pairs defines a queue. When the backend for a queue is **piobe**, each queue also has an associated virtual printer. While it is possible to create virtual printer definitions the hard way, virtual printer definitions are typically created at the same time as the queue definition, via **smit** and the **piomkpq** command. The virtual printer definition is not contained in /**etc**/**qconfig**. Its presence is implied by the fact the spooler backend for a given queue is **piobe**, but it is stored elsewhere in the AIX file system. The name of the queue is used to identify and access the virtual printer definition.

The physical printer known to AIX as **lp1** clearly supports at least four distinct data stream types; they are ASCII (`asc`), Plotter Emulation (`gl`), Printer Command Language (`pcl`), and PostScript (`ps`). Each queue with its associated virtual printer definition is designed to process a particular data stream type, hence the four queues. This is the basis for the AIX notion of a logical separation of physical and virtual printers.

Spooler Queue Names and Status Formats

Spooler queue names (the name of a queue stanza) can be over seven characters in length but only the first seven characters will be displayed in the output of a queue status query. Device names (the name of a device stanza) are limited to five characters in the output of a queue status query.

In spooler queue status queries, remote spooler queues will show up twice: once for the local queue, and once for the remote queue on the print server. For instance, if /**etc**/**qconfig** contains this entry:

```
myps:
        device = @kricket
        up = TRUE
        host = kricket
        s_statfilter = /usr/lib/lpd/aixshort
        l_statfilter = /usr/lib/lpd/aixlong
        rq = myps
@kricket:
        backend = /usr/lib/lpd/rembak
```

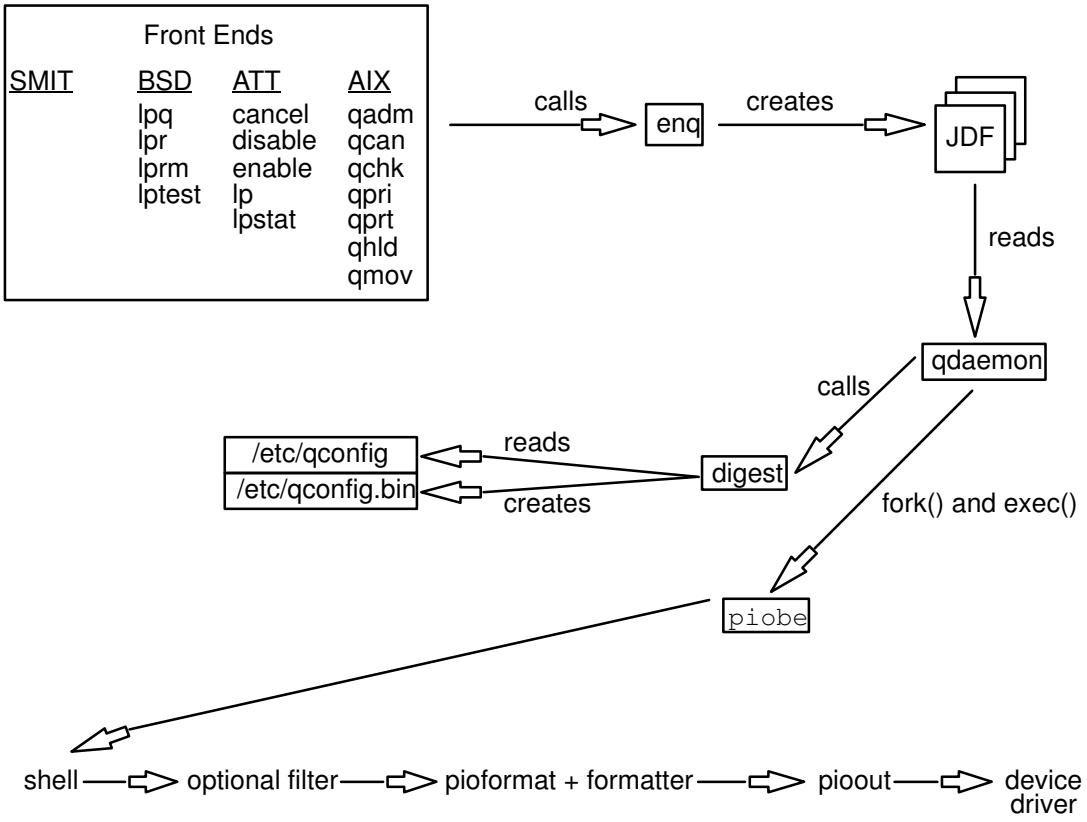
the command **lpstat –pmyps** would return the following:

```
Queue   Dev   Status     Job Files    User      PP %  Blks Cp  Rnk
------- ---   --------- --- -------- --------- -- -  ---- --  ---
myps    @krik READY
myps    myps  READY
```

The first line of the output indicates that the local spooler queue named `myps` , with a device stanza whose name is listed as `@krik` , has a status of **READY**. The second line indicates that the target remote spooler queue, also named `myps` , whose device stanza is listed as `myps` , also has a status of **READY**. (It is the author's habit to make a local spooler queue name the same as the print server spooler queue name. It's then easy to visually group the two lines in the output of a spooler queue status query.)

Summary

The Spooler Data Flow Summary figure summarizes the high–level flow of a spooler print job through the AIX spooler.



Spooler Data Flow Summary

The box labeled *Front Ends* contains the commands, including the **smit** interface, that users can use to submit one type of job or another to the spooler. Each of these commands, with the exception of queues status queries, calls the **enq** command which creates a job description file (JDF); the queue status queries call **enq** but do not create a JDF.

The **enq** command notifies the **qdaemon** of the existence of a new JDF. The **qdaemon** reads the JDF and begins the process of attempting to acquire all of the resources necessary to process the job. When the **qdaemon** has acquired those resources , it uses the fork() and exec() subroutines to set the queue backend into execution. The **qdaemon** passes the backend all of the relevant arguments from the original job submission command as well as an open file descriptor (from the *file* parameter in /**etc**/**qconfig**) to the backend.

In the case of a spooler queue where the backend is **piobe**, **piobe** uses the name of the queue to access the virtual printer definition for this queue, determining the full path to all of the processes that will become the pipeline of filters that actually processes the spooler job. This pipeline is passed to a shell for realization.

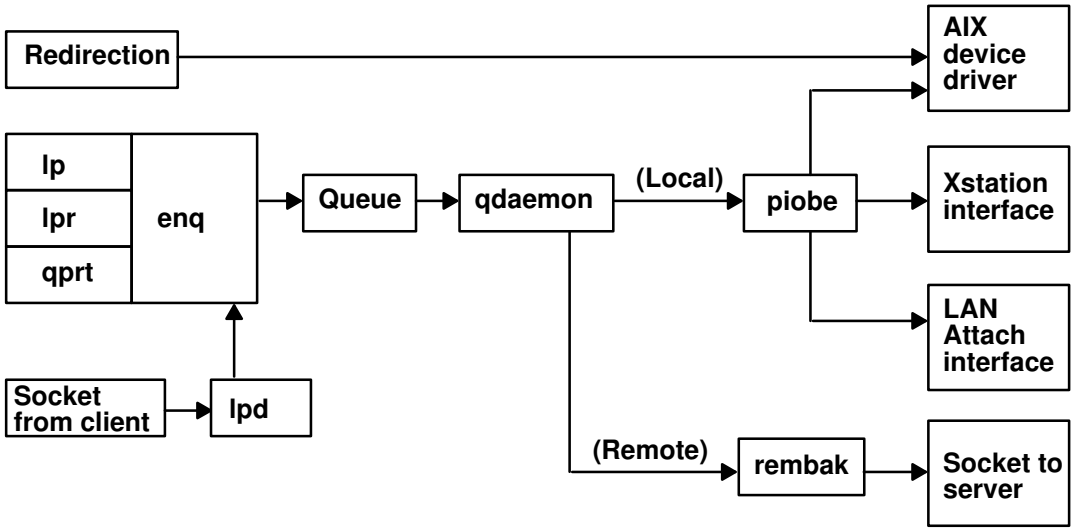
In the case of **piobe**, the pipeline can begin with an optional pre–filter, such as the **pr** command. The output from the **pr** command becomes the stdin of the formatter driver, **pioformat**, which dynamically loads, links, and drives the formatter. The output from **pioformat** becomes the stdin of **pioout**. **pioout** uses the open file descriptor passed by the **qdaemon** to deliver the processed spooler job to the device driver, a character–special file in the /**dev** directory. If no pre–filter is specified, **pioformat** becomes the first process in the pipeline.

Chapter 4. Printer, Plotter, and Spooler Subsystem Programming

This section discusses:

Printer Backend Overview for Programming

The AIX printer backend receives and processes print requests from a spooler, usually the **qdaemon** command. The printer backend is a standard feature of the AIX system. It is implemented by the **piobe** command and functions as depicted in the Printing with AIX Operating System figure.



Printing with AIX Operating System

The printer backend supports all of the printers installed in the Object Data Manager (ODM) Predefined database. You can customize the printer backend to assist in the administration of the printing subsystem. For more information, see ”Printer Overview”, on page 0 . You can also modify the printer backend to add unsupported printers and National Language Support (NLS) code page translation tables.

Adding a printer to the printer backend involves adding a printer colon file for that printer. In many cases, the printer colon file of a similar printer can be duplicated with little modification. If modification of an existing printer colon file is not sufficient, you can write a print formatter. If the modifications exceed the scope of the print formatter, you may need to write a new printer backend.

Refer to the following sections for more information:

- ”Adding a Printer Using the Printer Colon File”, on page 4-57 provides a procedure for duplicating a printer colon file.
- ”Printer Colon File Escape Sequences”, on page 4-14 provides information useful in modifying a printer colon file.
- ”Understanding Backend Routines in libqb”, on page 4-33 and ”Understanding the Interaction between qdaemon and the Backend”, on page 4-28 can assist you in writing a new printer backend.

The procedure for translating NLS code points in the print file to code points for the printers varies depending upon whether the code sets are single–byte or multibyte. For more information, see:

- ”Printer Code Page Translation Tables”, on page 4-35
- ”Print Code Page Translation for Multibyte Code Sets”, on page 4-36 .

Third–party vendors may want to customize the printer backend for special purposes.

Printer Backend Data Flow

The primary purpose of a backend is to send characters to a device, usually a printer. The printer backend is invoked once for every file or group of files to be printed, with the name of each file passed to the backend as a parameter. The backend opens the file, reads it, and sends it to the device. The recommended method for a backend to operate is to write to its standard output, with the **qdaemon** process opening the device onto the correct file descriptor. This requires setting the `file` field in the **qconfig** file.

The name of the file to be printed can be a direct or relative path name. The user ID and group ID of the backend are those of the process that invoked the **enq** command.

When a backend is invoked, it has access to the user's environment. To access the user's environment, the backend may invoke the **getenv** subroutine. For example, to access the user's directory, **getenv(PWD)** returns a pointer to the directory name. The backend can use this to read from or write to this directory.

If the backend writes to its standard output, the **qdaemon** opens the device in root–user mode. If the backend needs to open the device itself, it must have the correct permissions to open the device. Since the backend runs under the permissions of the user sending the print job, you may need to change the protections on the device or install the backend set–user–ID or set–group–ID.

By default, **stdin, stdout,** and **stderr** are all open to the null device (/**dev**/**null**), although it is possible to override the setting of **stdout** (and possibly **stdin**) with the `file` and `access` fields in the **qconfig** file.

Virtual Printer Definitions and Attributes

A *virtual printer definition* is a file that pairs the attributes or characteristics of a specific printer with the attributes of a specific data stream type. If a specific printer supports more than one data stream type, you must create a virtual printer definition, pairing the attributes of the printer with each data stream type. Thus, if a printer supports both ASCII and PostScript data streams, you must create two virtual printer definitions for the printer.

The *colon* file stores the virtual printer definition for a printer or plotter. Colon files reside in the predefined and customized database directories. The printer backend uses the attribute values stored in colon files to format print requests.

All attribute values reside in colon files as character strings, regardless of whether they represent strings, integers, or Booleans. An attribute value can contain embedded references to other attribute values or embedded logic that dynamically determines the content of the value.

For more information on colon files and how embedded references and logic are used in attribute strings, see ”Printer Colon File Conventions”, on page 4-20 and ”Printer Colon File Escape Sequences”, on page 4-14.

Working with Virtual Printer Attributes

The commands used to create a virtual printer (the **mkvirprt** or **smit virprt** commands) copy a predefined virtual printer definition and create a customized virtual printer definition for the specified queue and queue device. The attribute values in the custom definition can be further changed, with the **chvirprt** or **smit lsvirprt** commands.

You must create a virtual printer for each data stream type supported by a specific printer device. The supported data stream types include:

Data Stream Type	Code for Attribute Name/Value	Description
asc	a	Extended ASCII
pcl	c	Hewlett–Packard PCL
630	d	Diablo 630
gl	g	Hewlett–Packard GL
	p	Pass–through (sent to printer unmodified)
ps	s	PostScript
855	a	Texas Instruments 855
kji	k	Kanji

When you use the **mkvirprt** or **smit virprt** command to create a virtual printer, the system prompts you to select the desired printer from a list of defined printers. If you have just configured a printer port for a new printer, select the new printer port. When the virtual printer command is executed, the system creates a print queue and copies the colon file for the selected printer in the predefined database directory, **/usr/lib/lpd/pio/predef/***, to the customized database directory **/var/spool/lpd/pio/custom/***.

Note: If no flags are specified, the **mkvirprt** command becomes interactive.

Use the **chvirpt** or **smit lsvirprt** command to change or further customize the attribute values stored in a virtual printer definition. To change an attribute value with **smit lsvirprt**, enter *attribute_name=attribute_value* with no spaces on either side of the = (equal) sign.

Each attribute name in a virtual printer definition must be unique. Attribute names can contain the characters **a** through **z**, **A** through **Z**, **0** through **9**, and _ (underscore). Attribute

names must not begin with a numeral. All attribute names must be two characters long, except for group header attribute names, which can be five characters long.

Attribute names for group headers begin with _ _ (two underscores) and must not be longer than five characters. A group header attribute marks the beginning of a group of related attributes.

The rest of this section describes the following groups of virtual printer attributes.

- Default Flag Value Attributes
- System Administration Attributes
- Input Data Stream Attributes
- Prohibited Flags Attributes
- Filter Flag Attributes
- Directory Attributes
- Miscellaneous Attributes
- Work Variable Attributes
- Command Aggregate Attributes
- (ASCII) Control Code Attributes
- Escape Sequences Attributes

Examples show some of the typical attributes for a supported PostScript laser printer (4029 LaserPrinter). Each example shows how the **lsvirprt** and **smit lsvirprt** commands display virtual printer attributes (with a descriptor for each attribute) and how those same attributes are stored in the printer colon file.

Default Flag Value Attributes

Default flag value attributes are grouped under the **_ _FLG** group header attribute. If a flag corresponding to the attribute is used with a print command, values for these attributes are overridden from the command line. For example, the **_l** attribute in a virtual printer definition contains a value for the number of lines to print on a page. Assume that the default value stored in the **_l** attribute is 66. The following print request does not specify a number of lines per page with the **–l** flag:

```
qprt -P Pro myfile
```

The printer subsystem uses the default **_l** value of 66 to process the print request. The following print request uses the **–l** flag to specify 50 lines of text per page:

```
qprt -l 50 -P Pro myfile
```

The **–l** flag value overrides the default value in the **_l** attribute of the virtual printer definition for the `Pro` printer.

The first character for a default flag value attribute is always the _ (underscore). The second character corresponds to the command flag for which the default value is stored.

The following example shows some of the attribute values under the **_ _FLG** group header. These values are typical for a supported PostScript laser printer.

```
Name  Description                                          Value
_ _FLG VALUES THAT MAY BE OVERRIDDEN WITH FLAGS
        ON THE COMMAND LINE
_1    Page Headings Wanted For Text Converted              !
        to PostScript? (!: no;  +: yes)
_2    Use Two Columns for Text Converted to                !
        PostScript? (!: no;  +: yes)
_3    Gaudy Mode Wanted for Text Converted to              !
        PostScript? (!: no;  +: yes)
_4    Print Garbage File Anyway for Text                   !
        Converted to PostScript? (!: no;  +: yes)
_5    List Characters Not In Font When Converting          !
        Text to PostScript? (!: no;  +: yes)
_6    Font Name for Header Line of Text Converted          300
        to PostScript
_A    stderr returned? 0:no; 1:yes, & pipelines;           1
        2:yes, & values, pipelines
_H    Name To Replace Host Name On Burst Page
_J    Restore the Printer at the End of the ?              +
        Print Job (!: no;  +: yes)
_L     Wrap Long Lines (!: no;  +: yes)                    +
```

The preceding attributes are stored in the colon file as:

```
:056:_ _FLG::
:466:_1::!
:467:_2::!
:469:_3::!
:470:_4::!
:471:_5::!
:472:_6::300
:013:_A::1
:022:_H::
:027:_J::+
:030:_L::+
```

System Administration Attributes

The **_ _SYS** group header attribute stores values for attributes such as the **sh**, **si**, and **st** attributes. The **sh** and **st** attributes store the pipelines for the header page and the trailer page.

The **si** attribute identifies who receives printer–intervention messages when the printer needs attention. A null string specifies that intervention messages should go to the user who submitted the print job. Separate user names with a comma. Use the SMIT Virtual Printers option or the **chvirprt** command to change the attribute as needed.

For example, `si=` specifies that the user who submitted the print job should receive the messages, `si=mary` specifies the user `mary` should receive the messages, and `si=,jim@server02` specifies that both the user who submitted the print job and `jim` at node `server02` should receive intervention messages.

The first character for a system administration attribute is **s**.

Some typical **_ _SYS** attributes for a supported PostScript laser printer are:

```
_ _SYS OTHER VALUES OF INTEREST TO THE SYSTEM
         ADMINISTRATOR
sh     Pipeline for Header Page
                            %Ide/pioburst
                            %F[H %Idb/H.ps |
                            %Ide/pioformat -@%Idd/
                            %Imm-!%Idf/piofpt%f[j]
si     Users, Separated by Commas, to Get Intervention
         Messages; Null String Is Job Submitter
sp     Command Line Flags Prohibited For All -d values;
         Ignored: cmnrBDMPRT
st     Pipeline for Trailer Page
                            %Ide/pioburst
                            %F[H] %Idb/T.ps |
                            %Ide/pioformat -@%Idd/
                            %Imm -!%Idf/piofpt%f[j]
sw     Width of Attribute Value Area On Header Page   78
         (0 means ignore width)
```

These same attribute values would be stored in the printer colon file as:

```
:060:_ _SYS::
:321:sh::%Ide/pioburst %F[H] %Idb/H.ps | %Ide/pioformat -@%Idd/%Imm
-!%Idf/piofpt %f[j]
:322:si::
:323:sp::
:324:st::%Ide/pioburst %F[H] %Idb/T.ps | %Ide/pioformat -@%Idd/%Imm
-!%Idf/piofpt %f[j]
:325:sw::78
```

Input Data Stream Attributes

The **_ _IDS** group header attribute heads the list of attributes that store pipelines for different input data streams. Some of the attributes in this group are the **ia** attribute that stores the extended ASCII input data stream pipeline, and the **is** attribute that stores the PostScript input data stream pipeline. The **ip** attribute is another typical attribute in this group. The **ip**, or pass–through, attribute passes the output from a formatter filter to the printer unmodified.

The first character for an input data stream attribute is **i**. The second character designates the input data stream type.

The following example of **_ _IDS** attributes shows typical input data stream pipelines for a supported PostScript laser printer (4029 LaserPrinter).

```
_ _IDS PIPELINES FOR INPUT DATA STREAMS (2 char, 1st="i",
        2nd=data stream name)
ia     Pipeline for Input Data Stream "a" (extended ASCII)
        /usr/bin/enscript -p- -q%?%G_2%t -2%;%?%G_z%t -r%;%?%G_3%t
        -G%;%?%G_1%t%e -B%;%?%G_L%t%e -c%;%?%Ch%t%fbh%e%?%L_h%t
        -b'%I_h'%;%; -L%G_l%d -f%?%Cs%t%f!s%e%I_s%;%G_p%d
        %?%G_1%t-F%Iw7%G_p%d%;%?%G_4%t-g%;%?%G_5%t -o%;%?%L_f%t%e%I@1%;
        | %Iis
il     Command Line Flags Prohibited For Input Data
        Stream; Ignored: cmnrBDMPRT
        /interleaf/ileaf5/bin/pl2ps-ppd IBM17521.PPD -r 1270-nf-np |
        %Ide/pioformat -@%Idd/%Imm-!%Idf/piofpt %f[juJZ]
in     Pipeline for Input Data Stream "n" (troff
        (ditroff) intermediate output)
        /usr/bin/psc |s%Ii
ip     Pipeline for Input Data Stream "p"
        (pass-through)
        %Iis
is     Pipeline for Input Data Stream "s" (PostScript)
        %Ide/pioformat-@%Idd/%Imm -!%Idf/piofpt %UH %f[juJZ]
```

The colon file stores these same attributes in the following format:

```
:057:_ _IDS::
:274:ia::/usr/bin/enscript -p- -q%?%G_2%t -2%;%?%G_z%t -r%;%?%G_3%t
-G%;%?%G_1%t%e -B%;%?%G_L%t%e -c%;%?%Ch%t%fbh%e%?%L_h%t -b'%I_h'%;%;
-L%G_l%d -f%?%Cs%t%f!s%e%I_s%;%G_p%d %?%G_1%t-F%Iw7%G_p%d%;%?%G_4%t
-g%;%?%G_5%t -o%;%?%L_f%t%e %I@1%; | %Iis
:001:il::/interleaf/ileaf5/bin/pl2ps -ppd IBM17521.PPD -r 1270 -nf -
np | %Ide/pioformat -@%Idd/%Imm -!%Idf/piofpt %f[juJZ]
:465:in::/usr/bin/psc | %Iis
:277:ip::%Iis
:273:is::%Ide/pioformat -@%Idd/%Imm -!%Idf/piofpt %UH %f[juJZ]
```

Prohibited Flags Attributes

The attributes grouped under the **_ _PFL** group header attribute store the names of command flags to be rejected by the printer backend for a particular data stream. If you use a prohibited command flag in a front–end print request (such as **qprt**), the system rejects the flag and returns a message that the flag is prohibited by system administration. The first character of a prohibited flag attribute name is **I** and the second character represents the data stream type to be rejected.

To prohibit multiple flags for a data stream type, store the single–character flag names with no spaces, commas, or other delimiters. For example, to reject the **–e** (emphasized print) flag and the **–E** (double–high print) flag for the extended ASCII input data stream, run the **smit lsvirprt** command and enter the following to set this attribute:

```
Ia=eE
```

The following example shows the **Is** attribute that sets the prohibited flag attribute for the PostScript data stream on a supported PostScript printer. The descriptor for the **Is** attribute contains the string `Ignored: cmnrBDMPRT`. This string indicates that the backend ignores the flags represented by the individual characters `cmnrBDMPRT`. These flags are flags that address the spooling subsystem, not the backend. Thus, listing one of these flags as a prohibited flag has no effect on the backend; the flag is not prohibited.

```
_ _PFL FLAGS PROHIBITED FOR INPUT DATA STREAMS (2
         char,1st="I",2nd=data str name)
Is     Command Line Flags Prohibited For Input Data
         Stream; Ignored: cmnrBDMPRT
```

The colon file stores the attributes in the preceding example as follows:

```
:059:_ _PFL::
:001:Is::
```

Filter Flag Attributes

Attributes grouped under the **_ _FIL** group header attribute store command strings for text filter flags. The first character of the attribute name is always **f** and the second character denotes the type of filter. Filter flags, such as **–p** and **–n** specify to the backend program the type of filter used to format the print job. Filter attribute designations are:

`fp` **pr** filter

`fn` Formats files containing *ditroff* (device–independent *troff*) data

`fl` Prints control characters and suppresses page breaks

`ft` Formats files containing data produced with **troff** commands

`fd` DVI filter formats files created with **tex**

`fg` Formats standard plot data files (files created with **plot**)

`fv` Formats raster image files

`fc` Formats files containing data produced with **cifplot**

`ff` Interprets the first character of each line as a FORTRAN carriage control character.

`fb` Determines the locale support for Arabic and Hebrew. Must be `/usr/bin/bprt`. The width must be set to `80` and the data stream set to `a` for extended ASCII. Add the flag **– tashkeel** to print documents with diacritics.

The value stored in a filter attribute designates the command string for the specified filter. Entries for a supported PostScript laser printer can include:

```
_ _FIL COMMAND STRINGS FOR FILTER FLAGS (2 char,
        1st=”f”,2nd=flag)
fn     Command String for the ”n” Filter.
       /usr/bin/psc%is
fp     Command String for the ”p” Filter
       /bin/pr –l%G_l%d –w%G_w%d%F[h] %I@1%ia
fb     Command String for the ”b” Filter.
       /usr/bin/bprt-w%I_w –d%I_d-tashkeel
```

These same attribute values are stored in the colon file as follows:

```
:055:_ _FIL::
:269:fn::/usr/bin/psc%is
:270:fp::/bin/pr –l%G_l%d –w%G_w%d%F[h] %I@1%ia
```

The **fd** attribute is a typical filter attribute. It is used to specify a DVI filter for the virtual printer. Use SMIT or the **chvirprt** command to specify this filter. For example, to specify a DVI filter by using SMIT, enter:

```
smit lsvirprt
```

Select the desired virtual printer and type the following:

```
fd=/usr/bin/dvi_to_printer%ip
```

where `dvi_to_printer` specifies the full pathname of the filter that converts the DVI output from **tex** to the format expected by the printer. The `%ip` designation forces the pass–through pipeline (the **ip** attribute) to be used to process the print file instead of the ASCII pipeline (**ia** attribute). The pass–through pipeline causes the output from the filter to be passed to the printer unmodified.

Once the DVI filter has been specified in the **fd** attribute, you can send a print command such as **lpr –d DviFile** or **qprt –fd DviFile**. The **–d** and **–fd** flags for the respective commands pass **DviFile**, an output file produced by **tex**, through the DVI filter and send the results to the printer.

Directory Attributes

Directory attributes are grouped under the **_ _DIR** group header attribute. These attributes store path names to various files needed to process print requests, such as translate tables,

files containing header and trailer page text, downloadable font files, and temporary files. The first character in a directory attribute name is **d**, and the second character designates the directory.

The following example shows some of the directory attribute values for a supported PostScript laser printer:

```
_ _DIR                                  DIRECTORIES
d1  Directory Containing Stage 1        /usr/lib/lpd/pio/trans1
    Translate Tables
    (data stream to intermed.)
d2  Directory Containing Stage 2        /usr/lib/lpd/pio/trans2
    Translate Tables
    (intermediate to printer)
dD  Directory Containing Dummy Device   /usr/lib/lpd/pio/
    Files For Printers Driven By,
    But Not Attached To, the dev
    Host Computer (example: printers
    attached to Xstations)
dF  Directory Containing Flags files   /var/spool/lpd/pio/@local/flags
    (keeps track of loaded fonts)
```

The same attribute values are stored in the colon file as:

```
:053:_ _DIR::
:160:d1::/usr/lib/lpd/pio/trans1
:161:d2::/usr/lib/lpd/pio/trans2
:509:dD::/usr/lib/lpd/pio/dev
:414:dF::/var/spool/lpd/pio/@local/flags
```

Miscellaneous Attributes

The **_ _MIS** group header attribute groups miscellaneous printer attributes. Miscellaneous attributes begin with the letter **m** and store values such as the printer description and printer model number. The device name and queue name are also stored in the miscellaneous group. The **mn** attribute stores the device name and the **mq** attribute stores the queue name.

Here are some typical miscellaneous attributes for a supported PostScript laser printer:

```
_ _MIS MISCELLANEOUS
mA    Printer Data Stream Description                    PostScript
mD    Name of message catalog Containing Attribute       pioattr1.cat
        Descriptors
mF    Path Name of Font File To Be Downloaded (must
        include download commands)
mL    Printer Description                                IBM 4029 Laser
                                                         Printer
mN    Printer model number                               029
mY    Datastream Mode to Which Printer is Restored at    3
        End of Job (0: IBM PPDS;  1: HP PCL;  2:
        Plotter;  3: PostScript)
mc    String to Send to Printer ”mz” Times When          \0
        Job Is Cancelled
md    Output Data Stream Type (example: ascii);          ps
        Initialized By ”piodigest”
mf    Path Name of the Default Formatter (used when      %Idf/piofpt
        running standalone)
mi    Input Data Stream Names (1 character,              s,l
        separated by commas) for mp Attribute
mm    File Name Of (Digested) Data Base; Init. By
        ”piodigest” (mt.md.mn.mq:mv)
mn    Device name (example: lp0); Initialized By         lp1
        ”piodigest”
mo    Command String to Invoke Device Driver I/F         %Ide/pioout %v
        Program (end of pipeline)                        [ABCDFINOPRS]
mp    Strings (separated by commas) That Identify        %%!,\320OPS
        Print File Data Types (see mi)
mq    Queue Name; Initialized By ”piodigest”             ps1
```

These same attributes are stored in the colon file in the following format:

```
:058:_ _MIS::
:330:mA::PostScript
:332:mD::pioattr1.cat
:287:mF::
:331:mL::IBM 4029 LaserPrinter
:295:mN::4029
:516:mY::3
:301:mc::\0
:302:md::ps
:303:mf::%Idf/piofpt
:304:mi::s,l
:305:mm::
:306:mn::lp1
:307:mo::%Ide/pioout %v[ABCDFINOPRS]
:308:mp::%%!,\320OPS
:309:mq::ps1
```

Work Variable Attributes

Work variable attributes (values change while formatting) begin with the letter *w* and are listed under the **_ _WKV** group header attribute.

Some typical work variable attributes for a supported PostScript printer are:

```
_ _WKV WORK VARIABLES
w7     Font Name for Header LIne of Text Converted to
         Postscript

%?%S_s%”Courier”%=%tCourier-Bold%e%S_s%”Times-Roman”%=%tTimes-Bold%e%S_s%
”Helvetica”%=%tHelvetica-Bold%e%S_s%”Times-Italic”%=%tTimes-BoldItalic%e%
S_s%”Helvetica-Oblique”%=%tHelvetica-BoldOblique%e%Iw8%;

wl    Smallest legal sheetfeeder drawer number           0
wu    Largest legal sheetfeeder drawer number            3
```

The colon file stores these same values as:

```
:062:_ _WKV::
:472:w7::%?%S_s%"Courier"%=%tCourier-Bold%e%S_s%"Times-Roman"%=%tTim
es-Bold%e%S_s%"Helvetica"%=%tHelvetica-Bold%e%S_s%"Times-Italic"%=%t
Times-BoldItalic%e%S_s%"Helvetica-Oblique"%=%tHelvetica-BoldOblique%
e%Iw8%;
:370:wl::0
:381:wu::3
```

Command Aggregate Attributes

Command aggregate attributes, grouped under the **_ _CAG** group header attribute, store values such as the command to initialize the printer and the command to restore the printer after a print job is completed. Attributes in this category begin with the letter **c**. Typical command aggregate attributes for a supported PostScript printer are:

```
_ _CAG COMMAND AGGREGATES
ci    Command To Initialize the Printer
      %Iez\4%?%G_j%{1}%=%tstatusdict begin%Iat %Iar %?%Gmw%t%IaF%; end%;

cr    Command To Restore the Printer at Job End
      %o\4%Iex
```

These same attributes are stored in the colon file as:

```
:051:_ _CAG::
:144:ci::%Iez\4%?%G_j%{1}%=%tstatusdict begin %Iat %Iar %?%Gmw%t%IaF
%; end%;
:152:cr::%o\4%Iex
```

(ASCII) Control Code Attributes

The **_ _CTL** group of virtual printer attributes store ASCII control codes used by the printer. These attributes begin with the letter **a** and store such values as the control code used to advance paper to the next page. The following control codes are typical for a supported PostScript printer:

```
_ _CTL CONTROL CODES (ASCII)
aF     PostScript Command to Set Simplex/Duplex and Tumble Mode
         %?%G_Y%ttrueduplex %?%G_Y%{1}%=%tfalse tumble%etrue
         tumble%;%efalseduplex%;
af     ASCII Control Code to Advance the Paper to
         Top of Next Page (FF)
         showpage
ar     Cannot access message catalog pioattr1.cat.
         %G_6%d setresolution
at     Cannot access message catalog pioattr1.cat.
         %G_u%d setpapertray
```

The colon file stores these attributes as follows:

```
:052:_ _CTL::
:512:aF::%?%G_Y%ttrue duplex %?%G_Y%{1}%=%tfalse tumble%etrue tumble
%;%efalse duplex%;
:113:af::showpage
:119:ar::%G_6%d setresolution
:115:at::%G_u%d setpapertray
```

Escape Sequences Attributes

Escape sequence attributes begin with the letter **e** and are grouped under the **_ _ESC** group header attribute. Typical PostScript printer values are:

```
_ _ESC ESCAPE SEQUENCES
ex     Command to Restore Printer Datastream Mode
         (used only on restore)
          \33[K\3\0\4\61%?%GmY%{2}%>%t%{8}%c%e%GmY%{1}%+%c%;
ez     (used only on init/restore) Set initial
         conditions
         \33[K\5\0\4\61\10\0\0
```

These same values are stored in the colon file as:

```
:054:_ _ESC::
:514:ex::\33[K\3\0\4\61%?%GmY%{2}%>%t%{8}%c%e%GmY%{1}%+%c%;
:263:ez::\33[K\5\0\4\61\10\0\0
```

Printer Colon File Escape Sequences

Embedded references and logic for attribute values in the printer backend's database colon files are defined with escape sequences placed at appropriate locations in the attribute string. These escape sequences are not to be confused with printer escape sequences. The first character of each escape sequence is always the **%** (percent sign) character, which indicates the beginning of an escape sequence. The second character (and sometimes subsequent characters) define the operation to be performed. The remainder of the characters (if any) in the escape sequence are operands used to perform the specified operation.

Calculations performed by the escape sequences can use a stack to hold integers or pointers to strings to be operated on and can use internal variables **a** through **z** to save integer values for later use.

Since the **%** character is used to define the beginning of an escape sequence, a **%** character that is part of the data must be represented in the database as two adjoining **%** characters (**%%**). Only one **%** character appears in the constructed string.

The escape sequences that can be specified in an attribute string are listed and described in the following table. They are based on the **terminfo** file escape sequences for terminals, which have been modified and extended for printers.

Esc. Seq.	Description
%%	Generates a **%** (percent sign) character.
ASCII Output From Stack:	
%d	Pops an integer value from the stack and converts it to ASCII, without leading zeros. Produces a field width large enough to hold the ASCII numeric digits. Similar to **%d** with the **printf** subroutine.
%[1–9]d	Pops an integer value from the stack and converts it to ASCII. The result is 1 to 9 characters long, depending on the digit specified before the **d**. If the value does not fill the specified field width, it is padded on the left with zeros. If the value will not fit in the field, excess high–order digits are discarded. For example, with a value of **243** from the stack, **%4d** produces **0243** and **%2d** produces **43**. A stack value of **–243** would cause **%5d** to produce **–0243**.
Binary Output From Stack:	
%c	Pops an integer value from the stack and discards all but the low–order byte.
%h	Pops an integer value from the stack and discards all but the two low–order bytes.
%a	Similar to **%h**, except that the two bytes from the stack are in an alternate order: low–order byte, then high–order byte.
Input String:	
%Ixx	Includes the string attribute whose name is **xx**. **%I** and can be used recursively; that is, the included string can also contain a **%I**. Note that the included string does not inherit the current stack. Instead, it is assigned a new stack.
%I[. . .]	If multiple, contiguous includes are to be done, the attribute names can be separated by commas and enclosed with brackets. For example, the string **%Icp%Icc%IeW** can be specified as **%I[cp,cc,eW]**.

%Dxx Downloads to the printer the contents of the file whose full path name is specified by the **xx** attribute. The print job must have read access to the file. The primary use of this operator is to download fonts to a printer.

%"sss" Pushes a pointer to the **sss** string constant onto the stack. The only operation that can be performed on the string pointer is to use **%=** to compare the string with another string whose pointer is also on the stack.

%‘xx Inserts the standard output produced when the command string specified by the **xx** attribute is passed to a shell. Note that ‘ is the grave accent character.

%’ "*String* **"** Passes the quoted string as a command to a sub shell. Any double quotes within the quoted string must be back–quoted to prevent the internal quotes from being read as delimiters for the string. Note that ‘ is the grave accent character.

Input Integer To Stack:

%#xx"..@.." Extracts a selected portion of the string attribute named **xx**. The selection criteria is defined by the pattern **"...@..."**. The selection pattern consists of three parts:

1. The string immediately preceding the string to be extracted. If the prefix regular expression is missing, the extracted string consists of the entire string preceding the pattern specified by the suffix regular expression.
2. The extracted string replaces the **%#xx"..@.."** operation sequence in the attribute currently being processed.
3. The string immediately following the string to be extracted. If the suffix regular expression is missing, the extracted string consists of the entire string following the pattern specified by the prefix regular expression.

No string is extracted if the value of the string attribute is null. No string is extracted if the prefix or suffix regular expression is nonnull and does not have a corresponding match in the attribute value string.

Note: The ampersand (@) and quote (**"**) characters need to be surrounded with a separate pair of quotes if their meaning is to be taken literally. Otherwise, the program reads these symbols as delimiters.

When embedding a **%#** operator within a regular expression portion of another **%#** operator, the ampersand (@) and quote (**"**) characters cannot be used for their literal meaning. To avoid this situation, place the embedded **%#** operator in a separate attribute value and include the new attribute within the regular expression of the outer **%#** operator.

%Gxx Gets the integer attribute whose name is **xx** and pushes it onto the stack. If the attribute is a string instead of an integer, the string is assumed to be an ASCII integer. It is converted to a binary integer using the **atoi** subroutine and pushed onto the stack.

%’c’ Pushes character constant **c** onto the stack, where it becomes the low–order byte of an integer value. The high–order bytes are set to 0 (zero).

%{nn} Pushes integer constant **nn** onto the stack. The constant is a decimal value and can be either positive or negative.

Internal Variables:

Internal variables **a** through **z** are integer variables for use by **%P**, **%Z**, and **%g**. They are initialized to zero and their values change only if a **%P** or **%Z** changes them. There are two independent sets of these variables: one set is used by the **piobe** command for building pipelines, while the other set is used exclusively by a formatter. The values for a formatter's set are maintained for the duration of the formatter's processing.

%P[a–z]	Pops an integer value from the stack and stores it in the specified internal variable. For example, **%Pf** moves an integer value from the stack to variable **f**.
%Z[a–z]	Zeroes the specified internal variable. For example, **%Zg** stores a value of 0 in variable **g**.
%g[a–z]	Pushes the value of the specified internal variable onto the stack. The value of the internal variable is not changed. For example, **%gb** reads the integer value in variable **b** and pushes it onto the stack.

Arithmetic Operators:

%+ %– %* %/ %m	Pushes the result onto the stack.
%+	Adds the first two values popped off the stack. For example, **%{5}%{6}%+** pushes a value of 11 onto the stack.
%–	Subtracts the first value popped off the stack from the second value popped off the stack. For example, **%{12}%{3}%–** pushes a value of 9 onto the stack.
%*	Multiplies the first two values popped off the stack. For example, **%{2}%{3}%*** pushes a value of 6 onto the stack.
%/	Divides the first value popped off the stack into the second value popped off the stack. For example, **%{6}%{2}%**/ pushes a value of 3 onto the stack.
%m	(modulus) Similar to **%/**, except that the remainder, instead of the quotient, is pushed onto the stack. For example, **%{17}%{9}%m** pushes a value of 8 onto the stack.

Note: The first value to be popped off the stack is the last one to be pushed onto the stack, and the second value to be popped off the stack is the one that was pushed onto the stack first.

Relational and Logical Operators:

%= %> %< %!	Pushes a value of 1 if true, or 0 if false, onto the stack.
%=	Are the first two values that are popped off the stack equal? For example, **%{2}%{2}%=** pushes a value of 1 (true) onto the stack, and **%{2}%{3}%=** pushes a value of 0 (false) onto the stack.
%>	Is the second value popped off the stack greater than the first value popped off the stack? For example, **%{2}%{3}%>** pushes a value of 0 (false) onto the stack.
%<	Is the second value popped off the stack less than the first value popped off the stack? For example, **%{2}%{3}%<** pushes a value of 1 (true) onto the stack.
%!	Negate the value popped off the stack and push the result onto the stack: nonzero value to 0; 0 value to 1. For example, **%{0}%!** pushes a value of 1 (true) onto the stack, **%{1}%!** pushes a value of 0 (false) onto the stack, and **%{2}%!** pushes a value of 0 (false) onto the stack.

Note: The first value to be popped off the stack is the last one to be pushed onto the stack, and the second value to be popped off the stack is the one that was pushed onto the stack first.

Bitwise Logical Operators:

%& %| %^ %~	Pushes the result onto the stack.
%&	ANDs the first two values popped off the stack. For example, **%{6}%{3}%&** pushes a value of 2 onto the stack.
%|	ORs the first two values popped off the stack. For example, **%{6}%{3}%|** pushes a value of 7 onto the stack.
%^	EXCLUSIVE ORs the first two values popped off the stack. For example, **%{6}%{3}%^** pushes a value of 5 onto the stack.
%~	ONE'S COMPLEMENTs the first value popped off the stack and inverts the value of each bit. For example, **%{–1}%~** pushes a value of 0 (all bits off) onto the stack (assumes two's complement notation for –1).

Conditional (if–then–else) Operators:

%? expr %t thenpart %e elsepart %;	**%t** pops a value off the stack and tests it. If the value is **TRUE** (nonzero), **thenpart** is run. Otherwise, **elsepart** (if present) is run.

else–if construct

```
%? c1 %t b1 %e c2 %t b2 %e c3 %t b3 %e b4 %;
```

where **c1**, **c2**, **c3** denote conditions and **b1**, **b2**, **b3**, **b4** denote bodies. For example, **%?%{1}%t%{2}%e%{3}%;** pushes a value of 2 onto the stack, and **%gx%{6}%?%=%t%{2}%e%{3}%;%d** outputs a value of 2 if the value of the internal variable **x** is 6. If value of **x** is not 6, a value of 3 is output.

When developing complex logic, it is sometimes useful to show it in structured form. The preceding example, in structured form, might look like this:

%gx	Pushes the value of **x** onto the stack
%{6}	Pushes a value of 6 onto the stack
%?%=%t	If the stack values are equal then
%{2}	pushes a value of 2 onto the stack
%e	else
%{3}	pushes a value of 3 onto the stack
%;	endif
%d	Outputs
the value in ASCII format	

Pass–through:

%x	(The **piocmdout** subroutine call only.) Pass through from input to output the number of bytes specified by the **passthru** argument to the **piocmdout** subroutine.

Loops

%wx **While** loop. Whenever a matching **%;** is reached, the value of the internal variable *x* (*x* can be **a** through **z**) is decremented by one. If the result is greater than 0, execution is transferred to the character following **%wx**.

Mode:

%o Starts using only original default values from the database instead of values that may have been updated from the command line (or during formatter processing).

%r Returns to using the values that were being used before **%o**.

Pipeline Overrides:

%p Indicates where to embed the prefix–filter pipeline in the main pipeline. If not present, it is assumed to be at the beginning of the main pipeline. Ignored if the first character of the attribute name is not **i** (that is it is not a main pipeline)

%z Indicates where to embed the **pioout** string (device–driver interface routine) in the main pipeline. If not present, it is assumed to be at the end of the main pipeline. If the first character of the attribute name is not **i** (that is, it is not a main pipeline), it is ignored.

%ix Can be specified only in a prefix filter string (that is, the first character of the attribute's two–character name is **f**). The **x** variable represents a pipeline identifier character. The **%ix** variable specifies that the attribute name for the main pipeline should be **ix** instead of **iy**, where **y** is the parameter specified (or defaulted) for the **–d** flag. As a special case **%i!** specifies that a null string should be used as the main pipeline.

Command Line Flags:

These operators are usually used in pipeline definitions, where they apply to flags specified by the print job submitter. If specified in attribute strings used by a formatter, they apply to the flags passed to the formatter. Valid flag letters are **a** through **z**, **A** through **Z**, and **0** through **9**.

%Cy Pushes a value of 1 (true) onto the stack if flag **y** was specified on the command line. Otherwise, pushes a value of 0 (false) onto the stack.

%Fxy or %F[...] Shorthand for **%?%Cy%t–x %I_y%;**. If the **y** flag was specified on the command line, generates **–x yarg**, where **yarg** is the argument specified for the **y** flag. If **!** is specified for **x**, **–x** will not be generated. If **yarg** contains an unprotected (not immediately preceded by an odd number of back slashes) single or double quote, an error message will be issued and the print job terminated.

If multiple flags are to be specified using **%Fxy**, and each flag's **x** and **y** values are identical, a list of flag letters can be specified in brackets. For example, **%Faa%Fbb%Fcc** can be specified as **%F[abc]**.

The values referenced by **y** or **[. . .]** have attribute names whose first character is _ (underscore) and whose second character is **y** or a character in the string **[. . .]**.

%fxy or **%f[. . .]**

Similar to **%Fxy** and **%F[. . .]**, except that no space is placed between the flag name and the argument, unless the argument is a null string.

%vxy or **%v[...]** Similar to **%fxy** and **%f[. . .]**, but used only in the command string for the **pioout** command, the Device Driver Interface Program, to generate flags and arguments for override values specified by the **piobe** command, the Print Job Manager. Flags are not generated when their arguments are equal to predefined default values.

With **%v**, the values referenced by **y** or **[. . .]** have attribute names whose first character is @ (at sign) and whose second character is **y** or a character in the string **[. . .]**.

%Ux

or **%U[. . .]**

Indicates to the **piobe** command that the **x** flag (or each flag in the string **[. . .]**) is actually referenced even though it is not referenced by a pipeline; for example, the **x** flag may be referenced by a printer command instead of by a filter in a pipeline. This prevents the **piobe** command from rejecting the flag when specified on the command line.

Printer Colon File Conventions

Printer and printer data stream attributes reside in colon files. Colon files reside in the **/usr/lib/lpd/pio/predef** and **/var/spool/lpd/pio/@local/custom/*** directories. The **/usr/lib/lpd/pio/predef** directory contains the predefined database and the **/var/spool/lpd/pio/@local/custom/*** directory contains the customized database.

The following sections describe the conventions for printer and attribute names and values in colon files.

- Colon File Format
- Attribute Names
- Attribute Values

Colon File Format

Colon files in both the predefined and customized databases have five fields (separated by colons) for each attribute. They are:

Message catalog ID

Identifies the message catalog where the attribute description is stored. The message catalog ID can take any of three forms:

- Null string: The string value for the **mD** attribute is assumed to be the file name of the message catalog (for example, `mydescriptors.cat`).
- One character: An abbreviation for **pioattr***x***.cat**, where *x* is the one–character catalog ID. This form of the catalog ID is normally used only by the operating system.
- Catalog file name: The file name of the message catalog (for example, `mydescriptors.cat`).

Either the one–character form or the catalog file name form of the catalog overrides the catalog file name specified with the **mD** attribute.

Message number

Identifies the message index in the catalog that contains the description of this attribute. Leading zeros are ignored.

Attribute name Specifies two characters, except for group header attributes, which are five characters.

Limits field Specifies limits for the attributes.

Attribute value string

Specifies zero to 1000 characters.

Following is an example of one line in a colon file:

```
:023:_w::80
```

The attribute name is **_w**, the attribute value string is `80`, and the attribute description is stored in message number `23` in the message catalog specified by the **mD** attribute.

Note: All attribute descriptions are stored in message catalogs. If an attribute has the same description for multiple printers, the attribute in each printer's database can reference the same catalog and message number. If the same attribute name has a different description for different printers, separate message numbers are used.

Attribute Names

The following conventions have been established for virtual printer attribute names:

- Each attribute name must be unique.
- Attribute names can contain the characters **a** through **z**, **A** through **Z**, **0** through **9**, and _ (underscore). The name cannot begin with a numeral.
- All attribute names must be two characters long (except group header attribute names, which can be five characters long).
- Attribute names for group headers begin with _ _ (two underscores) and must not be longer than five characters. A *group header attribute* (formerly called a comment attribute) marks the beginning of a group of related attributes. For example, the group header attribute **_ _FLG** marks the beginning of a group of attributes that define the default values for command line flags. The grouping of attributes is for readability purposes and does not affect how the attributes are processed.
- An attribute name beginning with _ (an underscore), except for group headers, can be overridden by a command line flag of the same name as the second character of the attribute name. For example, `-w 132`, specified with the **qprt** command, overrides with a value of `132` the value specified for the **_w** attribute in the colon file.

Automatic Attributes

Automatic attributes are names and values that are provided automatically and that cannot be in the database:

@0 Always a null string. This attribute name can be used wherever an attribute name for a null string is needed.

@1 A string containing the full path name of the file being printed. This attribute name is available only to attributes that define pipelines and attributes included by pipelines. The file being printed will be a temporary file if the **–c** flag is specified with the **qprt** command.

@2 An integer containing the number of bytes to be passed through when **%x** is found in a command string by the **piocmdout** subroutine (obtained from the **passthru** parameter passed to the **piocmdout** subroutine).

@3 An integer value indicating how the printer is attached:

0	Neither parallel nor serial
1	parallel
2	serial

@4 The full path name of the **pio** directory whose subdirectories (**burst**, **etc**, **fmtrs**, **fonts**, **predef**, **trans1**, and **trans2**) contain STATIC data files and utility programs used to configure virtual printers and process print jobs. The directory must be a subdirectory of the directory containing the **piobe** command invoked by the qdaemon. The value for **@4** is normally the /**usr**/**lib**/**lpd**/**pio** directory.

@5 The full path name of the **pio** directory whose subdirectories (**custom**, **ddi**, **dev**, and **flags**) contain DYNAMIC data files used to configure virtual printers and process print jobs. The value for **@5** is normally the /**var**/**spool**/**lpd**/**pio** directory.

The following attribute names are used for communicating from the **piobe** command (the print job manager) to the **pioout** command (the device driver interface program). The attribute values are referenced by flag arguments passed to the device driver interface program as specified in the pipelines.

@A Number of bytes already printed.

@B Total number of bytes to print.

@C Number of times to send the cancel string (**@D**) to the printer at print job cancel.

@D String to send to the printer if the print job is canceled.

@I User to which to send `intervention required` messages.

@O Name of file to be generated by the **pioout** command in which to store data instead of sending it to the printer.

@P Name of file (usually the header page) to be sent to the printer before the first byte of the print file is sent.

@S Name of file to be sent to the printer after the last byte of the print file has been sent.

Reserved Attribute Names

Reserved attribute names are names that are assumed by the print job manager:

First two characters are _ _	Group header attribute.
First character is @	Value is provided automatically.
First character is _	Default value for flag argument.
First character is i	Pipeline for input data stream.
First character is l	Flags prohibited for input data stream.
First character is f	Command string for the filter flag.

First character is z and second character is D, P, or S:

zD Default state of the colon file when in the **/var/spool/lpd/pio/custom/*** directory (**+** means expanded, **!** means contracted).

zP Name of the colon file's parent colon file. The parent colon file is assumed to be in the **/usr/lib/lpd/pio/predef/*** directory.

zS Current state of the colon file (**+** means expanded, **!** means contracted).

First character is y	Values for terminal–attached printers.

Suggested Attribute Names

Suggested attribute names are names that are assumed by many formatter filters:

First character is s	System administrator value.
First character is d	Directory path.
First character is m	Miscellaneous value (constant).
First character is w	Work value (changes while formatting).
First character is c	Command aggregate.
First character is a	ASCII control code.
First character is e	Printer escape sequence.
First character is t and second character is 0–9	Full path names of zero or more. Stage 2 translation tables used by formatter. Multiple values must be separated by commas.

Attribute Values

The following conventions have been established for attribute values:

- Printer names are of the form `4201-3`, reflecting the printer name (`4201`) and model number (`3`).
- File names in the Predefined Database are of the form *PrinterType.DataStreamType*; for instance, `4216-31.asc` indicates a 4216 Model 31 printer and an ASCII data stream.
- File names in the Customized Database are of the form *QueueName:QueueDeviceName*, such as `proq:mypro`.
- Attribute values can contain a \ (backslash) followed by one to three octal digits to represent non–ASCII values. A \ (backslash) that does not begin an octal sequence should be represented by either `\\` or `\134`.
- Characters can be represented by hexadecimal notation of the form `\xXX`, where `XX` represents a hexadecimal value.
- Boolean values can be represented by a + (plus sign) for true, and an ! (exclamation point) for false.
- Because attribute values reside in colon files, a colon character must not appear in the attribute value. Instead, a colon should be represented by `\072`.
- An attribute value that references an integer attribute requiring translation from a lookup table should always appear in a colon file after the referenced integer attribute: For example, from the string **red** to an equivalent integer value of 2. Integer values are created from a colon file in the same order they are defined in the colon file. Listing the attribute value first ensures that when the integer attribute is referenced, it has been converted before it is referenced by the **%G** escape sequence.
- Run all the shell commands using **ksh** instead of **bsh**.

Limits Field

The limits field in the colon file contains two types of information. SMIT dialog information and validation information.

SMIT Dialog Information

Information used in building SMIT objects represent colon file attributes in the object data manager (ODM). These objects will be used in the Print a File, Printer Setup, and Default Job Characteristics dialogs.

The limits field gives you some control over the type of sm_cmd_opt ODM object that is built for every object. You can control whether or not an attribute is always displayed, never displayed, or displayed only if it is referenced in a pipeline. You can modify the following fields:

- id_seq_num
- entry_type
- cmd_to_list_mode
- required
- op_type
- multi_select
- disp_values
- aix_values
- values_msg_file
- values_msg_set
- values_msg_id
- help_msg_id
- help_msg_loc

Validation Information

Validation information validates attribute values when the colon file is complete and a print job is submitted.

Example of Print Formatter

This example shows how print formatters can interact with the documented printer formatter subroutines. The procedure for writing a print formatter involves four steps:

1. Creating a print formatter source file as shown below.
2. Creating an imports file, on page 4-27.
3. Creating an exports file, on page 4-27.
4. Compiling and linking the print formatter, on page 4-27.

Create the Print Formatter Source File

Use an ASCII editor to create a formatter source file named `sample.c`. The file should contain the following lines:

```
#include <stdio.h>
#include <piostruct.h>

/* STRING CONSTANTS */
/* Initialize Printer, Restore Printer, Form Feed */
#define INIT_CMD    ”ci”
#define REST_CMD    ”cr”
#define FF_CMD      ”af”

/* INTEGER and STRING VARIABLES */
/* page length, page width, top margin, bottom margin */
#define Pglen           (*(_Pglen + piomode))
#define Pgwidth         (*(_Pgwidth + piomode))
#define Tmarg           (*(_Tmarg + piomode))
#define Bmarg           (*(_Bmarg + piomode))

/* indentation, begin page, form feed?, pass-through? */
#define Indent          (*(_Indent + piomode))
#define Beginpg         (*(_Beginpg + piomode))
#define Do_formfeed     (*(_Do_formfeed + piomode))
#define Passthru        (*(_Passthru + piomode))

/* initialize printer?, restore printer? */
#define Init_printer     (*(_Init_printer + piomode))
#define Restoreprinter   (*(_Restoreprinter + piomode))

/* Command names: form feed, vertical increment and decrement */
#define Ff_cmd          (*(_Ff_cmd + piomode))
#define Vincr_cmd       (*(_Vincr_cmd + piomode))
#define Vdecr_cmd       (*(_Vdecr_cmd + piomode))

/* Work variables for vertical increment and decrement */
#define Vincr           (*(_Vincr + piomode))
#define Vdecr           (*(_Vdecr + piomode))

/* Variables referenced by above #defines */
int *_Pglen, *_Pgwidth, *_Tmarg, *_Bmarg, *_Indent, *_Beginpg, *_
Do_
formfeed, *_Passthru, *_Init_printer, *_Restoreprinter, *_Vincr,
*_V
decr;
struct str_info *_Ff_cmd, *_Vincr_cmd, *_Vdecr_cmd;
```

```
/* TABLE OF ATTRIBUTE VALUES */
struct attrparms attrtable[] = { /*
name  data type  lookup  address of pointer */
"_b",  VAR_INT,   NULL,   (union dtypes *) &_Bmarg,
"_g",  VAR_INT,   NULL,   (union dtypes *) &_Beginpg,
"_i",  VAR_INT,   NULL,   (union dtypes *) &_Indent,
"_j",  VAR_INT,   NULL,   (union dtypes *) &_Init_printer,
"_l",  VAR_INT,   NULL,   (union dtypes *) &_Pglen,
"_t",  VAR_INT,   NULL,   (union dtypes *) &_Tmarg,
"_w",  VAR_INT,   NULL,   (union dtypes *) &_Pgwidth,
"_J",  VAR_INT,   NULL,   (union dtypes *) &_Restoreprinter,
"_Z",  VAR_INT,   NULL,   (union dtypes *) &_Do_formfeed,
"wp",  VAR_INT,   NULL,   (union dtypes *) &_Passthru,
"wf",  VAR_STR,   NULL,   (union dtypes *) &_Ff_cmd,
"wi",  VAR_STR,   NULL,   (union dtypes *) &_Vincr_cmd,
"wy",  VAR_STR,   NULL,   (union dtypes *) &_Vdecr_cmd,
"wV",  VAR_INT,   NULL,   (union dtypes *) &_Vincr,
"wD",  VAR_INT,   NULL,   (union dtypes *) &_Vdecr,
NULL,  0     ,   NULL,    NULL };
int pglen, tmarg, bmarg, vpos, vtab_base;
struct shar_vars sharevars;

struct shar_vars * /*** Setup Processing ***/
setup(argc, argv, passthru)
   unsigned argc;
    char *argv[];
    int passthru:
{

/* Initialize variables and command line values */
(void) piogetvals(attrtable, NULL);
(void) piogetopt(argc, argv, NULL, NULL);
/* (need to verify values entered by user) */

/* Initialize work variables */
pglen = Pglen * Vincr;
tmarg = Tmarg * Vincr;
bmarg = Bmarg * Vincr;
piopgskip = Beginpg - 1;

/* Check for pass-through option */
if (Passthru = passthru)
     return(NULL);

/* Initialize pointers to vertical spacing */
/* variables shared with formatter driver  */
/* (Refer to /usr/include/piostruct.h)     */
sharevars._pl            = &pglen;
sharevars._tmarg         = &tmarg;
sharevars._bmarg         = &bmarg;
sharevars._vpos          = &vpos;
sharevars._vtab_base     = &vtab_base;
sharevars._vincr         = &Vincr;
sharevars._vincr_cmd     = (&Vincr_cmd)->ptr;
sharevars._vdecr         = &Vdecr;
sharevars._vdecr_cmd     = (&Vdecr_cmd)->ptr;
sharevars._ff_cmd        = (&Ff_cmd)->ptr;
sharevars._ff_at_eof     = &Do_formfeed;
return(&sharevars);
}

initialize() /*** Initialize the Printer ***/
{
if (Init_printer)
      (void) piocmdout(INIT_CMD, NULL, 0, NULL);
return(0);
}
```

```
lineout(fileptr)  /***  Format a Line  ***/
FILE *fileptr;
{
int ch, charcount = 0;
for (ch = 0; ch < Indent; ch++)
          pioputchar(' ');
while ((ch=piogetc(fileptr)) != '\n' && ch != EOF
             && charcount < Pgwidth) {
           charcount++;
            pioputchar(c);
}
vpos += Vincr;
return(charcount);
}

passthru()  /*** Pass-through Option ***/
{
int ch;
while ((ch = piogetc(stdin)) != EOF)
           pioputchar(ch);
if (piodatasent && Do_formfeed)
          (void) piocmdout(FF_CMD, NULL, 0, NULL);
return(0);
}

restore() /*** Restore the Printer ***/
{
if (Restoreprinter)
       (void) piocmdout(REST_CMD, NULL, 0, NULL);
return(0);
}
```

Compile and Link the Print Formatter

Use an editor to create an imports file named `sample.imp`. The file should contain the following:

```
#!
main
piogetvals
piogetopt
piomsgout
pioexit
piomode
piodatasent
piopgskip
statusfile
piocmdout
piogetstr
```

Use an editor to create an exports file named `sample.exp`. The file should contain the following:

```
#!
setup
initialize
passthru
restore
lineout
```

Enter the following to compile and link the formatter:

```
cc -o sample -bI:sample.imp -bE:sample.exp sample.c
```

Understanding the Interaction between qdaemon and the Backend

Besides reading files and writing to devices, a backend must cooperate with the **qdaemon** in several ways:

- Print extra pages as requested.
- Periodically update status information (such as pages printed, percentage done, and waiting state).
- Supply charges (accounting data) for the completed job.
- Exit with some agreed–on codes.
- Pass error messages through a special routine.
- Set queue states as appropriate.
- Terminate cleanly on receipt of SIGTERM.

The **qdaemon** and the backend communicate through a status file. ”Understanding Backend Routines in libqb”, on page 4-33 explains the set of library routines that the backend should use to fulfill these communication requirements. These routines are in the /**usr**/**lib**/**libqb.a** library.

Using the Status File

When the **qdaemon** process invokes a backend, it passes the following parameters, in order:

1. The parameters appearing in the /**etc**/**qconfig** file.
2. The flags that the **enq** command did not recognize, in the order they were given. These flags will be preceded by the **–o** option on the command line.
3. The names of one or more files to be printed.

There is a status file for each device and its associated queue. These files are found in the /**var**/**spool**/**lpd**/**stat** directory.

The status file provides a means of communication for the **qdaemon** process and the backend. The **qdaemon** passes information such as the date of the file, whether to print burst pages, and the number of copies to be printed. The backend passes back the charge for the job it has just finished running. In addition, the backend periodically updates the number of pages it has printed and what percent of the job is finished. This information is read by the **qchk** command.

> **Note:** Backends should never explicitly write into their status file. They should call the **libqb** library routines to do this.

There are two reasons for calling the routines:

- The backend is spared the trouble of accessing the status file directly.
- The format of the status file can be changed without requiring backends to be rewritten. Should the format of the status file change, the backend only needs to be re–linked.

To initialize certain data common to the library routines, the backend must call the routine **log_init**. The call is:

```
log_init();
```

This routine should be called to initialize the status file interface. The **log_init** routine, like all **log_** routines in the library, returns a value of –1 if it fails.

Printing Extra Copies

The **enq –N** command prints extra copies of a file. For example, to print five copies of a file `filename` , enter this command:

```
enq –N5 filename
```

The **enq** command passes the information to the **qdaemon** process, which puts it into the status file. Backends should get the information by calling the **get_copies** routine, which returns the total number of copies requested.

Updating Job Status Information

The **qchk** command displays information about currently running jobs, including the originator, title, number of pages to be printed, and percentage completed. All this information comes from the status file. Most of the information is set up by the **qdaemon** when the backend is first invoked, except the **pages printed** and **percent done** fields, which must be filled in by the backend itself.

To provide this information, the backend should periodically call the **libqb** function **log_progress(pages,percent)**. If you prefer, you can use the individual functions **log_pages(pages)** and **log_percent(percent)**. The backend is free to call these routines at any time; once at the end of each page is recommended.

Charging for the Job

When a backend completes a job, the **qdaemon** reads the status file for a charge. If the **qconfig** file has been set up to do so, the charge is written to a file that is eventually processed by the accounting programs. This results in a bill (real or imaginary) for the user issuing the print request.

The backend passes the charge back to the **qdaemon** with the routine **log_charge(charge).** The backend should call this routine on exit. It should also call the routine along with **log_progress** while printing the job. Otherwise, if the job is canceled, no charge will be made for the pages printed up to that point.

The charge is interpreted by all current accounting programs as the number of pages printed. However, a backend can set the charge to be based on any multiplier, whole or fraction, of pages printed.

For more information about job accounting, see ”Spooler Overview for System Management”, on page 3-1 .

Using Exit Codes

When a backend exits, the **qdaemon** looks at its exit code for such information as whether the job was completed successfully and whether the device is still usable. Therefore, it is important that backends use the same convention for their exit codes. The backend should use **#include <IN/standard.h>** for the values of the codes given here.

The permissible exit codes are:

EXITOK	No problems encountered.
EXITBAD	The parameters could not be acted upon. Two common examples are a flag’s not being valid or a file that could not be opened. The **qdaemon** sets the state of the device (displayed by **qchk**) to OFF, sends a message to the console, and does not run any further jobs on that device until someone has explicitly set its state to ON again (with an **enq –Pqueuename –U** command).
EXITERROR	The backend could not finish printing the job. The **qdaemon** restarts the same job from the beginning on the same device. The **qdaemon** enforces a limit on the number of times the job will be restarted.

EXITFATAL	The job could not be finished because of a problem in the device that requires manual intervention. The **qdaemon** sets the state of the device (displayed by **qchk**) to OFF, sends a message to the console, and does not run any further jobs on that device until someone has explicitly set its state to ON again (with an **enq –Pqueuename –U** command).
EXITSIGNAL	The backend was interrupted by a **SIGTERM** signal (**#include <signal.h>**).
EXITWARN	The backend has issued a warning to the **qdaemon**. The job may or may not be completed successfully, but in either case, when the **qdaemon** receives an **EXITWARN** from the backend, **qdaemon** returns a message explaining the problem.

Returning Error Messages

When an error event occurs, the backend should send a message to the user. Before sending a message, the backend should check the **PIO_IPCWRITEFD** environment variable. If it is set, the message is sent to a print supervisor by way of a pipe. The print supervisor interprets the message and sends it to the user. If the **PIO_IPCWRITEFD** environment variable is not set, the backend sends the message to the user with the **sysnot** routine.

The **qdaemon** print spooler always uses the **sysnot** routine to send messages. Non–AIX print spoolers can use **sysnot** routine or the pipe to send messages.

Using the sysnot Routine

The backend can send messages directly to the user with the **sysnot** routine. The **sysnot** routine can either mail the message to the user or write the message to the user's terminal. The **sysnot** routine is called with the following syntax:

```
sysnot(user, host, message, pref)
   char *user;
   char *host;
   char *message;
   unsigned int *pref;
```

The value of the *pref* parameter should be DOMAIL or DOWRITE. DOMAIL mails the error message to the user. DOWRITE writes the message to the user's terminal if the user is logged on. If the user is not logged on, the message is mailed to the user. The DOMAIL and DOWRITE constants are defined in the **/usr/include/IN/backend.h** file.

Using a Pipe

The backend can send messages to the user by sending the message to a print supervisor by way of a pipe. This mechanism provides a one–way communication path between the printer backend and the print supervisor.

The print supervisor must open an unnamed pipe and obtain two file descriptors, one for read operations and one for write operations. The print supervisor must export the write end in the **PIO_IPCWRITEFD** environment variable before calling the printer backend with the **fork** and **exec** subroutines. If the **PIO_IPCWRITEFD** environment variable is set, the printer backend writes any messages to the write end of the pipe.

The print supervisor typically calls the **select** subroutine to poll the read side of the pipe for incoming messages. In addition to checking for exit status of the printer backend using the **waitpid** subroutine, the print supervisor polls for I/O on the pipe. The print supervisor sets up a signal handler for the **SIGCHLD** signal and performs a block read on the pipe. The signal handler examines the exit status of the printer backend and performs any action necessary. When no unread messages remain on the pipe, the print supervisor closes the pipe and proceeds to other cleanup work.

Message Format

Each message sent by the printer backend consists of a message header frame, zero or more parameter header frames, a fully expanded message, and text consisting of zero or more parameters. The message header specifies the message type, message catalog information, length of expanded message text, and the number of variable message parameters. The variable message parameters are used to build the expanded message text from the basic message text that is extracted from the message catalog. The structure formats for the message header and the message parameter header frames are defined in the **/usr/include/piostruct.h** file.

When extracting messages from the pipe, the print supervisor reads the message header frame, then reads the message parameter header frames (0–9, as specified by the number of parameters specified in the message header frame). The print supervisor reads the expanded message text, the length of which is specified in the message header frame, followed by the parameters (if any). The type and length of any parameters are specified in the individual message parameter header frames.

The type of message is specified in the message header frame. The two message types are:

- **ID_VAL_EVENT_ABORTED_BY_SERVER**
- **ID_VAL_EVENT_WARNING_RESOURCE_NEEDS_ATTENTION**

The actual message text is in expanded format. The parameters are placed in the message text after the parameters are extracted from the message catalog file in the server's locale. The print supervisor can use the message text or build its own message text from the supplied message catalog information and the message parameters. However, the printer backend cannot provide message catalog information (message number, set number, and catalog name) and variable message parameters in all cases. Therefore, the print supervisor must check for the catalog name field (**pm_catnm** field) to determine if the catalog name is a null string. If the catalog name is a null string, the print supervisor must use the supplied expanded message text.

If a catalog name is provided, the print supervisor can extract the message from the catalog and place any supplied message parameters in the message. The message parameters can be integer or string type. However, message parameters are passed from the printer backend as strings concatenated to the expanded message text. If the print supervisor extracts the message from the specified catalog and places the parameters in the message, the following conventions apply:

- Parameters can be integer or string type, but are always passed in the pipe as strings with a trailing **NUL** character. The length of each parameter in string format is supplied in the parameter's associated header frame.
- Extracted messages can contain escape sequences recognized by the **printf** subroutine. Therefore, while populating the message, the print supervisor checks for escape sequences such as `%s` , `%d` , and `%c` , and converts the parameters accordingly. Positional parameters are sometimes specified by using `%n$s` or `%n$d` . In such cases, the print supervisor fills in the parameters in the specified order.
- A maximum of nine parameters can be specified. Therefore, the print supervisor can use nine variables of *char type and assign the variables to the appropriate supplied parameter strings. After replacing all positional specifiers and integer specifiers, the parameters can be passed to the **printf** subroutine. For example, the extracted message text might contain the following:

```
Error %8$d in opening %6$s file
```

The print supervisor converts the message to the following:

```
Error %s in opening %s file
```

and assigns the first variable parameter pointer to the eighth parameter, the second variable parameter pointer to the sixth parameter, and the remaining variable parameter pointers to null strings. The print supervisor then calls the **sprintf** subroutine or a similar subroutine and pass the nine variable parameter pointers as parameters to the function.

- The printer backend specifies the correct type (integer or string) for each parameter, even though all parameters are passed in the pipe as strings. The appropriate type must be used for handling field width and precision when placing a parameter in an extracted message.
- The printer backend may or may not pass message catalog information and parameters for a message. Therefore, the print supervisor must be able to accept the expanded message itself, or accept the catalog information and parameters and then build the message accordingly.

Setting Queue States

The **qchk** command displays the status of a particular device. One of the entries in the table that is displayed shows the current state of the queue. This information is taken from the status file. See **/usr/include/IN/backend.h** for a list of valid queue states and their explanation.

Normally, the **qdaemon** keeps the status file updated. However, some backends may want to set explicitly the state to WAITING (**#include <IN/backend.h>**) if they can no longer send output to the device, and set it back to RUNNING when output resumes. For example, a backend that paused at the end of each page, waiting for user response, might want to set the status to WAITING during this time.

The **log_status(status)** routine can be used to change the status of the job from RUNNING to WAITING and back again. The parameter is the new status.

In the case of a **DEV_WAIT** state on a queue device, issue **enq –U –Pqueue** to attempt to get the queue to a state of readiness. If this does not work move all the jobs in that queue and issue **enq –G** in order to flush the other queues and bring down the **qdaemon**. Then restart the **qdaemon**.

Terminating on Receipt of SIGTERM

When a user cancels a running job with **qcan**, the command passes the request to the **qdaemon**. The backend must stop the print soon after receiving the signal. There are two ways to accomplish this.

First, the backend cannot do anything special about SIGTERM, in which case the signal stops the backend process immediately. This option is the simplest, but it does not allow the backend to do any cleanup (reset line speeds, put paper at top–of–form, hang up the phone) before it terminates.

Second, the backend can catch SIGTERM, carry out whatever cleanup tasks are required, and exit EXITSIGNAL **(#include <IN/standard.h>)**. The special exit code tells the **qdaemon** that the job was canceled.

Backends that decide to catch SIGTERM should exit very soon after receipt of the signal.

Understanding Backend Routines in libqb

This article defines the set of library routines that the backend should use to communicate with the **qdaemon** process. These routines are in the **/usr/lib/libqb.a** library; they were designed to make the task of writing a backend as easy as possible. These backend routines are available using the **ld** or **cc** command–line option **–lqb**.

For information on using these routines with the backend, see ”Understanding the Interaction between qdaemon and the Backend”, on page 4-28.

get_align()	Returns **TRUE** or **FALSE**, telling whether an alignment form–feed is to be printed. A form–feed is printed only when the printer has been idle and is about to print a new job. The form–feed aligns the paper to top–of–form and is helpful if someone moved the paper while the printer was idle.
get_cmd_line()	Returns a pointer to an array of characters containing the **enq** command line as invoked by the user. The string returned does not contain the name **/usr/bin/enq**, any of the file names specified, or any options that were sent to the backend using the **enq –o** option. For example, if the user enters the command line `enq –Plp0 –Bgn –o –i15 filename`, the **get_cmd_line** function returns the string `–Plp0 –Bgn`. This function is useful when the backend needs to know the command line options a user provided when the job was submitted.
get_copies()	Returns the number of copies to be printed. Its return value is of type int.
get_device_name()	Returns a pointer to an array of characters containing the device name.
get_feed()	Returns the number of feed pages to be printed. Its return value is of type unsigned int. Feed pages are blank pages printed only when the printer has become idle. This makes it easier to tear off paper from the printer.
get_from()	Returns an array of characters containing the name of the person who made the print request. The return value is of type char*.
get_header()	Returns **NEVER**, **ALWAYS**, or **GROUP** (**#include <IN/backend.h>**). Its return value is of type unsigned int. A header is a page preceding a file that shows its title, date, its recipient, and other information.
get_job_number()	Returns job number of current print. Its return value is of type int.
get_mail_only()	Returns **TRUE** if the user specifies mail–only.
get_qdate()	Returns a string showing the date that the request was queued. The return value is of type char*.
get_queue_name()	Returns an array of characters containing the queue name.
get_title()	Returns an array of characters containing the title of the job being printed. The return value is of type char*.
get_trailer()	Returns **NEVER**, **ALWAYS**, or **GROUP**. Its return value is of type unsigned int. A trailer is a page following a file that gives the name of the user of the output.
get_to()	Returns an array of characters containing the name of the person for whom the job is intended. The return value is of type char*.

get_was_idle() Returns **TRUE** if the printer was idle at job beginning (useful for paper feed: feed/no feed).

Returns the charge for printing the current job.

log_charge(*charge*) **int** *charge*;

Returns the charge for printing the current job.

log_init Initializes certain data common to the library routines.

log_pages(*pages***)** Updates the status file with the number of pages printed.

log_percent(*percent***)** Updates the status file with the percent of job completed.

log_progress(log_pages (*int***),log_percent(***char***))**

Updates the status file with the number of pages printed and percent of job completed. This function uses **log_pages** and **log_percent**.

log_status(*status***)** Changes the status of the job from RUNNING to WAITING and back again. The parameter is the new status.

put_header(*fnaddr***,***width***)**

int (**fnaddr***);**

int ****width*;** Prints a header page with no following form–feed and returns the number of lines printed. The *fnaddr* and *width* parameters are optional. The *fnaddr* parameter defines the format subroutine used to display characters on the header page. The default is the **putchar** subroutine. The *width* parameter defines the width of the form. The default value for the *width* parameter is **80**.

put_trailer(*user***,***fnaddr***,***width***)**

char ****user*;**

int (**fnaddr***);**

int ****width* Prints a trailer page for *user* with no following form–feed and returns the number of lines printed. The *fnaddr* and *width* parameters are optional. These parameters are identical to and take the same values as the *fnaddr* and *width* parameters for the **put_header subroutine.

sysnot(*user***,***host***,***message***,***pref***)**

char ****user*;**

char ****host*;**

char ****message*;**

unsigned int ****pref*;**

Sends a *message* to the *user* if the backend cannot run a job. The value of the *pref* parameter indicates whether to mail the message to the user or to write the message on the user's terminal. The valid values defined in /**usr**/**include**/**IN**/**backend.h** file are:

DOMAIL Mails the error message to the user.

DOWRITE Writes the message to the user's terminal if the user is logged on. If the user is not logged on, the message is mailed to the user.

Printer Code Page Translation Tables

Translation of code points in the print file to code points for the printer is a two–stage process (translation of code points for Oriental languages is handled differently). The first stage translates code points from the print file to code points in an intermediate code page. The intermediate code page consists of 16–bit integer code points for all supported characters. The first 256 code points in the intermediate code page are identical to IBM Code Page 850, except that code points 0 through 31 (decimal) are ASCII control characters instead of printable characters. The intermediate code page is defined in the **/usr/lib/lpd/pio/etc/codepage.txt** file.

Stage–1 Translation

The example C language code shown below generates a stage–1 translation table to translate code points from a hypothetical Code Page 123 to the intermediate code page.

```
#include <piostruct.h>
#include <fcntl.h>
/*** Table to Translate Code Points for Input Code Page ***/
/*** ”123” to Code Points for the Intermediate Code Page    ***/
short table[256] = {
/* 00 (000) */ CP, CP, CP, CP,
.
.
.
/* FC (252) */ CP, SC, 126, CP };
/*** Write the Table to a File (Error Processing Not Shown) ***/
main ( ) {
int fildes;
int fmt_type = 1;
fildes = open(”/usr/lib/lpd/pio/transl/123”, O_CREAT | O_WRONLY,\
0664);
write(fildes, ”PIOSTAGE1XLATE00”, 16);
write(fildes, &fmt_type, sizeof(fmt_type));
write(fildes, table, sizeof(table));
return(0);
}
```

The `CP` at code point 252 means that the code point should be copied with no change. The `SC` at code point 253 means the character is not defined in the intermediate code page and so a substitute character should be printed instead. The `126` at code point 254 means that code point 254 should be translated to code point 126.

The **–X** flag in the **qprt** command specifies the print file's code page name. When this value is 123, the formatter reads the table from the **/usr/lib/lpd/pio/trans1/123** file and uses it for stage–1 translation.

Stage–2 Translation

In the second stage of code point translation, one or more stage–2 translation tables convert code points from the intermediate code page to those appropriate for the printer. The **t0 – t9** attributes in the database colon file specify the full path names of stage–2 translation tables. Each of the **t0 – t9** attributes can specify multiple stage–2 translation tables by separating the names with commas. The print formatter reads in the stage–2 translation tables and chains them into a ring. Beginning with the table for the current printer code page, the formatter processes each character in the input print file. The first determination is whether the character is defined in that printer code page. In other words, the code point value is not larger than the number of code points in the table, and the value is not `SC`.

If the character is in the code page, the translated code point is sent to the printer. The formatter selects the printer code page by sending the appropriate printer command string.

By convention, the printer command string's 2–character attribute name is at index 0 in the Command Names array. If the character is not in the code page, the formatter repeats the process for the next stage–2 translation table in the ring. If the formatter cannot find a translation table in the ring that can print the character, it prints a substitute character (underscore) instead.

The following example C language code generates a stage–2 translation table named `XYZ.999`, which translates code points from the intermediate code page to code points for the printer's code page. The `c1` attribute is assumed to contain the printer command string that will cause the printer to select code page `XYZ.999`.

```
#include <piostruct.h>
#include <fcntl.h>
/*** Table to Translate Code Points for the Intermediate ***/
/*** Code Page to Code Points for a Printer Code Page ***/
struct transtab table[] = {
/* 00 (000) */ {CP}, {CP}, {CP}, {CP},
.
.
.
/* FC (252) */ {63}, {CP}, {94,1}, {SC} };

/*** Command Names for the Translate Table ***/
char cmdnames[][2] = {
{'c', '1'},              /* index 0 - select the code page */
{'e', 'b'} };            /* index 1 - next byte is graphic */

/*** Write the Table To a File (Error Processing Not Shown) ***/
main() {
int fildes;
int num_commands = sizeof(cmdnames) / 2;
fildes = open("/usr/lib/lpd/pio/trans2/XYZ.999", O_CREAT |
O_WRONLY,\ 0664);
write(fildes, "PIOSTAGE2XLATE00", 16);
write(fildes, &num_commands, sizeof(num_commands));
write(fildes, cmdnames, sizeof(cmdnames));
write(fildes, table, sizeof(table));
return(0);
}
```

The `{63}` at code point 252 means that code point 252 should be translated to code point 63 before being sent to the printer. The `{CP}` at code point 253 means that code point 253 should be sent to the printer with no translation. The `{94,1}` at code point 254 means that code point 254 should be translated to code point 94 before it is sent to the printer. The `,1` in `{94,1}` indicates that the printer command string whose 2–character attribute name is at index 1 in the Command Names array should be sent to the printer before sending the code point. The `SC` at code point 255 indicates that the character at code point 255 in the intermediate code page cannot be printed by the printer code page described by this stage–2 translation table.

Printer Code Page Translation for Multibyte Code Sets

Multibyte code set (MBCS) translation from the print file to the code set differs from translation for single–byte code set (SBCS) code points. Translation from print file to code set in multibyte environments is a two–stage process.

During the first stage of code–set translation, the input code set of the print file is translated to a process code set. The process code set must be one of the MBCS code sets supported by the **iconv** subroutine and locale database (DB), examples include the IBM–932, IBM–eucTW, and IBM–eucKR code sets. During the second stage, the process code set is translated to an appropriate output code set for the printer. The **iconv** subroutine translates the code set, if the **iconv** converter for the translation exists. When the input or output code set and process code are the same, no code–set translation is performed.

The **Ti** and **To** attributes in the printer–dependent colon files define the possible flow of the translating code set. The **Ti** attribute specifies the combination of the input and process code sets:

```
[Input_code_set, ... ]Process_code_set, ...
```

The **To** attribute specifies the combination of the process and output code:

```
Process_code_set [Output_code_set0, Output_code_set1,
Output_code_set2, Output_code_set3,... ], ...
```

For example, the **To** attribute for a Japanese printer is defined as:

```
::To::IBM-932[IBM-932, IBM-932, IBM-932], ibm-eucJP[IBM-932,
IBM-932, IBM-932,IBM-932]
```

All characters of the character set ID (CSID) are printed using ROM fonts when an output code set is specified for each CSID. Otherwise, bitmap images from the Xwindows font are used. The type of Xwindows font files, including the font image of each CSID, is selected by reading a file from the **/usr/lib/X11/nls** directory.

Printer Code Page Translation Tables for Multibyte Code Sets

A translation table consists of maps between code points that are not shared by the two code sets. A printer backend can communicate with other code sets even if the code set is not supported by the **iconv** subroutine by using a translation table provided in the **/usr/lib/lpd/pio/transJP** directory.

When an input or an output code set is not supported by the **iconv** subroutine, the unsupported code set translates one of the code sets that are supported or directly to a process code set using the translation tables found in the **/usr/lib/lpd/pio/transJP** directory. Users with root authority can add new code sets for printers by creating translation tables.

The naming convention for new translation tables is *FromCodeSetName_ToCodeSetName*. All translation tables must be defined in the **trans_dir** file. The **f_cp** from code point in a translation table must be sorted in alphabetical order in advance.

The **trans_dir** and **codeset.alias** files are in the **/usr/lib/lpd/pio/transJP** directory. The **trans_dir** file format is:

```
FromCodeSetName ToCodeSetName NameofTranslationFile
```

Code set aliases are defined in the **codeset.alias** file. The **codeset.alias** file format is:

```
CodeSetName AliasName ...
```

For example, to print an MBCS file that was written with a new code set on an IBM–932 printer follow these steps:

1. Create a translation table in the **/usr/lib/lpd/pio/transJP** directory. The naming convention for the new file is *NewCodeSetName*_**IBM–932**.
2. Define the translation table in the **trans.dir** file. The format to define a new code set named *NewCodeSet* is:

   ```
   newcodeset IBM-932 newcodeset_IBM-932
   ```

3. Define the alias name in the **trans.alias** file, if needed.
4. Append the code set name as input code in a colon file, for example:

   ```
   ::Ti::[NewCodeSetName, ...]IBM-932, ...
   ```

Using Xwindows Fonts with the qprt Command

MBCS printer backends use Xwindows fonts defined in the **/usr/lib/X11/fonts** directory to print characters that are not stored in the ROM of the printer. The **–F** and **–I** (uppercase i) flags for the **qprt** command designate Xwindow fonts for the printer. The default value of these **qprt** command options are specified in the colon files as the value of the **_F** and **_I** attributes.

The **qprt –F** flag specifies a font. The full path name, font alias, or the Xwindow Logical Function Description (XLFD) of an Xwindow font can be used with the **–F** flag.

The **–I** flag follows a font path to find the Xwindow fonts and creates the **_I** attribute entry. The colon file format for the **_I** attribute is:

```
::_I::/usr/lib/X11/fonts/JP,/usr/lib/X11/fonts
```

If the user specifies another font path with the **qprt –I** command, the printer backend looks in the specified font path not in the default paths listed in the **_I** colon file. If the **–I** option has a null value, the backend assumes the default /**usr**/**lib**/**X11**/**fonts** directory.

To specify a specific Xwindows font file using a full path name, font alias, or XLFD, enter:

```
$ qprt -F '*-27-*-ibm_udcjp' foo.txt    /* XLFD names list */
$ qprt -F IBM_JPN17                     / * Font alias name */
```

This example directs the MBCS printer backend to look in the **fonts.alias** and **fonts.dir** files to find the appropriate fonts for the code set specified with the **–X** option of the **qprt** command.

Translation Table Example

```
#include <fcntl.h>
struct trans_table              /*Translation Table Structure  */
{
       unsigned int reserv1;    /* Reserved                    */
       unsigned int f_cp;       /* From code point             */
       unsigned int reserv2;    /* Reserved                    */
       unsigned int t_cp;       /* To code point               */
};
/*
*Table to translate code points for input code set(NewCodeSet)
*to code points for the process code set(IBM-932).
*/
struct trans_table table[] =
{
        {0x0,0x81ca,0x0,0xfa54},{0x0,0x9e77,0x0,0x954f},\
        {0x0,0x9e8d,0x0,0x938e},
        /*  ....    */
        [0x0,0xfad0,0x0,0x8d56}
};
/* Write the table. Error processing not shown.  */
main()
{
        int ftrans;
        long hdsize = 32;        /* Header size                */
        long cpsize = 4;         /* Code point size            */
        long rsv1 = 0, rsv2 = 0; /* Reserved area              */
ftrans = open("usr/lib/lpd/pio/transJP/newcodeset_IBM-932",
               O_CREAT | O_WRONLY, 0664);
write(ftrans, "PIOSMBCSXLATE000", 16);
write(ftrans, &hdsize, sizeof(long));
write(ftrans, &cpsize, sizeof(long));
write(ftrans, &rsv1, sizeof(long));
write(ftrans, &rsv2, sizeof(long));
write(ftrans, table, sizeof(table));
return(0);
}
```

Printer Code Page Translation for Multibyte Code Sets

Multibyte code set (MBCS) translation from the print file to the code set differs from translation for single–byte code set (SBCS) code points. Translation from print file to code set in multibyte environments is a two–stage process.

During the first stage of code–set translation, the input code set of the print file is translated to a process code set. The process code set must be one of the MBCS code sets supported by the **iconv** subroutine and locale database (DB), examples include the IBM–943, IBM–eucTW, and IBM–eucKR code sets. During the second stage, the process code set is translated to an appropriate output code set for the printer. The **iconv** subroutine translates the code set, if the **iconv** converter for the translation exists. When the input or output code set and process code are the same, no code–set translation is performed.

The **Ti** and **To** attributes in the printer–dependent colon files define the possible flow of the translating code set. The **Ti** attribute specifies the combination of the input and process code sets:

```
[Input_code_set, ... ]Process_code_set, ...
```

The **To** attribute specifies the combination of the process and output code:

```
Process_code_set [Output_code_set0, Output_code_set1,
Output_code_set2, Output_code_set3,... ], ...
```

For example, the **To** attribute for a Japanese printer is defined as:

```
::To::IBM-943[IBM-932, IBM-932, IBM-932], ibm-eucJP[IBM-932,
IBM-932, IBM-932,IBM-932]
```

All characters of the character set ID (CSID) are printed using ROM fonts when an output code set is specified for each CSID. Otherwise, bitmap images from the Xwindows font are used. The type of Xwindows font files, including the font image of each CSID, is selected by reading a file from the **/usr/lib/X11/nls** directory.

Printer Code Page Translation Tables for Multibyte Code Sets

A translation table consists of maps between code points that are not shared by the two code sets. A printer backend can communicate with other code sets even if the code set is not supported by the **iconv** subroutine by using a translation table provided in the **/usr/lib/lpd/pio/transJP** directory.

When an input or an output code set is not supported by the **iconv** subroutine, the unsupported code set translates one of the code sets that are supported or directly to a process code set using the translation tables found in the **/usr/lib/lpd/pio/transJP** directory. Users with root authority can add new code sets for printers by creating translation tables.

The naming convention for new translation tables is *FromCodeSetName_ToCodeSetName*. All translation tables must be defined in the **trans_dir** file. The **f_cp** from code point in a translation table must be sorted in alphabetical order in advance.

The **trans_dir** and **codeset.alias** files are in the **/usr/lib/lpd/pio/transJP** directory. The **trans_dir** file format is:

```
FromCodeSetName ToCodeSetName NameofTranslationFile
```

Code set aliases are defined in the **codeset.alias** file. The **codeset.alias** file format is:

```
CodeSetName AliasName ...
```

For example, to print an MBCS file that was written with a new code set on an IBM–943 printer follow these steps:

1. Create a translation table in the **/usr/lib/lpd/pio/transJP** directory. The naming convention for the new file is *NewCodeSetName*_**IBM–943**.
2. Define the translation table in the **trans.dir** file. The format to define a new code set named *NewCodeSet* is:

   ```
   newcodeset IBM-943 newcodeset_IBM-943
   ```

3. Define the alias name in the **trans.alias** file, if needed.
4. Append the code set name as input code in a colon file, for example:

   ```
   ::Ti::[NewCodeSetName, ...]IBM-943, ...
   ```

Using Xwindows Fonts with the qprt Command

MBCS printer backends use Xwindows fonts defined in the **/usr/lib/X11/fonts** directory to print characters that are not stored in the ROM of the printer. The **–F** and **–I** (uppercase i) flags for the **qprt** command designate Xwindow fonts for the printer. The default value of these **qprt** command options are specified in the colon files as the value of the **_F** and **_I** attributes.

The **qprt –F** flag specifies a font. The full path name, font alias, or the Xwindow Logical Function Description (XLFD) of an Xwindow font can be used with the **–F** flag.

The **–I** flag follows a font path to find the Xwindow fonts and creates the **_I** attribute entry. The colon file format for the **_I** attribute is:

```
::_I::/usr/lib/X11/fonts/JP,/usr/lib/X11/fonts
```

If the user specifies another font path with the **qprt –I** command, the printer backend looks in the specified font path not in the default paths listed in the **_I** colon file. If the **–I** option has a null value, the backend assumes the default **/usr/lib/X11/fonts** directory.

To specify a specific Xwindows font file using a full path name, font alias, or XLFD, enter:

```
$ qprt -F '*-27-*-ibm_udcjp' foo.txt    /* XLFD names list */
$ qprt -F IBM_JPN17                     / * Font alias name */
```

This example directs the MBCS printer backend to look in the **fonts.alias** and **fonts.dir** files to find the appropriate fonts for the code set specified with the **–X** option of the **qprt** command.

Translation Table Example

```
#include <fcntl.h>
struct trans_table              /*Translation Table Structure  */
{
       unsigned int reserv1;    /* Reserved                    */
       unsigned int f_cp;       /* From code point             */
       unsigned int reserv2;    /* Reserved                    */
       unsigned int t_cp;       /* To code point               */
};
/*
*Table to translate code points for input code set(NewCodeSet)
*to code points for the process code set(IBM-943).
*/
struct trans_table table[] =
{
        {0x0,0x81ca,0x0,0xfa54},{0x0,0x9e77,0x0,0x954f},\
        {0x0,0x9e8d,0x0,0x938e},
        /*  ....    */
        [0x0,0xfad0,0x0,0x8d56}
};
/* Write the table. Error processing not shown.  */
main()
{
        int ftrans;
        long hdsize = 32;        /* Header size                */
        long cpsize = 4;         /* Code point size            */
        long rsv1 = 0, rsv2 = 0; /* Reserved area              */
ftrans = open("usr/lib/lpd/pio/transJP/newcodeset_IBM-932",
               O_CREAT | O_WRONLY, 0664);
write(ftrans, "PIOSMBCSXLATE000", 16);
write(ftrans, &hdsize, sizeof(long));
write(ftrans, &cpsize, sizeof(long));
write(ftrans, &rsv1, sizeof(long));
write(ftrans, &rsv2, sizeof(long));
write(ftrans, table, sizeof(table));
return(0);
}
```

Printer Attachment Files

Attachment files provide a simple interface for developers of printer attachments to create System Management Interface Tool (SMIT) screens that support new printer attachments. To learn more about attachment files, see:

- Understanding the SMIT Interface
- Attachment File Naming Conventions, on page 4-42
- Structure of Attachment Files, on page 4-43
- Attachment File Field Definitions, on page 4-44

Each new attachment type is defined in an attachment file. The attachment file contains the name of SMIT object IDs used to perform various printing tasks. The name of an attachment type is limited to 10 characters.

Understanding the SMIT Interface

Attachment files direct the branching from SMIT menus to SMIT object IDs. Every attachment file controls the branching from some or all of these SMIT menu options:

- Start a Print Job
- Add a Print Queue
- Add an Additional Printer to an Existing Queue
- Change/Show Print Queue Characteristics
- Change/Show Printer Connection Characteristics
- Remove a Print Queue
- Pre–Processing Filters

For example, when the Add a Print Queue menu option is selected from a SMIT dialog screen, the first information required from the user is which attachment type is being used. The user selects the desired attachment type, and SMIT searches the attachment type file to discover which SMIT object ID file to branch to.

SMIT selectors and dialogs for new printer attachments must create dialogs that add, change, and remove a print queue for the new attachment type. The names of the new SMIT dialogs are placed in the attachment file. The dialog names in the file are automatically branched to when creating, changing, or removing queues for the new attachment type.

Attachment File Naming Conventions

Attachment files must be named according to the following naming convention:

```
Attachment_type.attach
```

The *Attachment_type* string must contain a unique string that identifies the attachment. All attachment files must be located in the **/usr/lib/lpd/pio/etc** directory. The following attachment files are supplied:

local.attach	Contains the local system attached printers file.
xsta.attach	Contains printers attached to Xstations file.
ascii.attach	Contains ASCII–terminal attached printers file.
file.attach	Contains the output–to–file attachment file.
remote.attach	Contains the remote print queues attachment file.

Structure of Attachment Files

Attachment files are ASCII files. Each line in an attachment file defines a field using the following format:

```
FieldName = Value
```

The following field names have special meanings in the attachment file:

- `description`
- `seq_num`
- `supported`
- `unsupported`

The following field names define SMIT selector IDs. The *Value* variable must contain a SMIT selector ID. The selector ID value of each field specifies the target of the branch. The SMIT fields are:

- `submit_job`
- `add_queue`
- `add_printer`
- `remove_queue`
- `printer_conn`
- `change_queue`
- `change_filters`

Every attachment file should contain the `description`, `add_queue`, and `remove_queue` fields. All other fields are optional. Fields with a null value are treated as if the field were missing. There is no restriction on the other contents of an attachment file.

The following example attachment file is named `term_serv.attach`:

```
description = term_serv.cat,1,3; Printer Attached to Terminal
Server
seq_num = 2
submit_job = term_serv_start_job
add_queue = term_serv_add
add_printer = term_serv_printer
remove_queue = term_serv_remove
printer_conn = term_serv_printer_conn
change_queue = term_serv_change
change_filters = term_serv_change_filters
unsupported = ibm6252,ibm6262
```

Attachment File Field Definitions

The following field definitions detail the attachment type fields, formats for the field values, and practical examples of field values.

`description` Specifies the description string that appears on the SMIT Attachment type menu. The SMIT Attachment type menu lists all supported attachment types on the system. This field is required in order for the attachment type to appear on any list of supported types.

The format of the description field value is:

```
Message_catalog,Set,Message_#; DefaultTextString
```

Values for `Message_catalog`, `Set`, and `Message_#` are not required. For example, the two following example entries create the same menu item in SMIT. The first example uses the `term_serv.cat` message catalog, set number `1`, and message number `3`. If the message cannot be found, SMIT uses the default text in quotes. In the second example, no message catalog is designated, and the quoted message is used in the menu automatically:

```
description = term_serv.cat,1,3; Printer
Attached to Terminal Server
```

```
description = Printer Attached to Terminal
Server
```

`seq_num` Specifies the order in which a particular attachment type is displayed in the SMIT Attachment Type Selector menu. If this field is missing, the attachments are displayed in no particular order. For example, to display the attachment in the second position on the menu, type:

```
seq_num = 2
```

`supported/unsupported` Define a list of printer types that are either supported or not supported by the attachment. The `supported` field value is used to generate the list of printers supported by the attachment type on the SMIT dialog screen. The two fields are mutually exclusive.

The format of the value for the supported and unsupported fields is a comma–separated list of printer types. For example, to exclude the `ibm6252`, `ibm6262`, and `ibm4029` printers from the list of supported printers, enter:

```
unsupported = ibm6252, ibm6262, ibm4029
```

To show the `hplj-3`, `hplj-3-si`, and `hplj-2` printers on the list of available printer types, type:

```
supported = hplj-3, hplj-3-si, hplj-2
```

`submit_job` Specifies the name of the SMIT selector ID to branch to in order to start a print job. If this field is missing, the **enq** dialog value is used. For example, to branch to the `term_ser_start_job` selector from the Start a Print Job menu option if the queue selected is of the term_serv attachment type, type:

```
submit_job = term_serv_start_job
```

`add_queue` Specifies the name of the SMIT selector ID to branch to in order to add a print queue. For example, to branch to the `term_serv_add` selector ID from the Add a Print Queue menu option, type:

```
add_queue = term_serv_add
```

`add_printer` Specifies the name of the SMIT selector ID to branch to in order to add a printer to an existing queue. Functionally, this adds an additional queue device to an existing queue. To branch to the `term_serv_printer` selector ID from the SMIT Existing Print Queue menu option, type:

```
add_printer = term_serv_printer
```

`remove_queue` Specifies the name of the SMIT selector ID to branch to in order to remove a print queue. The Remove dialog screen removes any other queues, queue devices, virtual printers, and printer devices that were created at the time the print queue was created. To branch from the Remove a Print Queue menu option to the `term_serv_remove` selector ID, type:

```
remove_queue = term_serv_remove
```

`printer_conn` Specifies the name of the SMIT selector ID to branch to in order to change the printer connection characteristics of a print queue. The port communication characteristics would typically be baud rate, parity, stop bits, and so on. To branch to the `term_serv_printer_conn` selector ID from the SMIT Printer Port Communication Characteristics menu option, type:

```
printer_conn = term_serv_printer_conn
```

`change_queue` Specifies the name of the SMIT selector ID to branch to in order to change the characteristics of a printer queue. To branch to the `term_serv_change` selector ID from the SMIT Change/Show Print Queue Characteristics menu option, type:

```
change_queue = term_serv_change
```

`change_filters` Specifies the name of the SMIT selector ID to branch to in order to change the pre–processing filters defined for a print queue. To branch to the `term_serv_change_filters` selector ID from the SMIT Change/Show Pre–Processing Filters menu option, enter:

```
change_filters = term_serv_change_filters
```

Printer Colon File limits Field Operators

The `limits` field in the colon file contains two types of information:

- SMIT dialog information
- Validation information

The SMIT dialog information is used to build SMIT objects to represent colon file attributes in the Object Data Manager (ODM) database. Objects are used in the Print a File, Printer Setup, and Default Job Characteristics dialog screens.

The `limits` field gives the creator of the colon file control over the type of ODM object built for a given attribute. All objects built for the `limits` field are part of the **sm_cmd_opt** object class. The `limits` field allows control over the following fields in a **sm_cmd_opt** object class:

- `id_seq_num`
- `entry_type`
- `cmd_to_list_mode`
- `required`
- `op_type`
- `multi_select`
- `cmd_to_list_mode`
- `disp_values`
- `aix_values`
- `values_msg_file`
- `values_msg_get`
- `help_msg_id`
- `help_msg_loc`

These attributes can be set to be displayed always, never, or only if the attribute is referenced in the pipeline. Detailed descriptions of these fields are in ”sm_cmd_opt (SMIT Dialog/Selector Command Option) Object Class” in *AIX General Programming Concepts: Writing and Debugging Programs*.

The validation information is used to validate attribute values when the colon file is digested and when a print job is submitted.

To learn more about the limits field, see the following information:

- Contents of the `limits` Field
- `limits` Field Operators

Contents of the limits Field

The `limits` field is the fourth field in the colon file. Colon file attributes have the following format:

Information in the `limits` field has two components. The first component is a single letter operator specifying an action. The letter value can be one of the following values: **C**, **D**, **E**, **F**, **G**, **H**, **I**, **L**, **M**, **Q**, **R**, **S**, **T**, or **V**. The second component is the data. If the data is more than one character, it should be enclosed in square brackets ([ ]).

For example, if the `limits` field contained `'E#'` , the **sm_cmd_opt** object class `entry_type` field equals the numeric value assigned to **#**. The `entry_type` field with a `'E#'` value takes only numeric input.

In another example, when the `limits` field contains `'[none,full,emulator=0,1,2]'` then the **sm_cmd_opt** object class contains the following values:

Field Name	**Values**
`disp_values`	`none, full, emulator`
`aix_values`	`0,1,2`

The `limits` field operators provide the following types of control in SMIT:

- Attribute display
- Characteristics of the field representing the attribute
- Attribute validation and the type of auxiliary operations (for example, pop–up menus or ring lists)

For example, in the **qprt** and **admvirprt** SMIT dialogs, the following rules apply:

- If **D***y* (the `limits` operator **D** with a value of *y* for yes) is specified in a `limits` field for an attribute, then that attribute is always displayed.
- If **D***n* (the `limits` operator **D** with a value of *n* for no) is specified in a `limits` field for an attribute, then that attribute is never displayed.

In **qprt** SMIT dialogs, the following additional rules apply:

- All attributes defined in the printer colon file that begin with a _ (underscore; for example, `_j` and _ i) that are referenced in the pipeline are displayed.
- All attributes defined in the printer colon file that begin with a C combination flag (for example, `Cs` and `Ca`) and have their combination value referenced in the pipeline are displayed.

Rules specific to the **admvirprt** SMIT dialog are as follows:

- All attributes defined in the printer colon file beginning with either an _ (underscore) or a C combination flag are displayed, unless **D***n* is specified in their `limits` field.

limits Field Operators

Definitions and examples of the `limits` field operators are organized into the following groups:

- Display Operators
- Field Characteristics Operators
- Auxiliary Operations and Validation Operators

Display Operators

C Defines how multiple flags relate within the SMIT dialog, how the options for the flags are displayed, and what flags and options are available. To support interdependent flags (for example, flags that affect typestyle and pitch), combinations of flags must be used. Typically, there is a single match between a SMIT dialog field and a command line flag. The combination flag operator allows one field in a SMIT dialog to represent more than one command line flag. Referenced flags should be marked as non–display (`Dn`) type for SMIT dialogs, so that only the combination flag is displayed instead of the individual flags.

The **C** operator syntax is:

```
C[xx,yy,...]
```

The `xx` and `yy` values are flag attributes. When a **C** attribute is defined, the `limits` field must also contain an **R** ring operator to define the pop–up list that is displayed to SMIT users. The **R** operator also defines how the options on the list map to command–line flags.

```
:111:Cs:C[_s,_p]R[Courier 10, Prestige 12= -s Courier
   -p10, -s Prestige -p12]):-s %I_s -p %I_p
:999:_s:Dn:Courier
:222:_p:Dn:10
```

In this example, the **C** operator defines that the **–s** and **–p** flags are combination attributes. The **R** ring defines that when the Courier 10 option is chosen from the pop up menu, the flags on the command line are `-s Courier -p10` . The `-s %I_s -p%I_p` attribute value is resolved when the SMIT dialog is built and determines which item in the ring is displayed as the default.

D Designates the display mode. If the value is `y` , an object is built in the **sm_cmd_opt** object class. If the value is `n` , no object is built. The **D** operator allows programmers to suppress certain flags from being displayed in SMIT. If this operator is not specified, the object is built if the flag is referenced in the input pipeline.

S Designates the sequence number in the `id_seq_num` field of the **sm_cmd_opt** object class. The sequence number controls the position of the item in relation to other items in the dialog screen. If no **S** operator is specified, the dialog starts with the ID number 100, and items are numbered in the sequence they are found in the colon file.

The value for the **S** operator can be a string with a maximum length of 16 characters. For example, the following S operator entry places the item in position 100:

```
:100:_1:S[100]:60
```

Field Characteristics Operators

E

Controls the `entry_type` field of the **sm_cmd_opt** object. The possible values for the **E** option are:

# Indicates that numerical entry is allowed.

f Indicates that a file entry is allowed. A valid file name must be specified.

n Indicates no entry is allowed. The field cannot accept typed input.

r Indicates an alphanumeric entry is allowed.

t Indicates that text entry is allowed.

x Indicates that a hexacimal entry is allowed.

To allow numerical entry into the SMIT dialog field, enter:

```
:100:_L:E#:60
```

Q

Controls the value of the `required` filed of the **sm_cmd_opt** object. The `required` field determines if the field value should be sent to the **cmd_to_exec** command for this dialog.

A single character specifies the value type. The default value is `n` which means that the flag and value for the **sm_cmd_opt** object is passed only if the field value is changed. Possible values for the `required` field are:

n Represents no. Do not send flag unless user changes the initially displayed value. The **n** value is the default.

y Represents yes. Always sends the `prefix` field and value of the `entry` field even if it is null.

+ Send the `prefix` field and value. The value must contain 1 non–blank character.

? Always send the `prefix` field and values except when the value is null.

To ensure that the `prefix` field and the value of the `entry` field is always sent to **cmd_to_exec**, enter:

```
:100:_L:Qy:60
```

Auxiliary Operations and Validation Operators

Auxiliary operations for the SMIT dialog definitions determine the type of list and input required from the user. The types of lists available in the dialogs are list, multi–select list, range list, option ring, or multi–select option ring. The `limits` field operators that specify the type of auxiliary operation used by an attribute are **L**, **M**, **G**, and **R**.

Only one type of auxiliary operation is supported at a time. The default is `op_type=n` . The `n` value means that no auxiliary operation is permitted for the field.

F

Allows control of the `cmd_to_list_mode` field of the **sm_cmd_opt** object. The `cmd_to_list_mode` field specifies how much of an item from a list should be used. The list is produced by the command specified in the `cmd_to_list` field object. For example, if the `cmd_to_list` field produced the following list:

```
60 (6 line per inch)
80 (8 line per inch)
66
```

Possible values for the **F** operator are:

a Get all fields. This is the default value.

1 Get the first field.

2 Get the second field.

To instruct SMIT to retrieve the first field from the list, enter:

```
:100:_l:F1:60
```

G Specifies a range list. The **G** operator gives the **cmd_to_list_mode** an r value. The r value specifies that the information displayed by the `cmd_to_list` field is a range of information rather than a list.

Validity checking is always done on a range. The data in a range list is in the form of *x..y* (1..30) or *..y* (..30) or *x..* (1..) where *x* and *y* are integers and specify the upper and lower bounds of a range. Validity checking ensures that the attribute value is in the range specified. The integer can be negative; however the upper bound (*y* value) must be greater than or equal to the lower boundary (*x* value). To designate that the field list operation is a range between 50 and 100, enter:

```
:100:_l:G[50..100]:60
```

H Specifies the message catalog specification for help text for a corresponding attribute. The message catalog specification includes message catalog name, set number, and message number. The help text is used in SMIT dialog that use the attributes for which help is assigned.

To assign help to a flag, **–b**, from the **pioattrl cat** dialog, enter:

```
:100:_b:H[pioattr1.cat,5,123]:60
```

I Specifies the publication specification for help text for a corresponding attribute. The publication specification includes values for the `help_msg_id` , `help_msg_base` , and `help_msg_book` fields in the **sm_cmd_opt** SMIT object class. The help text is used in the SMIT dialog that uses the attributes for which help is assigned.

To assign help to a flag, **–b**, from the publication specification, enter:

```
:100:_b:I[100145]:60
```

L Specifies that a pop–up list is displayed when the user selects F4. The pop up list allows users to select only one option from a given list of options. The pop up list is constructed from the `cmd_to_list` field values. The `op_type` field value for a pop up menu is `l` (lowercase L).

Validity checking is done only when typed user input is prohibited. The entry type for a field that does not allow direct user input is `n` . The `cmd_to_list` field returns a newline–separated list. The values from that list are compared with the attribute value.

The possible values for the **L** operator are the shell command strings for the `cmd_to_list` field. The list generated from the command is a list of output values separated by newline characters. For example:

```
:100:_l:L[print "50\n55\n60\n65"]:60
```

M Specifies a multi–select list which allows users to select more than one value from a given list of options. The **M** operator works exactly like the **L** operator list except that the `multi-select` field must be set to an `m` value.

An example of a multi–select list operator entry is:

```
:100:_l:M[print ”50\n55\n60\n65”]:60
```

R Specifies an option ring type of list. The `op_type` field is set to `r`. A ring list differs from a regular list in that the user can continue to display list options by pressing either the tab (forward) or backtab (reverse) keys. When a ring list reaches the bottom of the options, it recycles to the top of the list. The ring list recycles in forward or reverse. A ring list becomes a regular list when the F4 key is pressed.

The option ring operator can control the `disp_values`, `aix_values`, `values_msg_file`, `values_msg_set`, and `value_smg_id` fields. The no message ID, just a message ID, message set and ID, or message set, catalog and ID are valid in a ring option list.

Validity checking is done if direct entry by the user is prohibited with the entry type value set to n. The ring has hardcoded values that are either stand–alone or are mapped to AIX values.

An example of stand–alone values would include a list of possible baud rates (`'1200,2400,9600,19200'`) where the rate values themselves are used as the flag arguments.

An example of mapped values would be an attribute to designate which paper drawer on the printer is to be used. In this example, the three possible display values are lower drawer, upper drawer, and envelope feed. These possibilities are mapped to AIX flag operands `'0,1,2'`. The AIX values are passed to the executed command.

Validity checking verifies that the attribute value is within the set of hardcoded values. The following examples illustrate several types of option ring lists:

```
:100:_l:R[0,1,2]:0
:100:_l:R[none,full,emulator=0,1,2]:0
:100:_l:R[;none,full,emulator=0,1,2]:0
:100:_l:R[21,none,full,emulator=0,1,2]:0
:100:_l:R[1,21;none,full,emulator-0,1,2]:0
:100:_l:R[pioattr9.cat,1,21;none,full,emulator=0,1,2]:0
```

T Allows multiple selections to be made from a pop up list and works identical to the **R** operator. The multi–select field equals `m`.

To allow multiple choices to be made from a pop up menu, enter:

```
:100:_l:T[none,full,emulator=0,1,2]:0
```

V Specifies additional validation for any attribute. The **V** operator does not affect how an ODM stanza is built for an attribute. The data specified with the **V** operator is colon file type code (**%** operators). The **%** operators do the validation. The colon file code resolves to one value. The value is either 0 or non–zero. If the resolved value is 0, then the attribute value is valid. If the value is non–zero, then the attribute value is invalid.

To verify that the value of **_l** is in the range 0 to 100, enter:

```
:100:_l:V[%?%G_l%{100}%>%t1%e%?%G_l%{0}%<%tl%e0%;%;]:60
```

Adding Support for Configuring a Network–Attached Printer

Note: The information in this article is provided for backward compatibility only. The preferred method for adding new printer attachment definitions is through attachment files. For more information, see ”Printer Attachment Files”, on page 4-42.

The following article discusses the information you need to add support for configuring a network–attached printer. This information is not necessary to configure a network–attached printer. It shows how support can be added to allow users to configure a non–supported device that is to be attached to a network and drive one or more printers.

Overview of Adding Support for Configuring Network–Attached Printers

Network–attached printers are printer devices that are not directly attached to the host computer, but are driven by the host over the network. For example, a printer attached to an Xstation is a network–attached printer. To configure a network–attached printer with the **mkvirprt** command, you need a device configuration file.

A device configuration file extends the capability of the **mkvirprt** command for network–attached printers. Specifically, a device configuration file can support six different types of statements to create a dialog of menus and prompts. This dialog starts when you use the **mkvirprt** command; you respond to the menus and prompts. The **mkvirprt** command uses the information you enter to create a stanza in the /**etc**/**qconfig** file that is customized for the device being configured. The device configuration file controls the queue device name, **backend =** statement, and the **file =** statement in the /**etc**/**qconfig** stanza.

Naming a Device Configuration File

The device configuration file must have the filename extension **.config** and must be located in the /**usr**/**lib**/**lpd**/**pio**/**etc** directory.

Statement Types Available in a Device Configuration File

Six different types of statements provide various capabilities for the dialog created in the device configuration file:

M	Menu header for list of menu choices
m	Menu choice
l	Menu choice list
V	Prompt user for value
v	Validation pipeline for entered value and error message
T	Text to be placed in a variable or in a **backend =** statement.

Each statement consists of the following 10 fields: `type`, `label`, `gotolabel`, `reserved1`, `text`, `variable`, `reserved2`, `pipeline`, `msgid`, and `defmsg`. The following matrix

shows the statement types, and the fields they support. An x (ex) indicates that the statement supports the field. A – (minus sign) indicates that the statement does not support the field.

Device Configuration File Statement Types								
Stmt	**type**	**label**	**gotolabel**	**text**	**variable**	**pipeline**	**msgid**	**defmsg**
M	X	X	X	X	X	–	X	X
m	X	–	X	X	–	–	X	X
l	X	–	–	–	–	X	–	–
V	X	X	X	X	X	–	X	X
v	X	–	–	–	–	X	X	X
T	X	X	X	X	X	–	–	–

Note: The `reserved1` and `reserved2` fields are for future use, but are not currently active and are not shown in table above (see ”Description of Statement Fields”, on page 4-53).

Statement Format for a Device Configuration File

Statements are constructed by separating each field with a colon, as in the following format:

```
type:
label:
gotolabel:
reserved1:
text:
variable:
reserved2:
pipeline:
msgid:
defmsg
```

The specific statement formats are as follows:

Statement	Format
M	`M:label:gotolabel::text:variable:::msgid:defmsg`
m	`m::gotolabel::text::::msgid:defmsg`
l	`l:::::::pipeline::`
V	`V:label:gotolabel::text:variable:::msgid:defmsg`
v	`v:::::::pipeline:msgid:defmsg`
T	`T:label:gotolabel::text:variable::::`

Description of Statement Fields

`type`	Identifies the type of statement.
`label`	Specifies the label that identifies this statement.

`gotolabel` Specifies the label of the statement to branch to after executing this statement.

- For **M** statements, specifies the label of the statement to go to for **m** statements that do not have a `gotolabel`. If the `gotolabel` field is null, fall through.
- For **m** statements, if the `gotolabel` field is null, branch to the `gotolabel` field of the **M** statement.
- For **V** statements, if the `gotolabel` field is null, fall through.
- For **T** statements, if the `gotolabel` field is null, fall through.

`reserved1` Reserved for future use.

`text` Specifies a string of text. How the text is used depends on the statement type.

- For **M** statements, specifies that the text be placed in the **backend =** statement.
- For **m** statements, specifies the text to be placed in the **backend =** statement if the corresponding **M** statement contains a null string in the variable field.
- For **V** statements, specifies that the text be placed in the **backend =** statement.
- For **T** statements, specifies the text to be used by the variable field.

The `text` field has the special capability to execute shell commands and insert the resulting standard output (**stdout**) into the text string. Any text between a pair of back quote characters is executed as a shell command. The **stdout** resulting from the shell is inserted where the back–quoted text was.

For example, suppose the environment variable **HOME** were equal to /**home**/**guest**. If the text field was `/tmp`echo $HOME`/file`, the resulting text would be `/tmp/home/guest/file`.

> **Note:** Inside the back–quoted text \‘ (backslash, single back–quote) represents the back–quote character and \ \ (backslash, backslash) represents the backslash character.

`Variable` Indicates the name of the variable in which to store data. This field can have multiple variables separated by commas. If null, place the data in the **backend =** statement. The data to be stored depends on the statement type:

- For **M** statements, the data stored is the selection value.
- For **V** statements, the data stored is the entered value.
- For **T** statements, the data stored is the `text` field.

The environment variable used to store the data consists of the string PIO prepended to the variable name. For example, if the variable field was: `var1`, The environment variable name would be **PIOvar1**.

There are two special cases of variable names:

dname In addition to the data being stored in the **PIOdname** environment variable, it is also used as the queue device name in the /**etc**/**qconfig** file.

fname In addition to the data being stored in the **PIOfname** environment variable, it is also used as the value for the **file=** statement in the /**etc**/**qconfig** file.

`reserved2`	Reserved for future use.
`pipeline`	Specifies a shell command to execute. Specifically: • For **l** statements, specifies the shell command to run. The output of the command is constructed into a menu. • For **v** statements, specifies the shell command executed to validate the values entered. A 0 (zero) return code indicates that the entered value is valid.
`msgid`	Specifies the message to be used by this statement. The field consists of the message catalog name (*CatalogName*), set number (*SetNumber*), and message number (*MessageNumber*), separated by commas. The message catalog name and set number only need to be specified on the first statement; null strings can be used for subsequent statements.
`defmsg`	Specifies the default message text to be used if a message cannot be found in the message catalog.

Comments in a Device Configuration File

A line with a # (pound sign) character in the first column will be ignored, allowing comment lines in the config line.

First Statement in a Device Configuration File

The first statement in the device configuration file must be the **m** (menu choice) statement type. This statement specifies the menu choice displayed by the **mkvirprt** command when prompting the user for the device they wish to configure.

If the message catalog name and set number are specified in this statement, null strings can be used for the catalog name and catalog set in subsequent statements.

Setting Up Menus and Prompts in a Device Configuration File

When configuring network–attached printers, you may want to customize specific types of information. To handle this, you can set up menus and prompts in the device configuration file.

Menus

Menus can be constructed in two ways:

1. Using one **M** statement in combination with one or more **m** statements.
2. Using one **M** statement in combination with one **l** statement.

The **M** statement identifies the beginning of a menu and specifies text for the menu header, which is displayed above the menu choices.

Each **m** statement specifies a different item under the menu.

The **l** statement specifies a shell command to be executed. The **stdout** from the shell command is constructed into a menu. In the construction of the menu the `\n` (newline) character is the delimiter for menu items. For example, the shell command:

```
echo Choice1\\nChoice2\\nChoice3
```

is constructed into the menu as:

1	Choice1
2	Choice2
3	Choice3

Prompts

Prompts can be constructed using the **V** statement plus one or more **v** statements to validate the response. After the **V** statement is executed, the user's response is stored in an environment variable. The **v** statement can then be used to execute a shell command to validate the response. A 0 (zero) return code from the shell indicates no errors. A non–zero return code means an error was found; the specified message is displayed, and the user is prompted again for the input value.

Example of a Device Configuration File

Refer to the **/usr/lib/lpd/pio/etc/xsta.config** file as an example of a device configuration file. This is the file used to support Xstation configuration.

Adding a Printer Using the Printer Colon File

Prerequisite Tasks or Conditions

- The printer must be physically attached to your system.
- Compare the similarities and differences between the printer you want to add and the currently supported printers. To see a list of supported printers, use the **lsdev** (list devices) command, or refer to ”Listing All Supported and Defined Printers”, on page 2-43.
- You must understand the printer colon files and their format. ”Printer Colon File Conventions”, on page 4-20 lists the conventions for printer and attribute names and values in colon files.

Procedure

1. Select the supported printer that the new printer most closely emulates. You might need to consult the printer documentation.
2. Use the **mkvirprt** command to create a virtual printer definition by entering:

   ```
   mkvirprt
   ```

   Respond to the prompts, specifying the printer type you selected. Remember that all device names and queue names must begin with an alphabetic character.
3. Review the attribute values and descriptions with the **lsvirprt** command. Because you will need to compare these values in a later step, redirect the output to a temporary file by entering:

   ```
   lsvirprt -q QueueName -d QueueDeviceName > tempfile
   ```
4. Display the output from the **lsvirprt** command, either in another window or as a hardcopy printout.
5. Compare the attribute descriptions and values to those of the printer you are adding. Determine the changes to be made.
6. Copy the printer colon file from the Predefined Database directory (**/usr/lib/lpd/pio/predef**) to the Customized Database directory (**/var/spool/lpd/pio/@local/custom**).
7. Change the attribute values in the colon file as described in ”Adding a New Printer Type” in *AIX Kernel Extensions and Device Support Programming Concepts*. These will include the printer type (`mt` attribute), the printer description (`mL` attribute), and the printer–emulation mode (`ep` attribute).
8. Run the **chvirprt** command, specifying the queue name and the queue device name with no attribute values. This action causes a digested version of the virtual printer definition to be built.
9. Verify that the newly defined printer prints correctly.
10. If you want to create a predefined virtual printer definition, do so with the **piopredef** command.

%Sxx Pushes a pointer to the current string value for the **xx** attribute onto the stack. The only operation that can be performed on the string pointer is to use **%=** to compare the string with another string whose pointer is also on the stack.

%Lxx Pushes the length of the **xx** constant or variable string onto the stack. For example, if the value of attribute **ss** is `IJKLMN`, the sequence `ABC%Lss%dDEFG` produces the string `ABC6DEFG`. However, if **xx** is the attribute that contains the **%Lxx** sequence, the length will be the length of that part of the string that has been constructed when the **%Lxx** is encountered. For example, if the value of the **st** attribute is `ABC%Lst%dDEFG`, the constructed string for attribute **st** is `ABC3DEFG`.

Printer–Specific Information

The format and content of the header and trailer pages can be customized by editing the files containing the prototype text. These files are in the **/usr/lib/lpd/pio/burst** directory. The file names are in the format *X.yyy*, where *X* is either **H** to indicate header pages or **T** to indicate trailer pages. *yyy* indicates the type of data stream: **ascii** for ASCII, **ps** for PostScript, or **gl** for plotter emulation. For example, the file named **H.ascii** is the prototype text for header pages to be printed in ASCII, and **T.ps** is the prototype text for trailer pages to be printed in PostScript. The escape sequences used in the text files begin with the **%** (percent) character and are described with the **pioburst** command.

The following sections give you information specific to certain printers that you might need to configure and set up your printer and queue systems:

- IBM Personal Printer II Models 2380, 2381, 2390, 2391, 2380–2, 2381–2, 2390–2, 2391–2
- IBM 3812 Model 2 Page Printer
- IBM 3816 Page Printer
- IBM 4019 LaserPrinter and 4029 LaserPrinter
- IBM 4037 LaserPrinter and 4039 LaserPrinter
- IBM 4076 InkJet Printer
- IBM Proprinter Models 4201–3, 4202–3, 4207–2, 4208–2
- IBM 4072 ExecJet
- IBM 4208–502, IBM 5572–B02, IBM 5573–H02, and IBM 5579–H02/K02
- IBM 4216 Personal Page Printer, Model 031
- IBM 4216–510 and IBM 5327–011
- IBM 4234 Printer
- IBM 5202 Quietwriter III
- IBM 5204 Quickwriter
- IBM 5575–B02/F02/H02 and IBM 5577–B02/F02/FU2/G02/H02/J02/K02
- IBM 5584–G02/H02, IBM 5585–H01, IBM 5587–G01/H01, and IBM 5589–H01
- IBM 6252 Impactwriter and IBM 6252 Printer
- IBM Network Color Printer
- IBM Network Printers 12, 17, and 24
- IBM InfoPrint 20
- IBM InfoPrint 32
- IBM InfoPrint 40
- Canon Laser Shot LBP–B404PS/Lite
- Canon Laser Shot LBP–B406S/D/E/G,A404/E,A304E
- Dataproducts LZR 2665 Laser Printer
- Hewlett–Packard LaserJets II, III, IIISi, 4, 4Si, 4Plus, 4V, 4000, 5Si/5Si MX, 5SI Mopier, 8000 Color, and 8500 Color
- Lexmark 4227 Forms Printer
- Lexmark OptraLaserPrinter

- Lexmark Optra Plus LaserPrinter
- Lexmark Optra Color 1200 Printer
- Lexmark Optra Color 40 Printer
- Lexmark Optra Color 45 Printer
- Lexmark Optra K 1220 Printer
- Lexmark Optra C Color
- Lexmark Optra E LaserPrinter
- Lexmark Optra N LaserPrinter
- Lexmark Optra E310 Laser Printer
- Lexmark Optra M410 Laser Printer
- Lexmark Optra Se Laser Printer
- Lexmark Optra T Laser Printer Family
- Lexmark Optra W810 Laser Printer
- Lexmark Plus Printer Models 2380–3, 2381–3, 2390–3, 2391–3
- OKI MICROLINE 801PS/+F, 801PSII/+F, 800PSIILT
- Printronix P9012 Line Printer
- QMS ColorScript 100 Model 20 Printer
- Texas Instruments OmniLaser 2115 Page Printer

IBM Personal Printer II Models 2380, 2381, 2390, 2391, 2380–2, 2381–2, 2390–2, 2391–2

Printers purchased in Greece or Turkey have the Greek or Turkish code pages available with the printer. To print Greek or Turkish characters, you must notify the system that the code pages are available. To do this:

1. As the root user, type `smit chpq` .
2. Select the appropriate print queue and select **Printer Setup** on the Change/Show Characteristics menu.
3. Change **COUNTRY** to the appropriate country selection.

IBM 3812 Model 2 Page Printer

The system assumes that a font diskette, Feature #3155, is in the printer's diskette drive. For the support of Greek or Turkish characters, the system assumes that a Language Group 3 font diskette is in the drive.

Fonts are loaded into printer memory from a font diskette inside the printer. The system maintains a record of which fonts have been loaded, and whether the fonts in memory may have been corrupted by a print job and therefore need reloading from diskette. If the printer is turned off and then turned back on, run the **splp** command with the **–F !** flag and the device name. This notifies the system that the fonts need to be loaded into the printer's memory.

Because of space limitations on the printer's font diskette, some fonts do not contain all the characters in Code Page 850. If you need the full set of characters for Code Page 850, specify either Courier 10 (`-s courier -p 10`) or Prestige 12 (`-s prestige -p 12`) with the **qprt** command.

The 3812 Model 2 Page Printer can print on paper other than the default 8–1/2 by 11 inch size. You can change the paper size using SMIT. This is described in "Specifying Paper Size

Using SMIT", on page 2-39 . To change paper size for a single print job, specify the **–Q** flag with the **qprt** command.

If you need support for Greek or Turkish characters, complete the following steps:

1. You must have a Language Group 3 font diskette installed in the printer.
2. As the root user, type `smit chpq` .
3. Select the appropriate print queue and select **Printer Setup** on the Change/Show Characteristics menu. For the font diskette, specify:
   - `CP851` to print Greek characters.
   - `CP853` to print Turkish characters.

IBM 3816 Page Printer

The system assumes that a font diskette, Feature #7652, is in the printer's diskette drive.

Fonts are loaded into printer memory from a font diskette inside the printer. The system maintains a record of which fonts have been loaded, and whether the fonts in memory may have been corrupted by a print job and therefore need reloading from diskette. If the printer is turned off and then turned back on, run the **splp** command with the **–F !** flag and the device name. This notifies the system that the fonts need to be loaded into the printer's memory.

The 3816 Page Printer can print on paper other than the default 8–1/2 by 11 inch size. The paper size can be changed using SMIT. This is described in "Specifying Paper Size Using SMIT", on page 2-39 . To change paper size for a single print job, specify the **–Q** flag with the **qprt** command.

IBM 4019 LaserPrinter and 4029 LaserPrinter

The system selects the IBM ASCII or PCL emulation data stream without manual intervention.

The LaserPrinter can print on paper other than the default 8–1/2 by 11 inch size and on envelopes other than the default #10 envelope. The paper or envelope size can be changed using SMIT and described in "Specifying Paper Size Using SMIT", on page 2-39 . To change paper or envelope size for a single print job, specify the **–Q** flag with the **qprt** command.

If a font card is installed, the system must be alerted. To handle this:

1. As the root user, type `smit chpq` .
2. Select the appropriate print queue and select **Printer Setup** on the Change/Show Characteristics menu.
   - Specify which font card is installed in the top card slot.
   - Specify which font card is installed in the bottom card slot.

   Note: The value of the `nn` variable is the font card identifier, which is the two–digit number just above the arrow on the font card.

If a PostScript option is installed in your 4019 LaserPrinter and the PostScript option supports automatic emulation/mode switching, the printer can be configured to switch automatically between PostScript mode and emulation modes, as well as switching between emulation modes. To determine if the PostScript option installed in your printer supports this, check the guide to operations manual that came with your PostScript option. Or, verify that the PostScript interpreter is version 52.3 or later, by checking the PostScript startup page that is printed when the printer is powered on in PostScript mode (unless it has been disabled). If automatic emulation/mode switching is indicated, notify the system as follows:

1. As the root user, type `smit chpq` .

2. Select the appropriate print queue and select **Printer Setup** on the Change/Show Characteristics menu. Specify **yes** in the AUTOMATIC MODE SWITCHING for PostScript attribute.

   Notes:

   a. The Japanese Base System Locale Package must be installed to print Japanese characters.

   b. Japanese characters cannot be printed with PostScript option.

   c. To print multibyte characters, specify 16x16 or 32x32 dot font with the **–F** option using the **qprt** command. For example:

```
qprt -Pkji -F'RomanKn23,Kanji23,IBM_JPN23' file
```

IBM 4037 and IBM 4039 LaserPrinter

The system selects the IBM ASCII or PCL emulation data stream without manual intervention.

The printers can print on paper other than the default 8–1/2 by 11 inch size. The paper size can be changed using SMIT. This is described in "Specifying Paper Size Using SMIT", on page 2-39 . To change paper size for a single print job, specify the **–Q** flag with the **qprt** command.

Notes:

1. The Japanese Base System Locale Package must be installed to print Japanese characters.
2. Japanese characters cannot be printed with PostScript option.
3. To print multibyte characters, specify 16x16 or 32x32 dot font with the **–F** option using the **qprt** command. For example:

```
qprt -Pkji -F'RomanKn23,Kanji23,IBM_JPN23' file
```

IBM 4072 ExecJet

If support for Greek or Turkish characters is needed and an NLS I font card is installed, the system needs to know that the font card is installed:

1. As the root user, type `smit chpq` .
2. Select the appropriate print queue and select **Printer Setup** on the Change/Show Characteristics menu.
   - Specify which font card is installed in the left card slot.
   - Specify which font card is installed in the right card slot.

   Note: The value of the `nn` variable is the last two digits of the font card part number.

IBM 4076 InkJet Printer

The system selects the IBM ASCII or PCL emulation data stream without manual intervention.

The InkJet printer can print on paper other than the default 8–1/2 by 11 inch size and on envelopes other than the default #10 envelope. The paper and envelope size can be changed using SMIT as described in "Specifying Paper Size Using SMIT", on page 2-39 . To change paper or envelope size for a single print job, specify the **–Q** flag with the **qprt** command.

IBM Proprinter Models 4201–3, 4202–3, 4207–2, 4208–2

If support for Greek or Turkish characters is needed and the appropriate font diskette is available, install the fonts by entering, as root user:

```
piofontin -t PrinterType -c CodePage [-d  DeviceName]
```

Specifically, when issuing this command, the `PrinterType` parameter is 4201–3, 4202–3, and the `CodePage` parameter is 851 (Greek) or 853 (Turkish). The `DeviceName` parameter (for example `/dev/fd1`) is needed only if the diskette device is not `/dev/fd0` , the standard 3.5–inch diskette drive.

Note: If Greek or Turkish fonts have been installed, you must enter the following to download the fonts whenever the printer is turned off and on:

```
splp -F! xxx
```

where *xxx* is the device name of the printer, such as lp0. This instructs the system to download the Greek or Turkish font to the printer.

IBM 4208–502, IBM 5572–B02, IBM 5573–H02, and IBM 5579–H02/K02

The Japanese and Proprinter data streams are supported. To print Japanese characters, specify 24x24 dot font with the **–F** option on the **qprt** command, as follows:

```
qprt -Pkji -F/usr/lib/X11/fonts/JP/IBM_JPN17.pcf.Z file
```

IBM 4216 Personal Page Printer, Model 031

The switches on the back of the printer must be set for automatic emulation switching, as specified in Appendix B of the *Personal Page Printer II Model 031 Guide to Operations* manual.

The system selects the PostScript, Proprinter XL emulation, PCL emulation, or Diablo 630 emulation without manual intervention.

ASCII files can also be printed using the PostScript data stream.

If you attach the printer to a serial port, you may need to send a special PostScript file to the printer to establish the baud rate, parity, and protocol for the printer. The *Personal Page Printer II Model 031 Guide to Operations* manual contains a sample file.

Print queues for the Proprinter XL, PCL emulation, and Diablo 630 emulations check the first two characters of each print file. If the first two characters are **%!**, the file is assumed to be a PostScript file, and the virtual printer for PostScript is used instead of the virtual printer implied by the print queue name. If you have not configured a print queue for PostScript, the print job will fail.

If you want to print a PostScript file as an ASCII file instead of a PostScript file, specify the **–da** flag and parameter with the **qprt** command when you submit the print job for the IBM Proprinter XL, PCL emulation, or Diablo 630 emulations.

IBM 4216–510 and IBM 5327–011

The Japanese data stream is supported. To print Japanese characters, specify 24x24 dot font with the **–F** option on the **qprt** command. as follows:

```
qprt -Pkji -F/usr/lib/X11/fonts/JP/IBM_JPN17.pcf.Z file
```

IBM 4234 Printer

The system assumes that the appropriate character set (printed language) has been selected from the printer's control panel. Refer to the section on setting a printed language in the printer's operating instructions manual.

If the selected character set is not 02 (PC Multilingual):

1. Type the SMIT fast path:

```
smit chpq
```

2. Select the appropriate print queue, then select **Printer Setup** on the Change/Show Characteristics menu.
3. Select the character set for the PRINTED LANGUAGE attribute.

IBM 5202 Quietwriter III

Although this printer detects the presence of a font cartridge, the host system cannot. You must tell the system about the font cartridge in any of the following cases:

- Plug in a font cartridge that includes a font in Code Page 850.
- Print using the font.
- Print characters unique to Code Page 850 (European characters).

To tell the system about the font cartridge:

1. Type the SMIT fast path:

```
smit chpq
```

2. Select the appropriate print queue and select **Printer Setup** on the Change/Show Characteristics menu.
3. Specify **yes** for the CODE PAGE 850 attribute.

IBM 5204 Quickwriter

If a font cartridge is installed to support Greek or Turkish:

1. Type `smit chpq` as the root user.
2. Select the appropriate print queue and select **Printer Setup** on the Change/Show Characteristics menu.
3. Specify font cartridge part number for the Font Cartridge attribute. Supported values are 1301598 (Greek) and 1301614 (Turkish).

IBM 5575–B02/F02/H02 and IBM 5577–B02/F02/FU2/G02/H02/J02/K02

To print Japanese characters, specify 24x24 dot font with the **–F** option on the **qprt** command, as follows:

```
qprt -Pkji -F/usr/lib/X11/fonts/JP/IBM_JPN17.pcf.Z file
```

IBM 5584–G02/H02, IBM 5585–H01, IBM 5587–G01/H01 and IBM 5589–H01

To print Japanese characters, specify 24x24 dot font with the **–F** option on the **qprt** command, as follows:

```
qprt -Pkji -F/usr/lib/X11/fonts/JP/IBM_JPN17.pcf.Z file
```

IBM 6252 Impactwriter and IBM 6252 Printer

If the active code page for the installed print band is not Code Page 850, you must notify the system:

1. Type `smit chpq` as the root user.
2. Select the appropriate print queue and select **Printer Setup** on the Change/Show Characteristics menu.
3. Select the code page for the ACTIVE CODE PAGE attribute.

IBM Network Color Printer

The predefined files on AIX Version 4.2.1 or later only supports the IBM Network Color Printer 2.0 or higher controller code level.

Additional **qprt** option flags that are valid using only the Network Color Printer PS queue:

–e #

Specifies brightness level.

0	Default Printer Setting
1	Lightest
2	Lighter
3	Light
4	Normal
5	Dark
6	Darker
7	Darkest

–E #

Specifies the finish.

0	Default Printer Setting
1	Normal
2	Matte
3	Glossy

–k #

Specifies the color model.

0	Default Printer Setting
1	CMYK
2	Grayscale

–K #

Specifies the color rendering dictionary.

0	Default Printer Setting
1	Scanner
2	Highlight
3	Photographic
4	Presentation
5	Monitor
6	Solid Color

–S #

Specifies the print mode.

0	Default Printer Setting
1	Photo Quality
2	Business Graphics

The following valid queue names are located on the IBM Network Color Printer:

ibmcolor_direct	1.03 or 1.1 controller code and 16MB of memory.
ibmcolor_print	1.03 or 1.1 controller code and 32MB or 48MB of memory.
ibmncp_direct	2.0 or higher controller code and 16MB of memory.
ibmncp_print	2.0 or higher controller code and 32MB or 48MB of memory.

Note: To determine the controller code level and amount of memory on your IBM Network Color Printer, print a configuration page from the printer operator panel. See the configuration page under ”GENERAL INFO.” Memory is the second item, and the third item is version of the controller code. The predefined files on AIX Version 4.2.1 or later only supports the IBM Network Color Printer 2.0 or higher controller code level.

IBM Network Printer 12, 17, and 24

IBM Network Printers can print on paper other than the default 8 1/2 by 11 inch size. The paper size can be changed using SMIT as described in ”Specifying Paper Size Using SMIT”, on page 4-65 . To change paper size for a single print job, specify the **–Q** flag with the **qprt** command.

To print more lines per page than the line space allows (6 or 8 lines per inch), specify the number of lines per page. The line spacing is compressed to allow the larger number of lines to fit on a page. For example, if the line spacing is 6 lines per inch, entering the command `qprt -l 66 FileName` causes the file `FileName` to print at 66 lines per page instead of the default 60 lines per page.

The IBM Network Printer 12, 17, and 24 support the following fonts and pitches:

courier	10, 12, or 17 pitch
courier–bold	10, 12, or 17 pitch
courier–italic–bold	10, 12, or 17 pitch
lettergothic	10, 12, or 17 pitch
lettergothic–bold	10, 12, or 17 pitch
lettergothic–italic	10, 12, or 17 pitch
lineprinter	17 pitch

For example, entering the following command `qprt -s Lineprinter -p 17 FileName` causes the file `FileName` to be printed in lineprinter font at 17 pitch (17 characters per inch).

The following are the type styles for Arabic, Greek, and Hebrew:

Arabic Type Styles	Greek Type Styles	Hebrew Type Styles
typing typing–italic typing–bold typing–bold–italic	grcour grcour–oblique grcour–bold grcour–bold–oblique	shalom shalom–bold shalom–italic shalom–bold–italic
rokaa rokaa–italic rokaa–bold rokaa–bold–italic	grhelvet grhelvet–bold grhelvet–oblique grhelvet–bold–oblique	narkisstam narkisstam–bold narkisstam–italic narkisstam–bold–italic
setting setting–italic setting–bold setting–bold–italic	grtimesnr grtimesnr–bold grtimesnr–oblique grtimesnr–bold–oblique	narkissim narkissim–bold narkissim–italic narkissim–bold–italic

Note: Be sure to download the fonts to the Flash SIM or to a hard disk drive on the printer when using the Arabic, Greek, or Hebrew type styles.

The IBM Network Printer 12, 17, and 24 support the following output bins. The output bins can be accessed using the (**–=**) flag of the **qprt** command. The following table shows the possible values and the corresponding output bin destination.

–= value (#)	**destination output bin**
IBM Network Printer 12	
0	Main output tray
1	Face–up (rear) tray
IBM Network Printer 17	
0	Main output tray
1	Mail Box Bin 1
2	Mail Box Bin 2
3	Mail Box Bin 3
4	Mail Box Bin 4
5	Mail Box Bin 5
6	Mail Box Bin 6
7	Mail Box Bin 7
8	Mail Box Bin 8
9	Mail Box Bin 9
10	Mail Box Bin 10
50	Offset Bin

–= value (#)	**destination output bin**
IBM Network Printer 24	
0	Auto Output Bin
1	Main Output Tray
2	Face–up (Rear Bin)
3	Upper Finisher Bin Face–down
4	Middle Finisher Bin Face–down
5	Lower Finisher Bin Face–down
6	Upper Finisher Bin Face–up
7	Middle Finisher Bin Face–up
8	Lower Finisher Bin Face–up
9	Auto Finisher Bin Face–down

Additional **qprt** option flags that are valid using the PS or PCL queue of the Network Printer 24 only:

–e #

Specifies staple and collation. The **–e #**option flag only works if a face–down finisher bin is selected. See **–=** option flag for more information.

0	Default Printer Setting
1	Portrait Staple
2	Landscape Staple
3	Two Portrait Staples
4	Two Landscape Staples
5	Offset Jog at end of Job
6	Offset Jog at end of Set
7	No Stapling or Collating

Valid queue names located on the IBM Network Printer 12, 17, and 24 include:

TEXT	Data that requires line feed and carriage–return processing.
PASS	Data that requires no further processing.

IBM InfoPrint 20

–q #

Specifies print quality options. The –q options for the InfoPrint 20 are:

600	Specifies 600 dpi
1200	Specifies 1200dpi. This produces prints that appear to have twice the actual printer resolution. 1200dpi print quality is recommended for printing data such as images that were created at 1200dpi.

–u #

Sets the paper source. The –u options for the InfoPrint 20 are:

0	Use current input source selected on printer
1	Tray 1
2	Auxiliary tray – manual feed for paper
3	Auxiliary tray – manual feed for envelopes
4	Auxiliary tray – automatic
5	Tray 2
6	Envelope tray
7	Tray 3
9	2000 sheet input drawer

–= #

Sets type of output paper handling. The –= options for the InfoPrint 20 are:

0	Main
1	Main with Offset Option set

–Q #

Specifies paper size for the print job. The –Q options for the InfoPrint 20 are:

1	Letter
2	Legal
3	Folio
4	11 x 17
5	A4
6	B4
7	A3
8	Universal paper size
9	B5–JIS
10	A5
11	Executive
12	Statement
13	Hagaki
14	Monarch envelope
15	COM10 envelope
16	C5 envelope
17	DL envelope
18	Universal envelope size

–s Name Specifies a type style with the Name variable. Typestyles for the InfoPrint 20 are:

- courier
- courier–bold
- courier–italic
- courier–bold–italic
- gothic
- lineprinter
- gothic–bold
- gothic–italic
- prestige elite
- prestige elite–bold
- prestige elite–italic
- prestige elite–bold–italic

–= #

Type of Output Paper Handling.

0	Default Printer Setting
1	Main (Face Down)
2	Face–up (Rear Bin)
3	Finisher Bin 1 (Face Down Top)
4	Finisher Bin 2 (Face Down Middle)
5	Finisher Bin 3 (Face Down Bottom)
9	Any Finisher Bin (Face Down)

–e #

Specifies Staple/Collation.
This option flag only works if a face down finisher bin is selected (See –= option flag).

0	Default Printer Setting
1	Portrait Staple
2	Landscape Staple
3	Two Portrait Staples
4	Two Landscape Staples
5	Offset Jog at end of Job
6	Offset Jog at end of Set
7	No Stapling or Collating

–k # Specifies the number of RePro Collated Copies Printer must have a hard disk drive installed to perform this function.

–s # Name Specifies a type style with the Name variable.
Examples are courier, courier–bold, courier–italic courier–bold–italic, lettergothic, lineprinter, lettergothic–bold, lettergothic–italic, prestigeelite, prestigeelite–bold, prestigeelite–italic, and prestigeelite–bold–italic.

–u #

Sets the paper source to one of the following:

0	Use Current Input Source Selected on Printer
1	Tray 1
2	Auxiliary Tray – Manual Feed (for papers)
3	Auxiliary Tray – Manual Feed (for envelopes)
4	Auxiliary Tray (automatic)
5	Tray 2
6	Envelope Tray
7	Tray 3
8	Tray 4
9	Tray 5

–z #

Rotates page printer output the number of quarter–turns clockwise as specified by the **Value** variable. The length (–l) and width (–w) values are automatically adjusted accordingly.

0	Portrait
1	Landscape
2	Reverse Portrait
3	Reverse Landscape

–Q #

Specifies paper size for the print job

1	Letter
2	Legal
3	Folio
4	11x17
5	A4
6	B4
7	A3
8	Universal Paper Size
9	B5–JIS
10	A5
11	Executive
12	Statement
13	Hagaki
14	Monarch Envelope
15	COM10 Envelope
16	C5 Envelope
17	DL Envelope
18	Universal Envelope Size

–= #

Type of Output Paper Handling.

0	Default Printer Setting
1	Main (Face Down)
2	Face–up (Rear Bin)
3	Finisher Bin 1 (Face Down Top)
4	Finisher Bin 2 (Face Down Middle)
5	Finisher Bin 3 (Face Down Bottom)
9	Any Finisher Bin (Face Down)

–e #

Specifies Staple/Collation. This option flag only works if a face down finisher bin is selected (See **–=** option flag).

0	Default Printer Setting
1	Portrait Staple
2	Landscape Staple
3	Two Portrait Staples
4	Two Landscape Staples
5	Offset Jog at End of Job
6	Offset Jog at End of Set
7	No Stapling or Collating

–k # Specifies the number of RePro Collated Copies. Printer must have a hard disk drive installed to perform this function.

–s # Name specifies a type style with the Name variable. Examples are courier, courier–bold, courier–italic, courier–bold–italic, lettergothic, lineprinter, lettergothic–bold, lettergothic–italic, prestigeelite, prestigeelite–bold, prestigeelite–italic, and prestigeelite–bold–italic.

–u #

Sets the paper source to one of the following:

0	Use Current Input Source Selected on Printer
1	Tray 1
2	Auxiliary Tray – Manual Feed (for papers)
3	Auxiliary Tray – Manual Feed (for envelopes)
4	Auxiliary Tray (automatic)
5	Tray 2
6	Envelope Tray
7	Tray 3
8	Tray 4
9	Tray 5

–Q #

Specifies the paper size for the print job.

1	Letter
2	Legal
3	Folio
4	11x17
5	A4
6	B4
7	A3
8	Universal Paper Size
9	BJ–JIS
10	A5
11	Executive
12	Statement
13	Hagaki
14	Monarch Envelope
15	COM10 Envelope
16	C5 Envelope
17	DL Envelope
18	Universal Envelope Size

Queue Names

Valid queue names located on the IBM Network Printer 12, 17, 24, and InfoPrint 20, 32, and 40 are as follows:

TEXT	Data that requires line feed, carriage return processing
PASS	Data that requires no further processing

Canon LASER SHOT LBP–B404PS/Lite

The Japanese PostScript and ASCII data streams are supported. Japanese language text files cannot be printed.

Canon LASER SHOT LBP–B406S/D/E/G, A404/E, A304E

The Japanese code sets are supported. Do not use IBM 5575 emulation card. The **lips3** queue cannot be used for models LBP–B406S/D,A404 with LIPS II+ mode.

Dataproducts LZR 2665 Laser Printer

The data stream (PostScript, Diablo 630) must be selected manually, using the control panel. ASCII files can also be printed using the PostScript data stream.

Hewlett–Packard LaserJets II, III, IIISi, 4, 4Si, 4Plus, 4V, 4000, 5Si/5Si MX, 5Si Mopier, 8000 Color, and 8500 Color

HP LaserJet printers can print on paper other than the default 8–1/2 by 11 inch size. The paper size can be changed using SMIT as described in ”Specifying Paper Size Using SMIT”, on page 2-39 . To change paper size for a single print job, specify the **–Q** flag with the **qprt** command.

To print more lines per page than the line space allows (6 or 8 lines per inch), specify the number of lines per page. The line spacing is compressed to allow the larger number of lines to fit on a page. For example, if the lines spacing is 6 lines per inch, entering the command `qprt –l 66 FileName` causes the file `FileName` to print at 66 lines per page instead of the default 60 lines per page.

The HP LaserJet III, IIISi, and 4 support the following fonts and pitches:

courier	10, 12, or 17 pitch
courier–bold	10 or 12 pitch
courier–italic	10 or 12 pitch
lineprinter	17 pitch

For example, entering the command `qprt –s Lineprinter –p 17 FileName` causes the file `FileName` to be printed in lineprinter font at 17 pitch (17 characters per inch).

Attaching a Hewlett–Packard LaserJet printer to an RS–422A serial port requires a special cable. You can construct the cable using the following pin–out information:

Socket Connector (System End)	Signal	Pin Connector (Device End)
shell	Shield Ground	1
2	TxA	3
3	RxA	9
4	TxB	18
5	RxB	10
7	Signal Ground	7

Output Bins

The base LaserJet 5Si and 5Si Mopier printers have two possible destinations:

- **Top output bin** that prints face down.
- **Left–side output bin** that prints face up in reverse order.

If an optional High Capacity Output (HC0) device is installed, the additional trays are available as well. AIX supports up to eight of the HC0 output bins for the HP 5Si printer, and up to 5 for the HC0 output bins and a stapler bin for the 5Si Mopier.

The output bins can be accessed using the (**–=**) flag of the **qprt** command. The following table shows the possible values and the corresponding output bin destination.

LaserJet 5Si:

–= value (#)	**destination output bin**
0	Printer top/face–down bin
1	HC0 face–down bin 1
2	HC0 face–down bin 2
3	HC0 face–down bin 3
4	HC0 face–down bin 4
5	HC0 face–down bin 5
6	HC0 face–down bin 6
7	HC0 face–down bin 7
8	HC0 face–down bin 8
50	HC0 face–up
50	Printer left/face–up bin (when HC0 not installed)

LaserJet 5Si Mopier:

–= value (#)	**destination output bin**
0	Printer top/face–down bin
1	HC0 face–down bin 1
2	HC0 face–down bin 2
3	HC0 face–down bin 3
4	HC0 face–down bin 4
5	HC0 face–down bin 5
50	HC0 face–up
50	Printer left/face–up bin (when HC0 not installed)
51	Stapler bin

Number of Copies (LaserJet 5Si Mopier)

The LaserJet 5Si Mopier supports printing copies internal with the **–W** flag. This differs from the **–N** flag supported by the spooler. With the **–N** flag, copies are processed on the AIX machine and then sent to the printer one at a time. However, the **–W** option on the LaserJet 5Si Mopier sends only one copy of the print job to the printer and the copies are then produced by the printer. The basic format is: **–W #**

Output Bins

The base LaserJet 8500 Color and LaserJet 8000 printers have two possible destinations:

- **Top output bin** that prints face down.
- **Left–side output bin** that prints face up in reverse order.

If an optional High Capacity Output (HC0) device is installed, the additional trays are available as well.

The output bins can be accessed using the (**–=**) flag of the **qprt** command. The following table shows the possible values and the corresponding output bin destination.

LaserJet 8500 Color:

–= value (#)	**destination output bin**
0	Printer top/face–down bin
1	HC0 face–down bin 1
2	HC0 face–down bin 2
3	HC0 face–down bin 3
4	HC0 face–down bin 4
5	HC0 face–down bin 5
6	HC0 face–down bin 6
7	HC0 face–down bin 7
8	HC0 face–down bin 8
50	HC0 face–up
50	Printer left/face–up bin (when HC0 not installed)

LaserJet 8000:

–= value (#)	**destination output bin**
0	Printer top/face–down bin
1	HC0 face–down bin 1
2	HC0 face–down bin 2
3	HC0 face–down bin 3
4	HC0 face–down bin 4
5	HC0 face–down bin 5
6	HC0 face–down bin 6
7	HC0 face–down bin 7
8	HC0 face–down bin 8
50	HC0 face–up
50	Printer left/face–up bin (when HC0 not installed)
51	Stapler bin

Number of Copies

The LaserJet 8000 and 8500 Color printers support printing copies internal. With the **–W** flag, only one copy of the print job is sent to the printer and the copies are then produced by the printer. The basic format is: **–W #**

Paper Size

Specifies paper size for the print job.

–Q 1	Letter
–Q 2	Legal
–Q 4	A4
–Q 5	Exec
–Q 8	A3

Paper Source

Paper source selection is supported by using the **–u** flag of the **qprt** command.

–u 1	tractor 1
–u 2	tractor 2

The banner and trailer pages use the same source as the print job. It is suggested that the printer be attended when switching between tractors.

Pitch, Font, and Quality

Pitch selection is supported by using the **–p** flag for the pitch, the **–s** flag for font name, and **–q** flag of the **qprt** command for print quality. The default values supported include:

10	pitch
courier	font
quality	1 or draft

The valid font values include:

Font Name

–s	fast draft
–s	draft
–s	courier
–s	gothic

The valid quality values include:

Quality (–q flag)

0	fast draft
1	draft
2	near letter quality

The valid pitch values are 10, 12, 17, and 20.

Notes:

1. Selection of draft or fast draft will override the selected font.
2. Bold font is supported using the **–e** flag and emphasized print. Italic font is supported using the **–k** flag and italic print.

Page Width

The **–w** flag controls the width of the printable page in characters. The default is `136` .

Lexmark Optra Laser Printer

Paper Source

Paper source selection is supported for both the enhanced PCL (R) 5 emulation and the PostScript Level 2 emulation by using the **–u** flag of the **qprt** command. There are several optional input sources. The input source number is the same for both PCL and PostScript:

–u 0	manual feed
–u 1	tray 1
–u 2	tray 2
–u 3	tray 3
–u 4	feeder or feeder 1
–u 5	feeder 2

By default the banner and trailer pages come from the top tray. To change the default, change the values for the uH and/or uT attributes respectively in the colon file to the value for the desired paper source (s0–S5). Use the **lsvirprt** command.

Paper Size

Paper size selection is supported by using either one or both of the **qprt** command flags, **–O** and **–Q**. The –O flag controls paper versus envelopes. A value of 3 indicates a paper size and 4 an envelope size. Envelopes are only valid for manual feed, feeder, or feeder 2. The default for **–O** is 3 or paper. The default for **–Q** is 1 or Letter for paper sizes and Com 10 for envelope sizes.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5 paper	10 (Com 10)
–Q 4 A4	DL
–Q 5 Executive	C5
–Q 6 A5	B5 Envelope
–Q 7	Other Envelope

Paper Type

The Optra printer supports paper types: rough, normal (default), transparency, labels, and cardstock using the **–y** parameter of the **qprt** command or the _y attribute in the colon file.

–y 1	Rough
–y 2	Normal (default)
–y 3	Transparency
–y 4	Labels
–y 5	Cardstock

Print Resolution

The Optra plus printer supports print resolution of 300, 600, and 1200 dpi using the –q flag of the **qprt** command. The default is 600 dpi.

–q	300
–q	600
–q	1200

Pitch

Pitch selection is supported for the PCL 5 emulation by using the **–p** flag for pitch and the **–s** flag for font name with the qprt command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bold italic	**–p** (1 to 100)
–s gothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–sgothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a PostScript queue. For postscript queues, **–p** stands for point size and the valid list of fonts are located in /**usr**/**lib**/**ps**/**fontmap**. Valid point sizes are any integer from 1 to 1008.

Also, only a pitch of 17 is supported for the lineprinter font style.

Duplex Mode

The optional duplex feature is supported by the **–Y** flag of the **qprt** command.

–Y 0	simplex
–Y 1	duplex, long–edge binding
–Y 2	duplex. short–edge binding

Lexmark Optra Plus LaserPrinter

Paper Source

Paper source selection is supported for both the enhanced PCL (R) 5 emulation and the PostScript Level 2 emulation by using the **–u** flag of the **qprt** command. There are several optional input sources. The input source number is the same for both PCL and PostScript:

–u 0	manual feed
–u 1	tray 1
–u 2	tray 2
–u 3	tray 3
–u 4	feeder or feeder 1
–u 5	feeder 2

By default the banner and trailer pages come from the top tray. To change the default, change the values for the uH and/or uT attributes respectively in the colon file to the value for the desired paper source (s0–S5). Use the **lsvirprt** command.

Paper Size

Paper size selection is supported by using either one or both of the **qprt** command flags, **–O** and **–Q**. The **–O** flag controls paper versus envelopes. A value of 3 indicates a paper size and 4 an envelope size. Envelopes are only valid for manual feed, feeder, or feeder 2. The default for **–O** is 3 or paper. The default for **–Q** is 1 or Letter for paper sizes and Com 10 for envelope sizes.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5 paper	10 (Com 10)
–Q 4 A4	DL
–Q 5 Executive	C5
–Q 6 A5	B5 Envelope
–Q 7	Other Envelope

Paper Type

The Optra Plus printer supports paper types: rough, normal (default), transparency, labels, and cardstock using the **–y** parameter of the **qprt** command or the _y attribute in the colon file.

–y 1	Rough
–y 2	Normal (default)
–y 3	Transparency
–y 4	Labels
–y 5	Cardstock

Print Resolution

The Optra Plus printer supports print resolution of 300, 600, and 1200 dpi using the **–q** flag of the **qprt** command. The default is 600 dpi.

–q	300
–q	600
–q	1200

Pitch

Pitch selection is supported for the PCL 5 emulation by using the **–p** flag for pitch and the **–s** flag for font name with the qprt command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–scourier–bold	**–p** (1 to 100)
–scourier–italic	**–p** (1 to 100)
–scourier–bold italic	**–p** (1 to 100)
–sgothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–sgothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a PostScript queue. For postscript queues, **–p** stands for point size and the valid list of fonts are located in /**usr**/**lib**/**ps**/**fontmap**. Valid point sizes are any integer from 1 to 1008.

Also, only a pitch of 17 is supported for the lineprinter font style.

Duplex Mode

The optional duplex feature is supported by the **–Y** flag of the **qprt** command.

–Y 0	simplex
–Y 1	duplex, long–edge binding
–Y 2	duplex, short–edge binding

Collation

The Optra Plus printer supports collation of multiple copies of a print job internally. This feature is controlled by the **–W** and **–S** flags of the **qprt** command.

–S ! collation off

–S + collation on

–S # number of copies

Note: This function is independent of the **–N** flag of the **qprt** command. The **–N#** flag will cause the printer job to be sent to the printer # times. The **–W#** will send the print job once, and # copies of the job will be printed.

Separator Pages

The Optra Plus printer supports internally generated separator pages. This feature is controlled by the –E flag of the **qprt** command.

–E 0 None

–E Between Copies

–E 2 Between Jobs

–E 3 Between Pages

The paper source defaults to Feeder. To change the default, the uS attribute must be changed in the virtual printer. The valid values for uS are the same as the paper source flag **–u** except that manual feed is not a valid source.

Note: This function is independent of the **–B** flag of the **qprt** command.

Lexmark Optra Color 1200 Printer

Paper Source

Paper source selection is supported for both the PCL 5 emulation and the PostScript Language by using the **–u** flag of the qprt command.

–u 0 manual feed

–u 1 tray 1

–u 2 tray 2

–u 3 tray 3

–u 4 multipurpose feeder

By default the banner and trailer pages come from the tray 1. To change the default, change the values for the uH and/or uT attributes respectively in the colon file to the value for the desired paper source. Valid values are the same as for the –u flag. Do this by editing the virtual printer colon file by using the ”chvirprt” command.

Paper Size

Paper size selection is supported by using the qprt command flags, **–O** and **–Q**. The **–O** flag controls paper versus envelope. A –O value of 3 indicates a paper size and 4 an envelope size. The values 1 and 2 were skipped for backward compatibility. The first five paper sizes are also numbered for backward compatibility. Whenever an invalid value for the input source is selected, it will be ignored.

Note: Envelopes are available through Manual and MP Tray only.

The default for **–O** is **3** or paper. The default for **–Q** is **1** or Letter for paper sizes and Monarch for envelope sizes.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5	10 (Com 10)
–Q 4 A4	DL
–Q 5 A5	C5
–Q 6 B4	B5 Envelope
–Q 7 A3	Other Envelope
–Q 8 11 X 17	–

Note: The printer file (lexOptraC1200.pcl) for PCL 5 defaults the paper size to letter. To change the default size, change the values for the s0–s3 attributes in the file respectively for the _u (paper source) attributes. For example, to make legal the default size for tray 2 change the s2 attribute value to 2.

SPECIAL NOTE: For PCL queues, if the selected size is not in the selected input source, a search sequence will be used to find the size requested. If the size is found that source will be used. For PostScript queues, if the selected size is not in the selected input source, the printer will prompt the user to load the source with the appropriate size. This may result in an unexpected paper source being used or an op–panel message that may not make sense at first. Please refer to the manual to determine appropriate responses.

Pitch

Pitch selection is supported for the PCL emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face). Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–scourier–bold	**–p** (1 to 100)
–scourier–italic	**–p** (1 to 100)
–scourier–bold italic	**–p** (1 to 100)
–sgothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–sgothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII files for other font styles use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a Postscript queue. For Postscript queues, –p stands for point size and the valid list of fonts can be found in **/usr/lib/ps/fontmap**. Valid point sizes are any integer from 1 to 1008.

Only a pitch of 17 is supported for the lineprinter font style.

Collation

Normally, the **–N** command line option is used to specify the number of copies desired. This method will cause that many copies of the entire print job to be submitted or queued to the print system. Since the Optra Color 1200 supports collation internally, options were added to support it and the number of copies of each page internally. This functionality– is limited by the amount of memory installed in your printer and the size of the job. The **–W#** option determines how many copies of each page is desired, where # is the number of copies. The **–S [!/+]** option controls whether collation is desired. The default is ! (or not). The main advantages of using the **–W** and **–S** options are to conserve printer subsystem usage and allow the printer to handle multiple copies instead of sending # copies to the printer. Using the **–S!** options with **–W#** also allows # copies of each page in a row, if that is desired. Note that using **–N** and **–W** simultaneously is allowed. This would result in –N print jobs with **–W** copies of each page in each job.

Separator Pages

The **–E** flag controls separator pages. The valid values are **0**, **1**, 2, and **3** which represent **NONE**, **BETWEENCOPIES**, **BETWEENJOBS**, and **BETWEENPAGES** respectively. The paper source for separator pages is set via the colon file attribute **uS** and defaults to TRAY 1. The valid values for **uS** are the same as **uH** and **uT**, except manual feed is not a valid source for separator pages. To change the default the **uS** attribute must be changed in the virtual printer to one of the valid values (see paper source above).

Paper Source

Paper source selection is supported for both the PCL 5 emulation and the PostScript Language by using the **–u** flag of the qprt command.

–u 0	manual feed
–u 1	tray 1

Paper Size

Paper size selection is supported by using the qprt command flags, **–O** and **–Q**. The **–O** flag controls paper versus envelope. A –O value of 3 indicates a paper size and 4 an envelope size. The values 1 and 2 were skipped for backward compatibility. The first five paper sizes are also numbered for backward compatibility. Whenever an invalid value for the input source is selected, it will be ignored.

Note: Envelopes available from Manual and Tray 1

The default for **–O** is **3** or paper. The default for **–Q** is 1 or Letter for paper sizes and Monarch for envelope sizes.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5	10 (Com 10)
–Q 4 A4	DL
–Q 5 Executive	C5
–Q 6 A5	B5 Envelope
–Q 7 Universal	Other Envelope

Note: The printer file (lexOptraC40.pcl) for PCL 5 defaults the paper size to letter. To change the default size, change the values for the s0–s3 attributes in the file respectively for the _u (paper source) attributes. For example, to make legal the default size for tray 2 change the s2 attribute value to 2.

Note: For PCL queues, if the selected size is not in the selected input source, a search sequence will be used to find the size requested. If the size is found that source will be used. For PostScript queues, if the selected size is not in the selected input source, the printer will prompt the user to load the source with the appropriate size. This may result in an unexpected paper source being used or an op–panel message that may not make sense at first. Please refer to the manual to determine appropriate responses.

Pitch

Pitch selection is supported for the PCL emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face). Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–scourier–bold	**–p** (1 to 100)
–scourier–italic	**–p** (1 to 100)
–scourier–bold italic	**–p** (1 to 100)
–sgothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–sgothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII files for other font styles use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a Postscript queue. For Postscript queues, –p stands for point size and the valid list of fonts can be found in **/usr/lib/ps/fontmap**. Valid point sizes are any integer from 1 to 1008.

Only a pitch of 17 is supported for the lineprinter font style.

Collation

Normally, the **–N** command line option is used to specify the number of copies desired. This method will cause that many copies of the entire print job to be submitted or queued to the print system. Since the Optra Color 40 supports collation internally, options were added to support it and the number of copies of each page internally. This functionality– is limited by the amount of memory installed in your printer and the size of the job. The **–W#** option determines how many copies of each page is desired, where # is the number of copies. The **–S [!/+]** option controls whether collation is desired. The default is ! (or not). The main advantages of using the **–W** and **–S** options are to conserve printer subsystem usage and allow the printer to handle multiple copies instead of sending # copies to the printer. Using the **–S!** options with **–W#** also allows # copies of each page in a row, if that is desired. Note that using **–N** and **–W** simultaneously is allowed. This would result in –N print jobs with **–W** copies of each page in each job.

Separator Pages

The **–E** flag controls separator pages. The valid values are **0**, **1**, 2, and **3** which represent **NONE**, **BETWEENCOPIES**, **BETWEENJOBS**, and **BETWEENPAGES** respectively. The paper source for separator pages is set via the colon file attribute **uS** and defaults to TRAY 1. The valid values for **uS** are the same as **uH** and **uT**, except manual feed is not a valid source for separator pages. To change the default the **uS** attribute must be changed in the virtual printer to one of the valid values (see paper source above).

Paper Source

Paper source selection is supported for both the PCL 5 emulation and the PostScript Language by using the **–u** flag of the qprt command.

–u 0	manual feed
–u 1	tray 1

Paper Size

Paper size selection is supported by using the qprt command flags, **–O** and **–Q**. The **–O** flag controls paper versus envelope. A **–O** value of 3 indicates a paper size and 4 an envelope size. The values 1 and 2 were skipped for backward compatibility. The first five paper sizes are also numbered for backward compatibility. Whenever an invalid value for the input source is selected, it will be ignored.

Note: Envelopes available from Manual and Tray 1

The default for **–O** is **3** or paper. The default for **–Q** is 1 or Letter for paper sizes and Monarch for envelope sizes.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5	10 (Com 10)
–Q 4 A4	DL
–Q 5 A5	C5
–Q 6 Executive	B5 Envelope
–Q 7 A3	Other Envelope
–Q 8 11 X 17	–
–Q 9 Universal	–

Note: The printer file (lexOptraC45.pcl) for PCL 5 defaults the paper size to letter. To change the default size, change the values for the s0–s3 attributes in the file respectively for the _u (paper source) attributes. For example, to make legal the default size for tray 2 change the s2 attribute value to 2.

Note: For PCL queues, if the selected size is not in the selected input source, a search sequence will be used to find the size requested. If the size is found that source will be used. For PostScript queues, if the selected size is not in the selected input source, the printer will prompt the user to load the source with the appropriate size. This may result in an unexpected paper source being used or an op–panel message that may not make sense at first. Please refer to the manual to determine appropriate responses.

Pitch

Pitch selection is supported for the PCL emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face). Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–scourier–bold	**–p** (1 to 100)
–scourier–italic	**–p** (1 to 100)
–scourier–bold italic	**–p** (1 to 100)
–sgothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–sgothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII files for other font styles use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a Postscript queue. For Postscript queues, –p stands for point size and the valid list of fonts can be found in **/usr/lib/ps/fontmap**. Valid point sizes are any integer from 1 to 1008.

Only a pitch of 17 is supported for the lineprinter font style.

Collation

Normally, the **–N** command line option is used to specify the number of copies desired. This method will cause that many copies of the entire print job to be submitted or queued to the print system. Since the Optra Color 45 supports collation internally, options were added to support it and the number of copies of each page internally. This functionality– is limited by the amount of memory installed in your printer and the size of the job. The **–W#** option determines how many copies of each page is desired, where # is the number of copies. The **–S [!/+]** option controls whether collation is desired. The default is ! (or not). The main advantages of using the **–W** and **–S** options are to conserve printer subsystem usage and allow the printer to handle multiple copies instead of sending # copies to the printer. Using the **–S!** options with **–W#** also allows # copies of each page in a row, if that is desired. Note that using **–N** and **–W** simultaneously is allowed. This would result in –N print jobs with **–W** copies of each page in each job.

Separator Pages

The **–E** flag controls separator pages. The valid values are **0**, **1**, 2, and **3** which represent **NONE**, **BETWEENCOPIES**, **BETWEENJOBS**, and **BETWEENPAGES** respectively. The paper source for separator pages is set via the colon file attribute **uS** and defaults to TRAY 1. The valid values for **uS** are the same as **uH** and **uT**, except manual feed is not a valid source for separator pages. To change the default the **uS** attribute must be changed in the virtual printer to one of the valid values (see paper source above).

Paper Source

Paper source selection is supported for both the ”enhanced PCL (R) 5e emulation” and the ”PostScript (tm) Level 2 emulation” by using the **–u** flag of the qprt command. There are several optional input sources (see your manual to determine which are installed). These numbers apply, no matter which ones are present. If one is not present, choosing one of those will simply default as per the user’s manual. The input source number is the same for both PCL and PostScript:

–u 0	manual feed
–u 1	tray 1
–u 2	tray 2
–u 3	multipurpose tray

By default the banner and trailer pages come from tray 1. To change the default, change the values for the **uH** and/or **uT** attributes respectively in the virtual printer to the value for the desired paper source. Do this via the command ”chvirprt”. Valid values are the same as for the **–u** flag.

Paper Size

Paper size selection is supported by using either one or both of the qprt command flags, **–O** and **–Q**. The **–O** flag controls paper versus envelope. A value of 3 indicates a paper size and 4 an envelope size. The values 1 and 2 were skipped for backward compatibility. Envelopes are only valid for manual feed, envelope feeder, or the multipurpose tray. The default for **–Q** is 1 or Letter for paper sizes and 3 or Com 10 for envelope sizes. To change the defaults change the **s0 – s7** attributes respectively for each of the valid input sources. Since manual feed and the multipurpose tray support both paper and envelopes, the default for paper is the ”else” part (%e1) and the default for envelopes is the ”then” part (%t3) of **s0** and **s7**.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5 (JIS B5)	10 (Com 10)
–Q 4 A4	DL
–Q 5 Executive	C5
–Q 6 A5	B5 Envelope
–Q 7 Custom (Universal)	Other Envelope

Note: For PCL queues, if the selected size is not in the selected input source, a search sequence will be used to find the size requested. If the size is found that source will be used. For PostScript queues, if the selected size is not in the selected input source, the printer will prompt the user to load the source with the appropriate size. This may result in an unexpected paper source being used or an op–panel message that may not make sense at first. Please refer to the manual to determine appropriate responses.

Pitch

Pitch selection is supported for the PCL emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face). Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–scourier–bold	**–p** (1 to 100)
–scourier–italic	**–p** (1 to 100)
–scourier–bold italic	**–p** (1 to 100)
–sgothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–sgothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII files for other font styles use the AIX enscript utility or the **–da** flag to a Postscript queue with the qprt command. Also, only a pitch of 17 is supported for the lineprinter font style.

Only a pitch of 17 is supported for the lineprinter font style.

Collation

Normally, the **–N** command line option is used to specify the number of copies desired. This method will cause that many copies of the entire print job to be submitted or queued to the print system. Since the Optra K 1220 supports collation internally, options were added to support it and the number of copies of each page internally. This functionality is limited by the amount of memory installed in your printer and the size of the job. The **–W#** option determines how many copies of each page is desired, where # is the number of copies. The **–S [!/+]** option controls whether collation is desired. The default is ! (or not). The main advantages of using the **–W** and **–S** options are to conserve printer subsystem usage and allow the printer to handle multiple copies instead of sending # copies to the printer. Using the **–S!** options with **–W#** also allows # copies of each page in a row, if that is desired. Note that using **–N** and **–W** simultaneously is allowed. This would result in –N print jobs with **–W** copies of each page in each job.

Separator Pages

The **–E** flag controls separator pages. The valid values are **0**, **1**, 2, and **3** which represent **NONE**, **BETWEENCOPIES**, **BETWEENJOBS**, and **BETWEENPAGES** respectively. The paper source for separator pages is set via the colon file attribute **uS** and defaults to TRAY 1. The valid values for **uS** are the same as **uH** and **uT**, except manual feed is not a valid source for separator pages. To change the default the **uS** attribute must be changed in the virtual printer to one of the valid values (see paper source above).

Lexmark Optra C Color LaserPrinter

Printing Color Files in PCL 5 Emulation Mode

To print color files, or any preformatted print job in PCL language, use the **–dp** flag of the **qprt** command. This sets the AIX printer backend to passthrough mode and should be used any time you are printing from an application in PCL emulation.

The print queue default can be changed to passthrough by modifying the _d attribute in the colon file. See *AIX Commands Reference, Volume 3* for information about the **lsvirprt** command.

Paper Source

Paper source selection is supported for both the PCL 5 emulation and the PostScript Language by using the **–u** flag of the **qprt** command.

PCL	PostScript
–u 1 Top tray	**–u** 1 Top tray
–u 2 Bottom tray	**–u** 2 Bottom tray
–u 3 feeder	**–u** 3 feeder

Paper Size

Paper size selection is supported for the PCL 5 emulation by using the **–Q** flag of the **qprt** command.

Paper Sizes	Size
–Q 1	Letter (default)
–Q 2	Legal
–Q 3	B5
–Q 4	A4

To change the default size, change the values for the s1–s3 attributes in the file. For example, to make A4 the default size for all paper sources, change s1, s2, and s3 to 4. This changes the top tray, bottom tray, and feeder tray sizes respectively.

Pitch

Pitch selection is supported for the PCL 5 emulation by using the **–p** flag for pitch and the **–s** flag for font name with the qprt command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bold italic	**–p** (1 to 100)
–s gothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–s gothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a PostScript queue. For postscript queues, **–p** stands for point size and the valid list of fonts are located in /**usr**/**lib**/**ps**/**fontmap**. Valid point sizes are any integer from 1 to 1008.

Also, only a pitch of 17 is supported for the lineprinter font style.

Collation

The Optra C printer supports collation of multiple copies of a print job internally. This feature is controlled by the **–W** and **–S** flags of the qprt command.

–S !	collation off
–S+	collation on
–S+	number of copies

Note: This function is independent of the **–N** flag of the **qprt** command. The **–N#** flag will cause the print job to be sent to the printer # times. The **–W#** will send the print job once, and # copies of the job will be printed.

Separator Pages

The Optra C printer supports internally generated separator pages. This feature is controlled by the –E flag of the **qprt** command.

–E 0	None
–E 1	Between Copies
–E 2	Between Jobs
–E 3	Between Pages

The paper source defaults to Feeder. To change the default, the uS attribute must be changed in the virtual printer. The valid values for uS are the same as the paper source flag.

Note: This function is independent of the **–B** flag of the **qprt** command.

Lexmark Optra E LaserPrinter

Paper Source

Paper source selection is supported for both the PCL 5 emulation and the PostScript Language by using the **–u** flag of the **qprt** command.

PCL

–u 1	manual feed
–u 2	top tray
–u 3	bottom tray

By default the banner and trailer pages come from the top tray. To change the default, change the values for the uH and/or uT attributes respectively in the colon file to the value for the desired paper source (s1–s3). Use the **lsvirprt** command.

Paper Size

Paper size selection is supported for the PCL 5 emulation by using the **–Q** and **–O** flags of the **qprt** command. A value of 3 for the **–O** flag indicates paper and a value of 4 indicates envelope. Envelopes are not valid in tray 2.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5 paper	10 (Com 10)
–Q 4 A4	DL
–Q 5	Executive C5
–Q 6 A5	B5 Envelope
–Q 7	Other Envelope

Note: The printer file (**optra_e.pcl**) for PCL 5 defaults the paper size to letter. To change the default size, change the values for the s1–s3 attributes in the file. For example, to make A4 the default size for all paper sources, change s1, s2, and s3 to 4. This changes the top tray, bottom tray, and feeder tray sizes respectively.

Paper Type

The Optra E printer supports paper types: rough, normal (default), transparency, labels, and cardstock using the **–y** parameter of the **qprt** command or the _y attribute in the colon file.

–y 1	Rough
–y 2	Normal (default)
–y 3	Transparency
–y 4	Labels
–y 5	Cardstock

Note: These values apply only to paper and not envelopes. The only values supported for tray 2 are rough and normal.

Print Resolution

The Optra E printer supports print resolution of 300 and 600 dpi using the **–q** flag of the **qprt** command. The default is 300 dpi.

–q	300
–q	600

Pitch

Pitch selection is supported for the PCL 5 emulation by using the **–p** flag for pitch and the **–s** flag for font name with the qprt command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bold italic	**–p** (1 to 100)
–sgothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–s gothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a PostScript queue. For postscript queues, **–p** stands for point size and the valid list of fonts are located in /**usr**/**lib**/**ps**/**fontmap**. Valid point sizes are any integer from 1 to 1008.

Also, only a pitch of 17 is supported for the lineprinter font style.

Number of Copies for Each Page

The **–W** flag allows the user to control how many copies of each page is produced by the printer itself. For example, if a three–page job is submitted with the **–W** flag of the **–qprt** command, then 2 copies of page one, followed by 2 copies of page two, followed by 2 copies of page three will be printed. The default value is 1, and the maximum value is 999.

Paper Source

Paper source selection is supported for both the enhanced PCL (R) 5 emulation and the PostScript Level 2 emulation by using the **–u** flag of the **qprt** command. There are several optional input sources (refer to your printer documentation to determine which are installed). The optional input sources apply no matter which ones are installed. If one is not present, choosing one will use the default. The input source number is for both PCL and PostScript:

–u 0	manual feed
–u 1	tray 1
–u 2	tray 2
–u 3	tray 3
–u 4	envelope feeder
–u 5	multipurpose tray

Paper Size

Paper size selection is supported by using **–O** and **–Q** flags of the **qprt** command. The **–O** flag controls paper versus envelope. A **–O** value of 3 indicates a paper size and 4 an envelope size. The values 1 and 2 were skipped for backward compatibility. The first five paper sizes are also numbered for backward compatibility. Whenever an invalid value for the input source is selected, it is ignored.

The default for **–O** is 3 or paper. The default for **–Q** is 1 or Letter for paper sizes and Monarch for envelope sizes.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5 paper	10 (Com 10)
–Q 4 A4	DL
–Q 5 Executive	C5
–Q 6 A5	B5 Envelope
–Q 7 B4	Other Envelope (MPT only)
–Q 8 A3	
–Q 9 Ledger (11x17)	
–Q 10 Custom (11.69x17.69)	

To change the defaults, change s0 – s5 attributes for each valid input value. Since manual feed, envelope feeder, and the multipurpose tray support both paper and envelopes, to change the defaults, edit s0, s4, or s5. For these three, the default for paper is the ”else” part (%e1), and the default for envelopes is the ”then” part (%t3).

Notes:

1. Envelopes are only valid for manual feed, envelope feeder, or the multipurpose tray.
2. Trays 1, 2, and 3 support only paper sizes.
3. The multipurpose tray (MPT) supports both paper and envelopes.
4. Tray 1 supports sizes –Q 1, 2, 4, and 7 (Letter, Legal, A4, and B4).
5. Trays 2 and 3 support sizes –Q 1, 2, 4, 7, 8, 9 (Letter, Legal, A4, B4, A3, Ledger).
6. The multipurpose tray supports all sizes of paper and envelopes.
7. The other envelope size is supported only by the multipurpose tray.
8. The printer and colon file defaults paper size to Letter for the US and A4 for Europe, and envelope size to COM10 for the US and DL for Europe.
9. Whenever an invalid value for the input source is selected, an error will be reported.
10. If the selected size is not in the input source selected (wrong size or empty), a search sequence is used to find the size requested. Refer to your printer documentation for more information.

Pitch

Pitch selection is supported for the PCL 5 emulation by using the **–p** flag for pitch and the **–s** flag for font name with the qprt command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bold italic	**–p** (1 to 100)
–s gothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–s gothic–italic	**–p** (1 to 100)
–slineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a PostScript queue. For postscript queues, **–p** stands for point size and the valid list of fonts are located in /**usr**/**lib**/**ps**/**fontmap**. Valid point sizes are any integer from 1 to 1008.

Also, only a pitch of 17 is supported for the lineprinter font style.

Duplex Mode

The optional duplex feature is supported by the **–Y** flag of the **qprt** command.

–Y 0	simplex
–Y 1	duplex, long–edge binding
–Y 2	duplex, short–edge binding

Collation and Number of Copiess

The Optra N printer supports collation of multiple copies of a print job internally. This feature is controlled by the **–W** and **–S** flags of the **qprt** command.

–S !	collation off
–S +	collation on
–W #	number of copies

Notes:

1. This function is independent of the **–N** flag of the **qprt** command. The **–N#** flag causes the printer to send the job to the printer # times. The **–W#** sends the print job once, and # copies of the job are printed.
2. The function is limited by the amount of memory installed in the printer and the size of the print job.

Separator Pages

The Optra N printer supports internally generated separator pages. This feature is controlled by the **–E** flag of the **qprt** command.

–E 0	None
–E 1	Between Copies
–E 2	Between Jobs
–E 3	Between Pages

The paper source defaults to tray 1. To change the default, the uS attribute must be changed in the virtual printer. The valid values for uS are:

uS 1	tray 1
uS 2	tray 2
uS 3	tray 3
uS 4	envelope feeder
uS 5	multipurpose tray

Note: This function is independent of the **–B** flag of the **qprt** command.

Output Bin

The equal sign (**=**) is the command line option for specifying the output destination. Valid values are:

0	printer top bin
1	finisher bin 1
2	finisher bin 2
3	finisher bin 3
50	printer side bin

The printer top bin or 0 is the default value for the output bin.

Note: If the printer side bin is selected and the finisher option is installed, the output will go to the active bin.

Faceup or Facedown

The **–U** option controls whether paper is output faceup or facedown for the finisher.

Note: The printer top bin is always facedown. A value of + or true indicates facedown and is the default. A value of ! or false indicates faceup. If faceup is selected the staples (**–y**) and job offset (**–e**) are ignored.

Staples

The **–y** option controls whether staples are desired or not. Only certain paper sizes are supported for each of the values for this flag. Also, there are several rules about output quantities and destinations. Refer to printer documentation for details on all the possibilities. The valid values are:

0	no staples (default)
1	one staple (top left)
2	two staples (left side)

Job Offset

The **–e** flag controls whether offsetting the first page of each job in the finisher bin is desired. The first page is offset toward the front of the finisher by 1.7 inches. The offset function is ignored if staples are not off. Separator sheets may be selected independently of offset. The valid values are:

+	job offset ON
!	job offset OFF (default)

Lexmark Optra E310 Laser Printer

Page Rotation

Page rotation selection is supported for the PCL 5 emulation by using the **–z** flag of the **qprt** command.

–z 0	Portrait
–z 1	Landscape

Paper Source

Paper source selection is supported for both the enhanced PCL 5 emulation and the PostScript Level 2 emulation by using the **–u** flag of the **qprt** command. The input source number is the same for both PCL and PostScript:

–u 0	manual feed
–u 1	tray 1

By default, the banner and trailer pages come from the top tray. To change the default, change the values for the **uH** and/or **uT** attributes respectively in the colon file to the value for the desired paper source. The valid values are the same as for the **–u** flag. Do this by editing the virtual printer colon file by using the **chvirprt** command.

Paper Size

Paper size selection is supported by using **–O** and **–Q** flags of the **qprt** command. The **–O** flag controls paper versus envelope. A **–O** value of 3 indicates a paper size and 4 an envelope size.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5	10 (Com 10)
–Q 4 A4	DL
–Q 5 Executive	C5
–Q 6 A5	B5 Envelope
–Q 7	Other Envelope (MPT only)

To change the defaults, change the **s1, s3** attribute values in the lexOptraE310.pcl colon file. The default for paper size is 1 or letter, and the default for envelopes is 3 or Com 10. The letter value is the *else* part (%e1) of the **s1** and **s3** attributes, and the envelope is the *then* part (%t3).

Paper Type

The Optra E310 printer supports paper types ROUGH, NORMAL (default), TRANSPARENCY, LABELS, and CARDSTOCK via the **–y** parameter to the **qprt** command, or the **–y** attribute in the colon file. The values to the **–y** option are 1 through 5 respectively for the above types.

–y 1	Bond
–y 2	Plain
–y 3	Transparency
–y 4	Labels
–y 5	Cardstock

Note: These values do not apply to envelopes.

Pitch

Pitch selection is supported for the PCL emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face) with the **qprt** command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bolditalic	**–p** (1 to 100)
–s gothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–s gothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a PostScript queue. For PostScript queues, **–p** stands for point size and the valid list of fonts is located in /**usr**/**lib**/**ps**/**fontmap**. Valid point sizes are any integer from 1 to 1008.

Only a pitch of 17 is supported for the lineprinter font style.

Number of Copies for Each Page

The **–W** flag of the **qprt** command controls how many copies of each page is printed. The default is 1 copy, and the maximum value is 999.

–w #	number of copies

Example: If a three–page job is submitted with **–W2** on the **qprt** command, then two copies of page 1 followed by two copies of page 2 followed by two copies of page 3 will occur in that order.

Page Rotation

Page rotation selection is supported for the PCL 5e emulation by using the **–z** flag of the **qprt** command.

–z 0 Portrait

–z 1 Landscape

Paper Source

Paper source selection is supported for both the enhanced PCL (R) 5e emulation and the PostScript Level 2 emulation by using the **–u** flag of the **qprt** command. There are several optional input sources (see your manual to determine which are installed). These numbers apply, no matter which ones are present. If one is not present, choosing one of those will simply default as per the user's manual. The input source number is the same for both PCL and PostScript:

–u 0 manual feed

–u 1 tray 1

–u 2 tray 2

–u 3 multipurpose tray

By default, the banner and trailer pages come from tray 1. To change the default, change the values for the **uH** and/or **uT** attributes respectively in the virtual printer to the value for the desired paper source. The valid values are the same as for the **–u** flag. Do this by editing the the **chvirprt** command.

Paper Size

Paper size selection is supported by using either one or both of the **qprt** command flags, **–O** and **–Q**. The **–O** flag controls paper versus envelope. A **–O** value of 3 indicates a paper size and 4 an envelope size. The values 1 and 2 were skipped for backward compatibility. Envelopes are only valid for manual feed, envelope feeder, or the multipurpose tray. The default for **–Q** is 1 or Letter for paper sizes, and 3 or Com 10 for envelope sizes. To change the defaults, change the **s0** – **s7** attributes respectively for each of the valid input sources. Since manual feed and the multipurpose tray support both paper and envelopes, the default for paper is the *else* part (%e1), and the default for envelopes is the *then* part (%t3) of **s0** and **s7**.

	Paper Sizes (–O 3)	Envelope Sizes (–O 4)
–Q 1	Letter	7 3/4 Monarch
–Q 2	Legal	9 (Com 9)
–Q 3	B5 (JIS B5)	10 (Com 10)
–Q 4	A4	DL
–Q 5	Executive	C5
–Q 6	A5	B5 Envelope
–Q 7	Custom (Universal)	Other Envelope

Note: For PCL queues, if the selected size is not in the selected input source, a search sequence will be used to find the size requested. If the size is found, that source will be used. For PostScript queues, if the selected size is not in the selected input source, the printer will prompt the user to load the source with the appropriate size. This may result in an unexpected paper source being used or an op–panel message that may not make sense at first. Please refer to the manual to determine appropriate responses.

Pitch

Pitch selection is supported for the PCL 5 emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face) with the **qprt** command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bolditalic	**–p** (1 to 100)
–s gothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–s gothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **–da** flag to a PostScript queue with the **qprt** command. Only a pitch of 17 is supported for the lineprinter font style.

Collation

Normally, the **–N** command line option is used to specify the number of copies desired. This method will cause that many copies of the entire print job to be submitted or queued to the print system. Since the Optra 410 supports collation internally, options were added to support it and the number of copies of each page internally. This functionality is limited by the amount of memory installed in your printer and the size of the job. The **–W #** option determines how many copies of each page is desired, where **#** is the number of copies. The **–S [!/+]** option controls whether collation is desired. The default is **!** (or not). The main advantages of using the **–W** and **–S** options are to conserve printer subsystem usage and allow the printer to handle multiple copies instead of sending **#** copies to the printer. Using the **–S!** options with the **–W #** also allows **#** copies of each page in a row, if that is desired. Note that using **–N** and **–W** simultaneously is allowed. This would result in **–N** print jobs with **–W** copies of each page in each job.

Separator Pages

The **–E** flag controls separator pages. The valid values are 0, 1, 2, and 3, which represent NONE, BETWEENCOPIES, BETWEENJOBS, and BETWEENPAGES, respectively. The separator page source defaults to TRAY 1 and is specified via the **uS** attribute. The valid values for **uS** are the same as for header and trailer pages (**uH** and **uT** respectively), except that the Manual Feeder is not supported. To change the default, the **uS** attribute must be changed in the virtual printer to one of the valid values (see the **chvirprt** command).

Page Rotation

Page rotation selection is supported for the PCL 5e emulation by using the **–z** flag of the **qprt** command.

–z 0 Portrait

–z 1 Landscape

Paper Source

Paper source selection is supported for both the enhanced PCL (R) 5e emulation and the PostScript Level 2 emulation by using the **–u** flag of the **qprt** command. There are several optional input sources (see your manual to determine which are installed). These numbers apply, no matter which ones are present. If one is not present, choosing one of those will simply default as per the user's manual. The input source number is the same for both PCL and PostScript:

–u 0 manual feed

–u 1 tray 1

–u 2 tray 2

–u 3 tray 3

–u 4 tray 4

–u 5 tray 5

–u 6 envelope feeder

–u 7 multipurpose tray

By default, the banner and trailer pages come from tray 1. To change the default, change the values for the **uH** and/or **uT** attributes respectively in the virtual printer to the value for the desired paper source. The valid values are the same as for the **–u** flag. Do this by editing the the **chvirprt** command.

Paper Size

Paper size selection is supported by using **–O** and **–Q** flags of the **qprt** command. The **–O** flag controls paper versus envelope. A **–O** value of 3 indicates a paper size and 4 an envelope size. The values 1 and 2 were skipped for backward compatibility. Envelopes are only valid for manual feed, envelope feeder, or the multipurpose tray. The default for **–Q** is 1 or Letter for paper sizes, and 3 or Com 10 for envelope sizes. To change the defaults, change the **s0** – **s7** attributes respectively for each of the valid input sources. Since manual feed and the multipurpose tray support both paper and envelopes, the default for paper is the *else* part (%e1), and the default for envelopes is the *then* part (%t3) of **s0** and **s7**.

Paper Sizes (–O 3)	Envelope Sizes (–O 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5 (JIS B5)	10 (Com 10)
–Q 4 A4	DL
–Q 5 Executive	C5
–Q 6 A5	B5 Envelope
–Q 7 Custom (Universal)	Other Envelope

Note: For PCL queues, if the selected size is not in the selected input source, a search sequence will be used to find the size requested. If the size is found, that source will be used. For PostScript queues, if the selected size is not in the selected input source, the printer will prompt the user to load the source with the appropriate size. This may result in an unexpected paper source being used or an op–panel message that may not make sense at first. Please refer to the manual to determine appropriate responses.

Paper Type

The Optra Se printers support paper types Plain Paper (default), Bond, Transparency, Card Stock, Labels, Letterhead, Preprinted, Colored Paper, Envelope (default for envelope feeder) and Custom Type **x**, where **x** can be 1 through 6. This colon file does not attempt to set these values and will use whatever the printer is set to for that input source. The user should insure that the proper paper type is actually installed in the specified source.

Pitch

Pitch selection is supported for the PCL 5 emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face) with the **qprt** command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bolditalic	**–p** (1 to 100)
–s gothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–s gothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **–da** flag to a PostScript queue with the **qprt** command. Only a pitch of 17 is supported for the lineprinter font style.

Duplex Mode

The **qprt** command line option **–Y** supports this.

0	simplex operation
1	duplex, long edge binding
2	duplex, short edge binding

Collation

Normally, the **–N** command line option is used to specify the number of copies desired. This method will cause that many copies of the entire print job to be submitted or queued to the print system. Since the Optra Se supports collation internally, options were added to support it and the number of copies of each page internally. This functionality is limited by the amount of memory installed in your printer and the size of the job. The **–W #** option determines how many copies of each page is desired, where **#** is the number of copies. The **–S [!/+]** option controls whether collation is desired. The default is **!** (or not). The main advantages of using the **–W** and **–S** options are to conserve printer subsystem usage and allow the printer to handle multiple copies instead of sending **#** copies to the printer. Using the **–S!** options with the **–W #** also allows **#** copies of each page in a row, if that is desired. Note that using **–N** and **–W** simultaneously is allowed. This would result in **–N** print jobs with **–W** copies of each page in each job.

Separator Pages

The **–E** flag controls separator pages. The valid values are 0, 1, 2, and 3, which represent NONE, BETWEENCOPIES, BETWEENJOBS, and BETWEENPAGES, respectively. The separator page source defaults to TRAY 1 and is specified via the **uS** attribute. The valid values for **uS** are the same as for header and trailer pages (**uH** and **uT** respectively), except that the Manual Feeder is not supported. To change the default, the **uS** attribute must be changed in the virtual printer to one of the valid values (see the **chvirprt** command).

Output Destination

The **–=** (equal sign) is the command line option for specifying the output destination. Valid values are:

0	standard bin
1	bin 1
2	bin 2
3	bin 3
50	active bin

The default value for the output destination is the standard bin (**0**). Note that if the active bin is selected, the printer will select the bin based on the state of output bin capacity sensing and the op–panel setting for ”Configure Bins” under the **PAPER MENU**. Please refer to your printer manual to determine exactly how the printer will respond.

Page Rotation

Page rotation selection is supported for the PCL 5e emulation by using the **–z** flag of the **qprt** command.

–z 0 Portrait

–z 1 Landscape

Paper Source

Paper source selection is supported for both the enhanced PCL (R) 5e emulation and the PostScript Level 2 emulation by using the **–u** flag of the **qprt** command. There are several optional input sources (see your manual to determine which are installed). These numbers apply, no matter which ones are present. If one is not present, choosing one of those will simply default as per the user's manual. The input source number is the same for both PCL and PostScript:

–u 0 manual feed

–u 1 tray 1

–u 2 tray 2

–u 3 tray 3

–u 4 tray 4

–u 5 tray 5

–u 6 envelope feeder

–u 7 multipurpose tray

By default, the banner and trailer pages come from tray 1. To change the default, change the values for the **uH** and/or **uT** attributes respectively in the virtual printer to the value for the desired paper source. The valid values are the same as for the **–u** flag. Do this by editing the the **chvirprt** command.

Paper Size

Paper size selection is supported by using **–O** and **–Q** flags of the **qprt** command. The **–O** flag controls paper versus envelope. A **–O** value of 3 indicates a paper size and 4 an envelope size. The values 1 and 2 were skipped for backward compatibility. Envelopes are only valid for manual feed, envelope feeder, or the multipurpose tray. The default for **–Q** is 1 or Letter for paper sizes, and 3 or Com 10 for envelope sizes. To change the defaults, change the **s0** – **s7** attributes respectively for each of the valid input sources. Since manual feed and the multipurpose tray support both paper and envelopes, the default for paper is the *else* part (%e1), and the default for envelopes is the *then* part (%t3) of **s0** and **s7**.

Paper Sizes (–0 3)	Envelope Sizes (–0 4)
–Q 1 Letter	7 3/4 Monarch
–Q 2 Legal	9 (Com 9)
–Q 3 B5 (JIS B5)	10 (Com 10)
–Q 4 A4	DL
–Q 5 Executive	C5
–Q 6 A5	B5 Envelope
–Q 7 Custom (Universal)	Other Envelope

Note: For PCL queues, if the selected size is not in the selected input source, a search sequence will be used to find the size requested. If the size is found, that source will be used. For PostScript queues, if the selected size is not in the selected input source, the printer will prompt the user to load the source with the appropriate size. This may result in an unexpected paper source being used or an op–panel message that may not make sense at first. Please refer to the manual to determine appropriate responses.

Paper Type

The Optra T printers support paper types Plain Paper (default), Bond, Transparency, Card Stock, Labels, Letterhead, Preprinted, Colored Paper, Envelope (default for envelope feeder) and Custom Type **x**, where x can be 1 through 6. This colon file does not attempt to set these values and will use whatever the printer is set to for that input source. The user should insure that the proper paper type is actually installed in the specified source.

Pitch

Pitch selection is supported for the PCL emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face) with the **qprt** command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bolditalic	**–p** (1 to 100)
–s gothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–s gothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **–da** flag to a PostScript queue with the **qprt** command. Only a pitch of 17 is supported for the lineprinter font style.

Duplex Mode

The **qprt** command line option **–Y** supports this.

0	simplex operation
1	duplex, long edge binding
2	duplex, short edge binding

Collation

Normally, the **–N** command line option is used to specify the number of copies desired. This method will cause that many copies of the entire print job to be submitted or queued to the print system. Since the Optra T supports collation internally, options were added to support it and the number of copies of each page internally. This functionality is limited by the amount of memory installed in your printer and the size of the job. The **–W #** option determines how many copies of each page is desired, where # is the number of copies. The **–S [!/+]** option controls whether collation is desired. The default is **!** (or not). The main advantages of using the **–W** and **–S** options are to conserve printer subsystem usage and allow the printer to handle multiple copies instead of sending **#** copies to the printer. Using the **–S!** options with the **–W #** also allows **#** copies of each page in a row, if that is desired. Note that using **–N** and **–W** simultaneously is allowed. This would result in **–N** print jobs with **–W** copies of each page in each job.

Separator Pages

The **–E** flag controls separator pages. The valid values are 0, 1, 2, and 3, which represent NONE, BETWEENCOPIES, BETWEENJOBS, and BETWEENPAGES, respectively. The separator page source defaults to TRAY 1 and is specified via the **uS** attribute. The valid values for **uS** are the same as for header and trailer pages (**uH** and **uT** respectively), except that the Manual Feeder is not supported. To change the default, the **uS** attribute must be changed in the virtual printer to one of the valid values (see the **chvirprt** command.

Output Destination

The **–=** (equal sign) is the command line option for specifying the output destination. Valid values are:

0	standard bin
1	bin 1
2	bin 2
3	bin 3
4	bin 4
5	bin 5
6	bin 6
7	bin 7
8	bin 8
9	bin 9
10	bin 10

The default value for the output destination is the standard bin (**0**).

Page Rotation

Page rotation selection is supported for the PCL 5 emulation by using the **–z** flag of the **qprt** command.

–z 0 Portrait

–z 1 Landscape

Paper Source

Paper source selection is supported for both the enhanced PCL (R) 5 emulation and the PostScript Level 2 emulation by using the **–u** flag of the **qprt** command. There are several optional input sources (see your manual to determine which are installed). These numbers apply, no matter which ones are present. If one is not present, choosing one of those will simply default as per the user's manual. The input source number is the same for both PCL and PostScript:

–u 0 manual feed

–u 1 tray 1

–u 2 tray 2

–u 3 tray 3

–u 4 tray 4

By default, the banner and trailer pages come from the top tray. To change the default, change the values for the **uH** and/or **uT** attributes respectively in the colon file to the value for the desired paper source. The valid values are the same as for the **–u** flag. Do this by editing the the virtual printer colon file by using the **chvirprt** command.

Paper Size

Paper size selection is supported by using the **–Q** flag of the **qprt** command. The first five paper sizes are also numbered for backward compatibility. Whenever an invalid value for the input source is selected, it will be ignored.

The default for **–O** is 3 or paper. The default for **–Q** is 1 or Letter for paper sizes and Monarch for envelope sizes.

Paper Sizes

–Q 1	Letter
–Q 2	Legal
–Q 3	B5 Paper
–Q 4	A4
–Q 5	Executive
–Q 6	A5
–Q 7	B4
–Q 8	A3
–Q 9	Ledger (11x17)
–Q 10	Universal (11.69x17.69)

To change the defaults, change the **s0 –s5** attributes respectively for each of the valid input valids. The default paper size is the *else* part (%e1).

Notes:

1. Manual Feed and Tray 1 support sizes –Q 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 (Letter, Legal, B4, A4, Executive, A5, B4, A3, 11x17, Universal).
2. Trays 2, 3, and 4 support sizes –Q 1, 2, 4, 7, 8, 9 (Letter, Legal, A4, B4, A3, 11x17).
3. The printer (and this colon file) defaults paper size to letter for the US and A4 for Europe.
4. An invalid paper size value for the selected input source will cause an error to be reported.
5. If the selected size is not in the selected input source, either wrong size or empty, a search sequence will be used to find the size requested. Please refer to the printer manual for assistance

Pitch

Pitch selection is supported for the PCL 5 emulation by using the **–p** flag for pitch and the **–s** flag for font name (or type face) with the **qprt** command. Pitch values between 1 and 100 characters per inch (cpi) in whole integers are supported. The condensed print flag, **–K**, is not supported.

Font Name	Pitch
–s courier	**–p** (1 to 100)
–s courier–bold	**–p** (1 to 100)
–s courier–italic	**–p** (1 to 100)
–s courier–bolditalic	**–p** (1 to 100)
–s gothic	**–p** (1 to 100)
–s gothic–bold	**–p** (1 to 100)
–s gothic–italic	**–p** (1 to 100)
–s lineprinter	**–p** 17

Note: To format ASCII for other font styles, use the AIX enscript utility or the **qprt** command with the **–da**, **–s**, and **–p** flags to a PostScript queue. For PostScript queues, **–p** stands for point size and the valid list of fonts can be found in /**usr**/**lib**/**ps**/**fontmap**. Valid point sizes are any integer from 1 to 1008.

Only a pitch of 17 is supported for the lineprinter font style.

Duplex Mode

The optional duplex feature is supported by the **–Y** flag of the **qprt** command. The default value is 0 or simplex mode.

–Y 0	simplex
–Y 1	duplex, long edge binding
–Y 2	duplex, short edge binding

Collation and Number of copies

The optra W810 printer supports collation of multiple copies of a print job internally. This feature is controlled by the **–W** and **–S** flags of the **qprt** command.

–S!	collation off
–S+	collation on
–W#	number of copies

Notes:

1. This function is independent of the **–N** flag of the **qprt** command. The **–N#** flag will cause the print job to be sent to the printer **#** times. The **–W#** flag will send the print job once, and **#** copies of the job will be printed.
2. The function is limited by the amount of memory installed in the printer and the size of the print job.

Separator Pages

The printer supports internally generated separator pages. This feature is controlled by the **–E** flag of the **qprt** command.

–E0	None
–E1	Between Copies
–E2	Between Jobs
–E3	Between Pages

The paper source defaults to Tray 1. To change the default, the **uS** attribute must be changed in the virtual printer. The valid values for **uS** are:

uS 1	Tray 1
uS 2	Tray 2
uS 3	Tray 3
uS 4	Tray 4

Note: This function is independent of the **–B** flag of the **qprt** command.

Finisher Stapes

The Optra W810 printer supports this option if it has an optional Finisher installed. The valid values for **y** are:

–y 0	Off
–y 1	On

Finisher Offset

The Optra W810 printer supports this option if it has an optional Finisher installed. The valid values for **e** are:

–e 0	Off
–e 1	On

Hole Punch

The Optra W810 printer supports this option if it has an optional Finisher installed. The valid values for **o** are:

–o 0	Off
–o 1	On

Output Destination

The **–=** (equal sign) is the command line option for specifying the output destination. Valid values are:

0	standard bin
1	bin 1
2	bin 2
3	bin 3
4	bin 4
5	bin 5
6	bin 6
7	bin 7
8	bin 8
9	bin 9
10	bin 10

The default value for the output destination is the standard bin (**0**).

Lexmark Plus Printer Models 2380–3, 2381–3, 2390–3, 2391–3

Paper Source

Paper source selection is supported by using the **–u** flag of the **qprt** command.

–u 1	tractor 1
–u 2	tractor 2

The banner and trailer pages use the same source as the print job. It is suggested that the printer be attended when switching between tractors.

Pitch, Font, and Quality

Pitch selection is supported by using the **–p** flag for the pitch, the **–s** flag for font name, and **–q** flag of the **qprt** command for print quality. The default values supported include:

10	pitch
courier	font
quality	1 or draft

The valid font values include:

Font Name	
–s	fast draft
–s	draft
–s	courier
–s	gothic
–s	prestige (239x only)
–s	presenter (239x only)
–s	orator (239x only)
–s	script (239x only)

The valid quality values include:

Quality (–q flag)	
0	fast draft
1	draft
2	near letter quality (238x only)
2	letter quality (239x only)
3	enhanced letter quality (239x only)

The valid pitch values are 10, 12, 17, 20, and 24 for 239x only.

Notes:

1. Selection of draft or fast draft will override the selected font.
2. Bold font is supported using the **–e** flag and emphasized print. Italic font is supported using the **–k** flag and italic print.

Page Width

The **–w** flag controls the width of the printable page in characters.

Plus Printer	Default
2380 and 2390	80
2381 and 2391	136

OKI MICROLINE 801PS/+F, 801PSII/+F, 800PSIILT

The Japanese PostScript and ASCII data streams are supported. Japanese language text files cannot be printed. All OKI MICROLINE series printers are connected by RS–232C cabling.

Printronix P9012 Line Printer

Only the Serial Matrix command set is supported. The P–series command set is not supported.

QMS ColorScript 100 Model 20 Printer

The QMS ColorScript 100 Model 20 printer can print color PostScript files and HPGL (Hewlett–Packard Graphics Language) files. The HPGL emulator is shipped on a DOS diskette with the printer. ASCII files can also be printed using the PostScript data stream.

To print PostScript files, do not enter a print queue name for the HPGL data stream when making the print queue. To print HPGL files, do the following:

1. Enter a print queue name for the HPGL data stream when making the print queue.
2. Insert the 3–1/2 inch diskette labeled HPGL Emulator in the diskette drive.
3. Make sure you are the root user.
4. Enter the following to copy the HPGL emulator files from the DOS diskette to the appropriate directory:

```
/usr/lib/lpd/pio/etc/pioqms100 -Q
```

When HPGL print files are submitted to the HPGL print queue, the system downloads the HPGL emulator to the printer and selects the emulator as needed.

PostScript files can also be submitted to the HPGL print queue. The files must begin with the two–character string **%!** so the system can recognize them as PostScript instead of HPGL files.

Texas Instruments OmniLaser 2115 Page Printer

Automatic selection of the printer data stream (PostScript, HP LaserJet+, Diablo 630, TI 855, Plotter) is not supported. The data stream must be selected manually, using the control panel.

You can also print ASCII files using the PostScript data stream.

Only DP mode is supported for the TI 855 software interface. WP mode is not supported.

Each time the printer controller is turned on, enter the following:

```
splp -F! lpx
```

where `lpx` is the printer device name, such as `lp0` . This tells the system that the HPGL emulator needs to be downloaded to the printer again.

When you reboot the system, turn the printer off and on to reinitialize it.

Printer Support

Support for each printer is provided as a separately installable package. To see a list of printers for which support has already been installed on your machine, type:

```
smit lssprt
```

To install support for additional printers, type:

```
smit printerinst
```

If your printer is not supported, you can configure it as a supported printer that is functionally similar to your printer. Otherwise, you can configure your printer as a generic printer. To do this:

1. Select **Other** as the printer manufacturer or printer model when adding a print queue for the printer.

   OR

2. Select **Other serial printer** or **Other parallel printer** when adding a printer device definition for the printer.

Printers

- Bull Compuprint 4/51
- Bull Compuprint 4/54
- Bull Compuprint 914
- Bull Compuprint 914 N
- Bull Compuprint 922
- Bull Compuprint 923
- Bull Compuprint 924
- Bull Compuprint 924 N
- Bull Compuprint 956
- Bull Compuprint 970
- Bull Compuprint 1070
- Bull Compuprint PageMaster 200
- Bull Compuprint PageMaster 201
- Bull Compuprint PageMaster 411
- Bull Compuprint PageMaster 413
- Bull Compuprint PageMaster 422
- Bull Compuprint PageMaster 721
- Bull Compuprint PageMaster 815
- Bull Compuprint PageMaster 825
- Bull Compuprint PageMaster 1015
- Bull Compuprint PageMaster 1021
- Bull Compuprint PageMaster 1025
- Bull Compuprint PageMaster 1625
- Bull PR–88
- Bull PR–88 VFU Handling

- Bull PR–90
- Canon LASER SHOT LBP–A404PS/Lite
- Canon LASER SHOT LBP–B406/S/D/E/G,A404/E,A304E
- Dataproducts LZR 2665 Laser Printer
- Dataproducts BP2000 Line Printer
- HP 2500C Color Printer
- HP LaserJet ll
- HP LaserJet III
- HP LaserJet IIISi
- HP LaserJet 4, 4M
- HP LaserJet 4Si, 4Plus, 4V, 4000
- HP LaserJet 5Si, 5Si MX
- HP LaserJet 5Si Mopier
- HP LaserJet 5000 D640 Printer
- HP LaserJet 8100 Printer
- HP LaserJet Color
- HP Color LaserJet 4500 Printer
- IBM 2380 Personal Printer II
- IBM 2380 Plus (Model 2)
- IBM 2381 Personal Printer II
- IBM 2381 Plus (Model 2)
- IBM 2390 Personal Printer II
- IBM 2390 Plus (Model 2)
- IBM 2391 Personal Printer II
- IBM 2391 Plus (Model 2)
- IBM 3112 Page Printer
- IBM 3116 Page Printer
- IBM 3812 Model 2 Page Printer
- IBM 3816 Page Printer
- IBM 4019 LaserPrinter
- IBM 4029 LaserPrinter
- IBM 4037 5E Printer
- IBM 4039 LaserPrinter
- IBM 4070 InkJet Printer
- IBM 4072 ExecJet
- IBM 4076 InkJet Printer
- IBM 4079 Color JetPrinter
- IBM 4201 Model 2 Proprinter II
- IBM 4201 Model 3 Proprinter III

- IBM 4202 Model 2 Proprinter II XL
- IBM 4202 Model 3 Proprinter III XL
- IBM 4207 Model 2 Proprinter X24E
- IBM 4208 Model 2 Proprinter XL24E
- IBM 4208 Model 502 Proprinter XL24EK
- IBM 4212 Proprinter 24P
- IBM 4216 Personal Page Printer, Model 031
- IBM 4216 Model 510
- IBM 4224 Printer, Models 301, 302, 3C2, 3E3
- IBM 4226 Printer
- IBM 4234 Dot Band Printer, Model 013
- IBM 5202 Quietwriter III
- IBM 5204 Quickwriter
- IBM 5327 Model 011
- IBM 5572 Model B02
- IBM 5573 Model H02
- IBM 5575 Model B02/F02/H02
- IBM 5577 Model B02/F02/FU2/G02/H02/J02/K02
- IBM 5579 Model H02/K02
- IBM 5584 Model G01/H01
- IBM 5585 Model H01
- IBM 5587 Model G01/H01
- IBM 5589 Model H01
- IBM 6180 Color Plotter
- IBM 6182 Auto Feed Color Plotter
- IBM 6184 Color Plotter
- IBM 6185–1 Color Plotter
- IBM 6185–2 Color Plotter
- IBM 6186 Color Plotter
- IBM 6252 Impactwriter
- IBM 6262 Printer
- IBM 7372 Color Plotter
- IBM Network Color Printer
- IBM Network Printer 12
- IBM Network Printer 17
- IBM Network Printer 24
- IBM InfoPrint 20 Printer
- IBM InfoPrint 40 Printer
- Lexmark Optra LaserPrinter

- Lexmark Optra Plus LaserPrinter
- Lexmark Optra C Color LaserPrinter
- Lexmark Optra E Color LaserPrinter
- Lexmark Optra E310 Laser Printer
- Lexmark Optra M410 Laser Printer
- Lexmark Optra N Color LaserPrinter
- Lexmark Optra Se Laser Printer
- Lexmark Optra T Laser Printer Family
- Lexmark Optra W810 Laser Printer
- Lexmark ExecJet IIc
- Lexmark ValueWriter 600
- Lexmark 2380 Plus Printer (Model 3)
- Lexmark 2381 Plus Printer (Model 3)
- Lexmark 2390 Plus Printer (Model 3)
- Lexmark 2391 Plus Printer (Model 3)
- Lexmark 4039 Plus LaserPrinter
- Lexmark 4079 Color JetPrinter Plus
- Lexmark 4227 Forms Printer
- OKI MICROLINE 801PS/+F, 801PSII/+F, 800PSIILT
- Printronix P9012 Line Printer
- QMS ColorScript 100, Model 20
- TI Omnilaser 2115 Page Printer

Pass–Through Mode

Both virtual printers and the printer device driver can operate, or function, either in pass–through mode or in non–pass–through mode. ”Pass–through mode” simply means that a data stream is ”passed through” to the printer, byte by byte, unmodified. The mode of operation selected for a given job determines how or even if a data stream is processed. It is important to understand the difference between the two modes, when each mode is in effect, and if the mode can be changed.

Printer Device Driver Pass–Through Mode

The printer device driver itself, for instance /**dev**/**lp0**, by default operates in non–pass–through mode. A user can query or modify the operating rules for /**dev**/**lp0** by issuing the **splp** command. For example, below are the results of issuing the command **splp lp0** on a system with an IBM 4029 LAserPrinter defined as lp0. The results are output to the display element specified by the **TERM** environment variable.

```
device = /dev/lp0      (+ yes     ! no)
CURRENT FORMATTING PARAMETERS (ignored by qprt, lpr, and lp commands)
Note: -p + causes the other formatting parameters to be ignored.
-p !    pass-through?                  -c +    send carriage returns?
-l 64   page length (lines)            -n +    send line feeds?
-w 80   page width (columns)           -r +    carriage rtn after line fee?
-i 0    indentation (columns)          -t +    suppress tab expansion?
-W !    wrap long lines?               -b +    send backspaces?
-C !    convert to upper case?         -f +    send form feeds?

CURRENT ERROR PROCESSING PARAMETERS
-T 600  timeout value (seconds)        -e !    return on error?

CURRENT SERIAL INTERFACE PARAMETERS
-B      19200baud rate                 -s 8    character size (bits)
-N !    enable parity?                 -S !    two stop bits?
-P !    odd parity?
```

The **–p** parameter determines whether or not the printer device driver, /**dev**/**lp0**, will default to a pass–through mode of operation; the mode of operation can be overridden for a specific data stream. By default, the value of the **–p** parameter is **!**, or **no**. It is important to note that the question asked by the **–p** parameter is ”Will the mode of operation be pass–through mode?”

If the value of the **–p** parameter is **!**, then all of the other parameters listed are honored by the device driver during data stream processing. Likewise, if the value of the **–p** parameter is **+**, or **yes**, then all of the other parameters are ignored during data stream processing.

Using the **splp** command to change the parameter values of the printer device driver does not affect the operation of the spooler. **Splp** affects commands such as **cat** when they are used to access the device driver directly, bypassing the spooler. For example, the command

```
cat /etc/motd > /dev/lp0
```

opens /**dev**/**lp0** and writes the contents of the ”message of the day” directly to the printer. The output on the printer is formatted similar to the following example:

```
This is a test version of /etc/motd, used to demonstrate what
happens when a printer device driver, such as /dev/lp0, is placed
into or taken out of passthru mode.  Printers will print either
exactly what they are sent, if you set the job conditions up
correctly, or, on the most current printers, you may be able to
direct the printer to perform certain mappings for you.

There are no carriage returns in this file, and the only blank li
ne occurs immediately before this one.
```

Notice that the **–r** parameter dictates the mapping of each linefeed to a linefeed and carriage return if the value of **–p** is **!**. This is necessary as most UNIX–based operating systems only use linefeeds; unlike DOS or OS/2 or other operating systems, in UNIX–based operating systems a linefeed implies a carriage return. While this works well with text editors

and in other similar situations, it does not work with printers. Printers only print the data which they are sent. Issuing the two commands

```
splp -p+ lp0

cat /etc/motd > /dev/lp0
```

results in something like the following appearing on the printer.

```
This is a test version of /etc/motd, used to demonstrate what hap
pens when a
printer device driver, such as /dev/lp0, is placed into or taken
out of passthru mode
.  Printers will print either exactly what they are sent, if you
set the job conditions up correctly, or, on the most current prin
ters, you may be able to direct
the printer to perform certain mappings for you.

There are no carriage returns in
this file, and the only blank line occurs
immediately before this one.
```

In the first example, all of the device driver settings are honored. In particular, the mapping of a linefeed to a linefeed and a carriage return is turned on. When the device drivers is writing characters to the physical printer, it sends a carriage return after each linefeed. It also honors the settings for page width.

In the second example, the device driver is limited to simply writing each single–byte character of /**etc**/**motd** to the physical printer, without any mapping or other modification of the data stream occuring. Most ASCII printers, current or not, have enough intelligence to make a few decisions of their own. When the first sentence of /**etc**/**motd** ends, the linefeed drops the printhead straight down one line; there is no carriage return to move the printhead back to the left margin. The first four letters of the word ”printer,” ”prin,” are printed. At that point the printer itself, not the device driver, determines that the right margin has been reached and so prints a carriage return, returning the printhead to the left margin. Printing continues with the next character in the data stream.

In the second example, the job does not even print until the reset button on the printer is pressed. This is because the printer has not received enough date (characters) to automatically eject a page, and no formfeeds were sent to the printer to cause it to eject the page; the **–f** parameter on the device driver is ignored.

Formatter Filter Pass–Through Mode

After a job is submitted to the spooler it eventually passes to the formatter filter for processing and delivery to the printer device driver. The formatter filter always opens the printer device driver in pass–through mode. Jobs submitted to the spooler, as opposed to data streams that are sent directly to the printer device driver, are always processed or otherwise modified by a formatter filter and not by the printer device driver.

Like the printer device driver, the formatter filter also has two modes of operation: pass–through and non–pass–through. Again, the mode of operation selected for a given job determines how or even if a data stream is processed.

The **_d** attribute in a virtual printer definition (a digested colon file) specifies the input data stream type for the queue associated with that virtual printer. The virtual printer definition also specifies the formatter filter for that input data stream type. When the formatter filter is invoked to process a job, the process that runs the formatter (**pioformat**) filter checks the value of the **_d** attributes and decides whether or not to invoke the formatter filter in pass–through mode. If pass–through mode is selected, the formatter filter simply uses the **passthru()** subroutine to read the input stream and send it unmodified to the printer device driver. If pass–through mode is not selected, the formatter filter uses the **lineout()** subroutine to process the input data stream line by line. In either case, the printer device driver was opened for writing in pass–through mode and performs no processing on the output data stream.

Note that input data streams such as PostScript are pass–through by definition; the processing is performed by the Postscript interpreter hardware on the printer.

Most of the printer device driver parameters that one can display or modify using the **splp** command also exist in the formatter filter. These parameters are stored in the digested version of the colon file for a given virtual printer. For example, the mapping between the printer device driver parameters and the corresponding parameters in the colon files for an ASCII queue on an IBM 4029 LaserPrinter is as follows:

pass-through?	-p	_d
page length (lines)	-l	_l
page width (columns)	-w	_w
indentation (columns)	-i	_i
wrap long lines?	-W	_L
convert to uppercase?	-C	N/A
send carriage returns?	-c	_x
send linefeeds ?	-n	_x
carriage rtn after linefeed	-r	_x
suppress tab expansion?	-t	N/A
send backspaces?	-b	N/A
send formfeeds?	-f	_Z

The values of the parameters in the righthand column can be permanently set in the virtual printer definition. They can also be overridden at the time a job is submitted by using certain flags on either the **qprt** or **enq** commands.

Viewing, Formatting, or Modifying Virtual Printer Definitions

An IBM 4029 LaserPrinter supports four distinct data streams. The root user can use the **mkvirprt** command to create both a queue and a virtual printer definition for each of the four data stream types. The root user can further use the **lsvirprt** command to view and modify the colon file underlying the virtual printer definition. For a system on which a queue of each type has been defined, issuing of the **lsvirprt** command results in the following list and query being displayed (queue names and device are chosen by the root user at queue creation time):

```
No. Queue             Device   Description

1   asc               lxx      4029  (IBM ASCII)
2   gl                lxx      4029  (Plotter Emulation)
3   pcl               lxx      4029  (HP LaserJet II Emulation)
4   ps                lxx      4029  (PostScript)

Enter number from list above (press Enter to terminate):  ->
```

From this list, the root user enters the number corresponding to the virtual printer that he wants to view, format, or modify. The following message and prompt are then displayed.

```
To LIST attributes, enter AttributeName1 ... (* for all attributes)
To CHANGE an attribute value, enter AttributeName=NewValue
To FORMAT and EDIT an attribute value, enter AttributeName~v
To EDIT the attribute file, enter ~v
To terminate, press Enter:
```

There are six options at this point, one of which is to simply press Enter and terminate the **lsvirprt** command. The other five are more interesting.

- Enter an asterisk (*****) and press Enter to view a list of all attributes in the colon file along with their text descriptions from the message catalog.
- Enter the name of an attribute and press Enter to view that attribute only, along with its text description from the message catalog.
- Enter the name of an attribute, an **=**, and a value, then press Enter to assign the attribute that value.
- Enter a **~v** and press Enter to engage in a **vi** session with the raw colon file.
- Enter the name of an attribute, immediately followed (no blank spaces) by a **~v**, and press Enter to engage in a **vi** session with a heavily formatted version of the attribute.

Each of these five options will be discussed in the context of the **asc** queue and the associated virtual printer definition with its underlying colon file.

Entering an asterisk (*****) and pressing Enter will result in the following being displayed:

```
Name    Description                                              Value
__FLG   VALUES THAT MAY BE OVERRIDDEN WITH FLAGS ON THE
          COMMAND LINE
_0      (not used)
_1      (not used)
_2      (not used)
_3      (not used)
_4      (not used)
_5      (not used)
_6      (not used)
_7      (not used)
_8      (not used)
_9      (not used)
_A      stderr returned? 0: no;  1: yes, & pipelines;  2:    1
          yes, & values, pipelines
_E      Double-High Print. (!: no;  +: yes)
_F      (not used) Font file name
_G      Page format (!: use only printable page   +: use     !
          entire addressable area)
_H      Name To Replace Host Name On Burst Page
_I      Font ID (overrides pitch and type style)
_J      Restore the Printer at the End of the Print Job?     +
          (!: no;  +: yes)
_K      (not used)
_L      Wrap Long Lines (!: no;  +: yes)                     +
_O      Type of Input Paper Handling (1: manual, 3:          3
          sheetfeed)
_Q      Paper or Envelope Size For the Paper Source          %IwQ
          Selected By the -O and -u Flag Values (Refer to
          the s0, s1, s2, s3, and s4 attributes); Default
          value: %IwQ
_S      High speed printing
_U      Unidirectional printing
_V      Vertical printing
_W      Double-Wide Print (!: no;  +: yes)                   !
_X      Code Page Name For Print Data Stream (file with      IBM-850
          same name in dir. "d1")
_Y      Duplex Output (0: Simplex  1: Duplex Long-Edge  2:   0
           Duplex Short-Edge)
_Z      Issue Form Feed Between Copies & At Job End (!:      +
          no;  +: yes)
:
```

The output is formatted by the **pg** command, hence the full colon (**:**) at the bottom of the display. The output above is only the first full screen. The rest is available through the normal **pg** subcommands but will not be displayed here for reasons of brevity. This output is view–only; the attributes cannot be modified.

Entering the name of an attribute, such as **_w** (page width in columns), and pressing Enter will result in something like the following being displayed.

```
Name    Description                                              Value
_w      Page Width (characters); Default Value: %IwX             %IwX
          (value based on paper size specified with s0 -
          s5 attributes)


To LIST attributes, enter AttributeName1 ... (* for all attributes)
To CHANGE an attribute value, enter AttributeName=NewValue
To FORMAT and EDIT an attribute value, enter AttributeName~v
To EDIT the attribute file, enter ~v
To terminate, press Enter:
```

The name of the attribute is displayed, along with its text description from the message catalog and its current value. The prompt is also redisplayed. Note that you do not have to type the underscore for attributes whose name begin with an underscore. For example, the results above could have been obtained by typing **w** and pressing Enter. This output is view–only; the attribute cannot be modified.

Other attributes may be much harder to read in this form. For instance, entering **ia** at the prompt and pressing Enter will result in something like the following being displayed:

```
Name    Description                              Value
ia      ASCII                                     %Ide/pioformat -@%
                                                  Idd/%Imm -!%Idf/pi
                                                  of5202 -l%IwL -w%I
                                                  wW %f[begijpqstuvx
                                                  yzEGIJLOQWXZ] %Uh

To LIST attributes, enter AttributeName1 ..(* for all attributes)
To CHANGE an attribute value, enter AttributeName=NewValue
To FORMAT and EDIT an attribute value, enter AttributeName~v
To EDIT the attribute file, enter ~v
To terminate, press Enter:
```

Entering the name of an attribute, an **=**, and a value, and pressing Enter will result in the attribute being assigned that value, and the new value being displayed. For instance, entering **_w=60** and pressing Enter, or entering **w=60** and pressing Enter, will result in something like the following being displayed:

```
To LIST attributes, enter AttributeName1 ..(* for all attributes)
To CHANGE an attribute value, enter AttributeName=NewValue
To FORMAT and EDIT an attribute value, enter AttributeName~v
To EDIT the attribute file, enter ~v
To terminate, press Enter:  w=60

Name    Description                                          Value
_w      COLUMNS per page                                      60


To LIST attributes, enter AttributeName1 ..(* for all attributes)
To CHANGE an attribute value, enter AttributeName=NewValue
To FORMAT and EDIT an attribute value, enter AttributeName~v
To EDIT the attribute file, enter ~v
To terminate, press Enter:
```

The new value of **w** is displayed. (This example would result in the page width for this queue being permanently set to 60 columns.)

Entering **~v** and pressing Enter will result in something like the following being displayed:

```
:056:__FLG::
:625:CB:S[B]DyEn:
:626:CC:S[C]DyEn:
:627:CD:S[D]DyEn:
:628:CE:S[E]DyEn:
:629:CF:S[F]DyEn:
:630:CG:S[G]DyEn:
:622:Ca:DyS[G500]I[1810532]EnR[pioattr1.cat,1,631;(diag1) - do not print
job; di
splay main pipeline and pre-processing filter,(diag2) - do not pr
int job; displa
y all pipelines and filters,(display) - print job; display all pi
pelines and fil
ters,(ignore) - print job; ignore stderr produced by filters,(nor
mal) - print jo
b; exit if filters produce stderr=-a1,-a0\x27 \x27-A3,-a0\x27 \x2
7-A2,-a0\x27 \x
27-A0,-a0\x27 \x27-A1]:%?%G_a%t-a%I_a%e-a%I_a\x27 \x27-A%I_A%;
:674:Cs:S[B005]I[1810500]EnC[_s,_p]R[%'W0]:-s%I_s\x27 \x27-p%I_p
:013:_A:DnEnR[0,1,2,3]:1
:789:_E:S[B020]I[1810501]%IWY:!
:790:_G:S[E025]I[1810502]%IWY:!
:621:_H:S[F350]I[1810503]Dy:
:024:_I:Dn:
:791:_J:S[C950]I[1810533]%IWY:+
:792:_K:Dn:
:793:_L:S[D020]I[1810504]%IWY:+
:697:_O:DnEnR[1,3]:3
:683:_Q:S[E020]I[1810505]En%IW6:%IwQ
:794:_W:S[B025]I[1810506]%IWY:!
:795:_X:S[D030]I[1810507]EtL[/usr/bin/ls -1 /usr/lib/lpd/pio/tran
s1 | /usr/bin/s
ed '/^850$/d']V[%'WX]:ISO8859-1
:808:_Y:Dn:
:614:_Z:Dn%IWY:+
:063:_a:DnEnR[0,1]:0
:635:_b:S[D010]I[1810508]E#G[0..%?%G_l%{0}%=%t%e%G_l%G_t%-%{1}%-%
d%;]:0
:658:_d:S[C925]I[1810509]EnL[%IW2]F1:a
:615:_e:S[B010]I[1810510]%IWY:!
:659:_f:S[C930]I[1810535]EtL[%IW3]F1V[%'W7]Dy:
:623:_g:S[C250]I[1810511]E#G[1..]:1
"/var/spool/lpd/pio/@local/custom/asc:lp1" 318 lines, 15318 chara
cters
```

As is indicated by the last line of this sample, this is a **vi** session with the raw, unformatted version of the undigested printer colon file for this queue. If a **write** command is issued in this **vi** session, the definition is digested by the **piodigest** command and a new version of the digested printer colon file is created.

The most powerful option in **lsvirprt** is to type an attribute name followed by a **~v**. For instance, entering **ia~v** and pressing Enter will result in something like the following being displayed:

```
ASCII
ia = %Ide/pioformat -@%Idd/%Imm -!%Idf/piof5202 -l%IwL -w%IwW %f[
begijpqstuvxyzEGIJLOQWXZ] %Uh
```

```
 %Ide       INCLUDE: (Directory Containing Miscellaneous Modules)
 '/pioformat -@'
 %Idd       INCLUDE: (Directory Containing Digested Data Base Fil
es)
 '/'
 %Imm       INCLUDE: (File Name Of (Digested) Data Base; Init. By
            "piodigest" (mt.md.mn.mq:mv))
 ' -!'
 %Idf       INCLUDE: (Directory Containing Loadable Formatter Rou
tines)
 '/piof5202 -l'
 %IwL       INCLUDE: (Page Length In Chars, Using Length From Dat
a Base (used in pipelines))
 ' -w'
 %IwW       INCLUDE: (Page Width In Characters, Using Width From
Data Base (used in pipelines))
 ' '
 %f[begijpqstuvxyzEGIJLOQWXZ]  For Each Flag x on Command Line: "
-xArgument" -> OUTPUT
 ' '
 %Uh        Indicate to piobe: Pass the Following Attributes to s
ubsequent printer commands

/tmp/asc:lp1.ia" 24 lines, 1001 characters
```

As is indicated by the last line of the sample, this is again a **vi** session, but this time the attribute definition has been formatted and annotated. Here the root user can modify the attribute definition; if a **write** command is issued in this **vi** session, the definition is digested by the **piodigest** command and a new version of the digested printer colon file is created.

The formatted sample is divided into three parts. The first part is the **ia=**, followed by the attribute definition strung out horizontally. The second part is the annotations on the right–hand side of the **vi** session, the comments that describe the function of each particular printer colon file escape sequence. The third part is the formatted printer colon file escape sequences aligned on the left margin of the **vi** session. These escape sequences also have a horizontal formatting component; indentations are used to clarify the flow of if–then–else statements, nested or otherwise.

The first and second parts can be edited, but the editing changes have no effect and should therefore not be performed. Any changes made to the initial definition of the attribute or to the annotations will be ignored by **piodigest** if you write the file. It is the third part, the formatted attribute definition, that can be edited. If this part is edited and written, **piodigest** will issue an error message if any syntax errors are found. As with normal programming languages, you can make logic errors, but not syntax errors.

For practical examples of modifying printer colon files, see "Modifying the mi, mp, and _d Attributes on a PostScript Queue", on page 4-134.

Modifying the mi, mp, and _d Attributes on a PostScript Queue

Input data stream attributes store the pipelines for different input data stream types. The definition for a generic Postscript printer on a system running AIX Version 3.2.5 has four input data stream pipelines: **ia** (extended ASCII), **in** (troff), **ip** (passthru), and **is** (PostScript). The **_d** attribute in the colon file controls which of the four input data stream processing pipelines will, by default, be used. The default value for **_d** on a generic PostScript queue is **s** (PostScript), so the pipeline defined by **is** will be used.

Submitting a non–PostScript ASCII job to a PostScript queue with a generic PostScript virtual printer definition will result in the job just vanishing. The root user can modify the **mi**, **mp**, and **_d** attributes in the virtual printer definition so that the queue backend can determine the file type (PostScript or non–PostScript ASCII) and set the print environment accordingly.

The **mi** attribute uses single, comma–separated characters to name input data stream types. The **mp** attribute uses comma–separated strings to identify input data stream types. There is a one–to–one pairing between the characters of **mi** and the strings of **mp**.

The default value of **mi** for a generic PostScript virtual printer is **s**. The default value for **mp** is **%%**!; the first two characters of a PostScript file are **%!**. (Recall that printer colon file escape sequences all begin with a **%** so, to use a literal **%** in an attribute definition, it must be escaped with another **%**.) The virtual printer will interpret all files beginning with **%!** as being of data stream type **s**, and use the **is** pipeline. Since non–PostScript ASCII file do not begin with a **%!**, they will not be printed by this queue.

To enable ASCII printing on this queue, the root user can use **lsvirprt** to modify the referenced attributes as follows:

- **mi=a,s**
- **mp=,%%!**
- **_d=%mi**

Use **lsvirprt** to select the generic PostScript queue. The following prompt will appear:

```
To LIST attributes, enter AttributeName1 ..(* for all attributes)
To CHANGE an attribute value, enter AttributeName=NewValue
To FORMAT and EDIT an attribute value, enter AttributeName~v
To EDIT the attribute file, enter ~v
To terminate, press Enter:
```

At the prompt:

- Type **mi=a,s** and press **Enter**.
- Type **mp=,%%!** and press **Enter**.
- Type **d=%mi** and press **Enter**.

After each attribute re–definition is entered, the attribute's new value will be displayed, followed by the prompt.

This sets up a pairing of input data stream type **a** (extended ASCII) with any string at all, and input data stream type **s** (PostScript) with the string **%!**. Input data streams that do not being with a **%!** will be processed by the **ia** pipeline, and all input data streams that do begin with a **%!** will be processed by the **is** pipeline.

> **Note:** With a generic PostScript virtual printer without the modifications described above, it is possible to print non–PostScript ASCII files by overidding the input data stream type from the command line. For instance, the **d** flag fo **qprt** can be used as follows:
>
> ```
> qprt -Pqueue_name -da /etc/motd
> ```

This command requests that the file named /**etc**/**motd** be printed on the queue named `queue_name` and that the input data stream be treated as ASCII (the **ia** pipeline will be used).

How piobe Uses Printer Colon Files

piobe has the ability to generate diagnostic output. A specific example of this diagnostic output is used in the following discussion to examine the following:

- How **piobe** uses printer colon files.
- How printer colon file escape sequences are evaluated to resolve path names.
- How printer colon file escape sequences are evaluated to resolve page length.
- How printer colon file escape sequences are evaluated to resolve page width.

This discussion is complex, and is intended for readers that need to understand printer colon file escape sequences at a low level, perhaps because they want to write their own colon file for a unique and unsupported printer. Before reading this discussion, you should be familiar with these topics:

- Printer Colon File Escape Sequences, on page 4-14
- Viewing, Formatting, or Modifying Virtual Printer Definitions, on page 4-129

The following command uses the **–a1** flag/argument to request diagnostic data from the **piobe** backend. The remainder of the command specifies that the job be processed by the queue named **asc**, that three copies of the file named /**etc**/**motd** be printed in a 12–point Courier font rotated 90 degrees, that the job be pre–processed by the **pr** filter, and that any messages generated by the job should be mailed to the user that submitted the job.

```
qprt -a1 -Pasc -fp -z1 -p12 -scourier -C -N3 /etc/motd
```

Issuing this command results in mail similar to the following being sent to the user that issued the command:

```
Message from qdaemon:
=====> MESSAGE FROM PRINT JOB 31 (/etc/motd) <=====
0782-034 Below is the preview information requested with the -a1
flag.
         No files will be printed.

PRINTER:
[devices.cat,71,66;IBM 4029 LaserPrinter] (ASCII)

FLAG VALUES:
a=1, b=0, d=a, e=!, f=p, g=1, h=, i=0, j=1, l=48, p=12, q=, s=cou
rier, t=0,
u=1, v=6, w=128, x=2, y=!, z=1, A=1, B=nn, C=+, E=!, G=!, H=, I=,
 J=+, L=+,
N=3, O=3, P=ascx:lxx, Q=1, W=!, X=ISO8859-1, Z=+

PIPELINE OF FILTERS:
/usr/bin/pr
   -l48
   -w128  /etc/motd |
/usr/lib/lpd/pio/etc/pioformat
   -@/var/spool/lpd/pio/@local/ddi/ibm4029.asc.lp1.asc:lp1
   -!/usr/lib/lpd/pio/fmtrs/piof5202
   -l48
   -w128
   -p12
   -scourier
   -z1
```

The mail specifies several items:

- The physical printer that would have been used.
- The values of the flags that pertain to this spooler queue.
- The pipeline of filters that would have been executed.

The flags values used on the command line, **a1**, **Pasc**, **fp**, **z1**, **p12**, **scourier**, **C**, and **N3**, can be seen in the section of the mail labeled FLAG VALUES.

Of more interest is the section of the mail labeled PIPELINE OF FILTERS. Here the pipeline of filters determined by **piobe** and constructed by the shell can be seen. The **pr** filter will pre–process the print job (/**etc**/**motd**) and send its output to **pioformat**, the device–independent formatter driver.

This is a good place to examine how **piobe** uses the virtual printer definition associated with the spooler queue named **asc**. The colon file (which contains the virtual printer definition for this queue) uses the attribute **ia** to specify the input data stream pipeline (the PIPELINE OF FILTERS section above) for ASCII jobs. The value of **ia** for this queue is:

```
%Ide/pioformat -@%Idd/%Imm -!%Idf/piof5202 -l%IwL -w%IwW
%f[begijpqstuvxyzEGIJLOQWXZ] %Uh
```

The **lsvirprt** command can be used to format **ia** so it reads as follows:

```
%Id          INCLUDE: (Directory Containing Miscellaneous Modules)
'/pioformat -@'
%Idd        INCLUDE: (Directory Containing Digested Data Base
Files)
'/'
%Imm      INCLUDE: (File Name Of (Digested) Data Base; Init. By
                "piodigest" (mt.md.mn.mq:mv))
' -!'
%Idf          INCLUDE: (Directory Containing Loadable Formatter
Routines)
'/piof5202 -l'
%IwL        INCLUDE: (Page Length In Chars, Using Length From Data
Base
                (used in pipelines))
' -w'
%IwW      INCLUDE: (Page Width In Characters, Using Width From
Data Base
                (used in pipelines))
' '
%f[begijpqstuvxyzEGIJLOQWXZ] For Each Flag x on Command
Line:"-xArgument" ->
                            OUTPUT
' '
%Uh    Indicate to piobe: Pass the Following Attributes to
subsequent printer commands
```

The **%Id** resolves to `/usr/lib/lpd/pio/etc`, the directory that contains miscellaneous modules. The '/**pioformat –@**' is appended, without the single quotes, to the previous string, becoming `/usr/lib/lpd/pio/etc/pioformat`, otherwise known as the full path name to the formatter driver. The **–@** after **pioformat** is a flag to the **pioformat** command which, in this instance, specifies the full path name of the digested database file to be accessed.

The value of the **–@** flag is specified by the concatenation of **%Idd**, '/', and **%Imm**. The value of **%Idd** is defined in the colon file as **%I@5**/**ddi**. The **@5** is an automatic variable whose value is `/var/spool/lpd/pio/@local`, so `%`**Idd** resolves to `/var/spool/lpd/pio/@local/ddi`. The '/', without the single quotes, is appended to that path. **%Imm** is defined in the colon file as **mt.md.mn.mq.mv**, five other virtual printer attributes. These five attributes define:

- **mt** – Printer type
- **md** – Output data stream type
- **mn** – Device name
- **mq** – Queue name (name of a queue stanza in /**etc**/**qconfig**)
- **mv** – Virtual printer name (name of a corresponding device stanza in /**etc**/**qconfig**)

These file virtual printer attributes are initialized by the **piodigest** command at the time the queue and virtual printer are created. The combination of the five is unique in the virtual printer database.

For this queue, the value of **mt.md.mn.mq.mv** is **ibm4029.asc.lp1.asc.lp1**. Thus the value of the **–@** flag to **pioformat** becomes `/var/spool/lpd/pio/@local/ddi/ibm4029.asc.lp1.asc.lp1`, the full path of the digested database file defining the virtual printer associated with this queue (**asc**).

The **'–!'** is a second flag to **pioformat**, specifying the full path name of the device–dependent formatter to be loaded, linked, and driven at runtime by the formatter driver, **pioformat**. It is here that you can see how and where the runtime connection between these two modules occurs.

The value of the **–!** flag is specified by the concatenation of the remainder of the printer colon file escape sequences shown in the formatted form of the **ia** attribute, beginning with **%ldf** and **'/piof5202 –l'**.

The value of **%ldf** in defined in the colon file as **%l@4/fmtrs**. The **@4** is an automatic variable whose value is `/usr/lib/lpd/pio`, so **%ldf** resolves to `/usr/lib/lpd/pio/fmtrs`. The **'piof5202 –l'**, without the single quotes, is appended to this string, so the value of the **–!** flag to this point becomes `/usr/lib/lpd/pio/fmtrs/piof5202 -l`. The **–l** is a flag to **piof5202**, the device–dependent formatter for an ASCII data stream on an IBM 4029 LaserPrinter, that specifies page width in characters.

The calculation of the argument to the **–l** flag, **%lwL**, is described in "Calculating Page Length Using Printer Colon File Escape Sequences", on page 4-138.

Calculating Page Length Using Printer Colon File Escape Sequences

The printer colon file for an ASCII queue on an IBM 4029 LaserPrinter defines page length, in lines, with the work attribute **wL**. Obtaining a numeric value for **wL** involves evalutating embedded references in the definition of **wL**. As formatted by the **lsvirprt** commmand, **wL** is defined as follows:

```
Page Length In Chars, Using Length From Data Base (used in
pipelines)
wL = %?%Cl%t%f!l%e%I_l%;

 %?             <IF>
     %Cl        PUSH: (1 If -l Flag on Command Line; Otherwise 0)
 %t             <THEN>
     %f!l       For Each Flag x on Command Line: "-xArgument" ->
OUTPUT
 %e             <ELSE>
     %I_l       INCLUDE: (LINES per page)
 %;             <END>
```

The **%Cl** checks to see if the **l** flag was used on the command line; if it was, then a **1** is pushed onto the stack, else a **0** is pushed onto the stack. In this case, the **l** flag was not used on the command line so a **0** is pushed onto the stack. The **%t** checks for a true (non–zero) value on the stack and, not finding one, executes the **%e** (else) construct **%I_l**.

_l is defined as `%IwY`, shown below as formatted by the **lsvirprt** command.

```
Default Page Length (lines)
wY = %?%G_z%{1}%&%t%GwJ%e%GwK%;%G_v%*%{300}%/%d

 %?             <IF>
     %G_z       PUSH: (Page ORIENTATION)
     %{1}       PUSH: (Integer Constant 1)
     %&         PUSH: (pop2 & pop1) -- Bitwise AND
 %t             <THEN>
     %GwJ       PUSH: (Primary Page Width (-z 0) or Secondary Page
                       Length (-z1), in pels)
 %e             <ELSE>
     %GwK       PUSH: (Primary Page Length (-z 0) or Secondary Page
                       Width (-z1), in pels)
 %;             <END>
 %G_v           PUSH: (LINE DENSITY (lines per inch))
 %*             PUSH: (pop2 * pop1)
 %{300}         PUSH: (Integer Constant 300)
 %/             PUSH: (pop2 / pop1)
 %d             POP -> ASCII String -> OUTPUT
```

The calculation of **_l** begins by pushing the value of **_z**, page orientation, onto the stack. The job submission command being used in this example, `qprt -a1 -Pasc -fp -z1 -p12 -scourier -C -N3 /etc/motd`, specifies a **z** value of **1**, so a **1** is pushed onto the stack. The **%{1}** pushes another **1** onto the stack, after which the **%&** pops the top two values (both **1**s) off the stack and performs a bitwise AND with the two values. The result of the bitwise AND, a **1**, is pushed onto the stack.

Note: The test is a bitwise AND instead of a simple test for equality because the legal values for the **z** flag are **0**, **1**, **2**, and **3**, correpsonding to the legal number of 90 degree rotations that can be applied to a printed page.

The next **%t** finds a **1** on the stack and so the `then` clause, **%GwJ**, is resolved before any more work is done on resolving **_l**.

As formatted by **lsvirprt**, **wJ** is defined as follows:

```
Primary Page Width (-z 0) or Secondary Page Length (-z1), in pels
wJ = %G_Q%Pq%?%GWu%{3}%<%t%?%gq%{1}%=%t%{2400}%e%gq%{2}%=%t%{2400
}%e%gq%{3}%=%t%{1999}%e%gq%{4}%=%t%{2330}%e%{2025}%;%e%?%gq%{1}%=
%t%{1012}%e%gq%{2}%=%t%{1012}%e%gq%{3}%=%t%{1087}%e%gq%{4}%=%t%{1
149}%e%gq%{5}%=%t%{1763}%e%{1928}%;%;%d

 %G_Q          PUSH: (PAPER SIZE override for input paper source)
 %Pq           POP -> Internal Variable q
 %?            <IF>
     %GWu      PUSH: (Calculate value for paper source based on _
                     O and _u.)
     %{3}      PUSH: (Integer Constant 3)
     %<        PUSH: (pop2 < pop1 ?)
 %t            <THEN>
     %?        <IF>
         %gq   PUSH: (Internal Variable q)
         %{1}  PUSH: (Integer Constant 1)
         %=    PUSH: (pop2 = pop1 ?)
     %t        <THEN>
         %{2400}  PUSH: (Integer Constant 2400)
     %e        <ELSE>
         %gq   PUSH: (Internal Variable q)
         %{2}  PUSH: (Integer Constant 2)
         %=    PUSH: (pop2 = pop1 ?)
     %t        <THEN>
         %{2400}  PUSH: (Integer Constant 2400)
     %e        <ELSE>
         %gq   PUSH: (Internal Variable q)
         %{3}  PUSH: (Integer Constant 3)
         %=    PUSH: (pop2 = pop1 ?)
     %t        <THEN>
         %{1999}  PUSH: (Integer Constant 1999)
     %e        <ELSE>
         %gq   PUSH: (Internal Variable q)
         %{4}  PUSH: (Integer Constant 4)
         %=    PUSH: (pop2 = pop1 ?)
     %t        <THEN>
         %{2330}  PUSH: (Integer Constant 2330)
     %e        <ELSE>
         %{2025}  PUSH: (Integer Constant 2025)
     %;        <END>
 %e            <ELSE>
     %?        <IF>
         %gq   PUSH: (Internal Variable q)
         %{1}  PUSH: (Integer Constant 1)
         %=    PUSH: (pop2 = pop1 ?)
     %t        <THEN>
         %{1012}  PUSH: (Integer Constant 1012)
     %e        <ELSE>
         %gq   PUSH: (Internal Variable q)
         %{2}  PUSH: (Integer Constant 2)
         %=    PUSH: (pop2 = pop1 ?)
     %t        <THEN>
         %{1012}  PUSH: (Integer Constant 1012)
     %e        <ELSE>
         %gq   PUSH: (Internal Variable q)
         %{3}  PUSH: (Integer Constant 3)
         %=    PUSH: (pop2 = pop1 ?)
     %t        <THEN>
         %{1087}  PUSH: (Integer Constant 1087)
     %e        <ELSE>
         %gq   PUSH: (Internal Variable q)
         %{4}  PUSH: (Integer Constant 4)
         %=    PUSH: (pop2 = pop1 ?)
```

```
     %t         <THEN>
         %{1149}  PUSH: (Integer Constant 1149)
     %e         <ELSE>
         %gq    PUSH: (Internal Variable q)
         %{5}   PUSH: (Integer Constant 5)
         %=     PUSH: (pop2 = pop1 ?)
     %t         <THEN>
         %{1763}  PUSH: (Integer Constant 1763)
     %e         <ELSE>
         %{1928}  PUSH: (Integer Constant 1928)
     %;         <END>
 %;             <END>
 %d             POP -> ASCII String -> OUTPUT
```

The calculation of **wJ** begins by pushing the value of **_Q**, the paper size override for the input paper source, onto the stack. The value of **_Q** is defined as **%lwQ**. As formatted by the **lsvirprt** command, **wQ** is defined as follows:

```
Paper or Envelope Size For the Paper Source Selected By the -O
and -u Flag Values (Refer to the s0, s1, s2, s3, and s4
attributes)
wQ=
%?%GWu%{0}%=%t%Gs0%e%GWu%{1}%=%t%Gs1%e%GWu%{2}%=%t%Gs2%e%GWu%{3}%
=%t%Gs3%e%Gs4%;%d
```

```
 %?             <IF>
     %GWu       PUSH: (Calculate value for paper source based on
_O and _u.)
     %{0}       PUSH: (Integer Constant 0)
     %=         PUSH: (pop2 = pop1 ?)
 %t             <THEN>
     %Gs0       PUSH: (PAPER SIZE for manual paper feed)
 %e             <ELSE>
     %GWu       PUSH: (Calculate value for paper source based on
_O and _u.)
     %{1}       PUSH: (Integer Constant 1)
     %=         PUSH: (pop2 = pop1 ?)
 %t             <THEN>
     %Gs1       PUSH: (PAPER SIZE for tray 1 (upper))
 %e             <ELSE>
     %GWu       PUSH: (Calculate value for paper source based on
_O and _u.)
     %{2}       PUSH: (Integer Constant 2)
     %=         PUSH: (pop2 = pop1 ?)
 %t             <THEN>
     %Gs2       PUSH: (PAPER SIZE for tray 2 (lower))
 %e             <ELSE>
     %GWu       PUSH: (Calculate value for paper source based on
_O and _u.)
     %{3}       PUSH: (Integer Constant 3)
     %=         PUSH: (pop2 = pop1 ?)
 %t             <THEN>
     %Gs3       PUSH: (ENVELOPE SIZE for envelope feeder)
 %e             <ELSE>
     %Gs4       PUSH: (ENVELOPE SIZE for manual envelope feed)
 %;             <END>
 %d             POP -> ASCII String -> OUTPUT
```

The calculation of **wQ** begins by pushing the value of **Wu**, onto the stack. As formatted by the **lsvirprt** command, the value of **Wu** is defined as follows:

```
Calculate value for paper source based on _O and _u.
Wu =
%?%CO%t%?%G_O%{1}%=%t%?%Cu%t%?%G_u%{2}%>%t%{4}%e%{0}%;%e%{0}%;%e%
G_u%;%e%G_u%;%d
```

```
 %?             <IF>
     %CO        PUSH: (1 If -O Flag on Command Line; Otherwise 0)
 %t             <THEN>
     %?         <IF>
         %G_O   PUSH: (Type of INPUT PAPER HANDLING (backward
compatibility
                purpose only))
         %{1}   PUSH: (Integer Constant 1)
         %=     PUSH: (pop2 = pop1 ?)
     %t         <THEN>
         %?     <IF>
             %Cu  PUSH: (1 If -u Flag on Command Line; Otherwise
0)
         %t     <THEN>
             %?  <IF>
                 %G_u  PUSH: (Input PAPER SOURCE)
                 %{2}  PUSH: (Integer Constant 2)
                 %>  PUSH: (pop2 > pop1 ?)
             %t  <THEN>
                 %{4}  PUSH: (Integer Constant 4)
             %e  <ELSE>
                 %{0}  PUSH: (Integer Constant 0)
             %;  <END>
         %e     <ELSE>
             %{0}  PUSH: (Integer Constant 0)
         %;     <END>
     %e         <ELSE>
         %G_u   PUSH: (Input PAPER SOURCE)
     %;         <END>
 %e             <ELSE>
     %G_u       PUSH: (Input PAPER SOURCE)
 %;             <END>
 %d             POP -> ASCII String -> OUTPUT
```

The calculation for the value of **Wu** begins by evaluating **%CO**, which pushes a **1** onto the stack if the **O** flag was specified on the command line, else it pushes a **0** onto the stack. The job submission command being used in this example did not use the **O** flag, so a **0** is pushed onto the stack. The next **%t**, finding a **0** on the stack, skips the next 23 lines of printer colon file escape sequences and evaluates the **%e** (else) clause on the fourth line from the bottom of the formatted form of the **Wu** attribute. The else clause is **%G_u**, which pushes the value of **_u**, the input paper source, onto the stack. The default value for **_u** for this virtual printer is **1**, so a **1** is pushed onto the stack. The next **%;** terminates the original **%?**. The only remaining escape sequence, **%d**, pops the top value (a **1**) off the stack and returns it in ASCII format to the in–progress calculation of **wQ**.

The **1** returned to the in–progress calculation of **wQ** is the value of **Wu**, and is pushed onto the stack. The next **%{0}** pushes a **0** onto the stack. **%=** pops the top two values (a **0** and a **1**) off the stack and, checking them for equality, fails; a **0** is pushed onto the stack.

The next **%t** finds the **0** and so skips the **%Gs0** and instead evaluates the **%e** (else) clause. **Wu** (a **1**) is again pushed onto the stack. The **%{1}** pushes another **1** onto the stack. The **%=** again pops the top two values (two **1**s) off the stack and, checking them for equality, succeeds; a **1** is pushed onto the stack.

The next **%t** finds the **1** and so evaluates the **%Gs1**. The **s1** attribute is a number representing the paper size for paper tray 1, the upper paper tray, and its default value in this virtual printer definition is **1**. This **1** is pushed onto the stack. All but the very last of the remaining printer colon escape sequences in the evaluation of **wQ** are skipped. The **%d** pops the top value (a **1**) off the stack and returns it in ASCII format to the in–progress calculation of **wJ**.

The **1** returned to the in–progress caclulation of **wJ** is the value of **_Q**, and is pushed onto the stack. It is immediately popped back off the stack and stored in the internal variable **q**. **Wu,** already determined to be **1**, is again pushed onto the stack. **%{3}** pushes a **3** onto the stack, then the **%<** pops the top two values off the stack and checks to see if the second

value popped is less than the first value popped. **1** is less than **3**, so a **1** is pushed onto the stack. The **%t** finds the **1** and so enters the if–then–else–then–else–then–else... sequence looking for an integer to pair with the paper size value calculated for **_Q**.

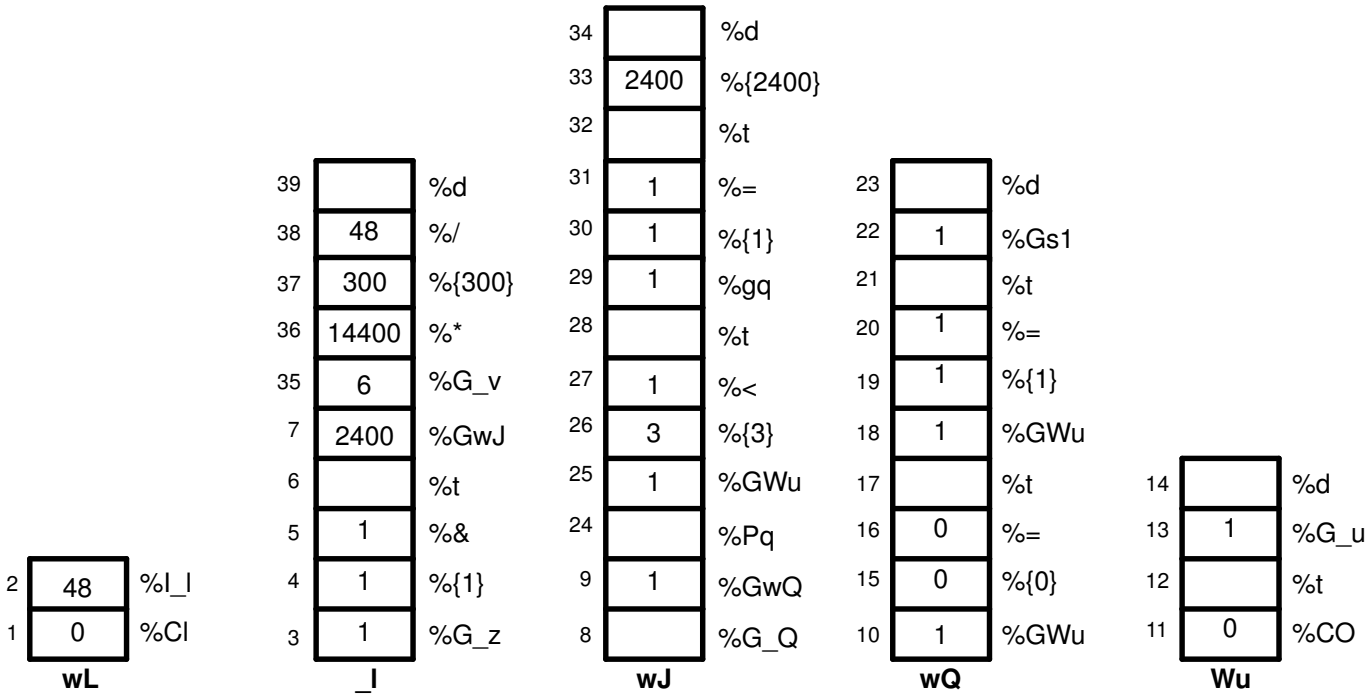
The **%gq** fetches the stored value of **_Q** from the internal variable **q**, and pushes it onto the stack. The **%{1}** pushes another **1** onto the stack. The **%=** pops the top two values (two **1**s) off the stack and, checking them for equality, succeeds; a **1** is pushed onto the stack. The **%t** finds the **1** and so evaluates the **%{2400}**, which pushes **2400** onto the stack. The calculation of **wJ** then falls through all but the last line of the remaining printer colon file escape sequences defining **wJ**. The last escape sequence, **%d**, pops the top value, **2400**, off the stack and returns it, in ASCII format, to the in–progress calculation of **wY**.

The **2400** returned to the in–progress calculation of **wY** is the value of **wJ**, and is pushed onto the stack. The **%GwK** in the else clause is skipped and the **%;** terminates the if–then–else sequence. The **%G_v** fetches the line density (in lines per inch), **6**, and pushes it onto the stack. The **%*** pops the top two values (a **6** and a **2400**) off the stack, multiplies them together, and pushes the result (**14400**) back onto the stack. The **%{300}** pushes a **300** onto the stack. The **%**/ pops the top two values (a **14000** and a **300**) off the stack, divides the second value popped off the stack by the first value popped off the stack, and pushes the result (**48**) onto the stack. The **%d** pops the top value (**48**) off the stack and returns it to the in–progress calculation of **wL**.

The **48** returned to the in–progress calculation of **wL** is the value of **_l**. The value of **wL** was originally referenced in the determination of the value of the **ia** attribute, the input datastream pipeline for ASCII jobs. The number **48** replaces the **%lwL** in that determination, so the value of the **–!** flag to **pioformat** becomes `/usr/lib/lpd/pio/fmtrs/piof5202 -l48`. The `-l48` can be seen in the original diagnostic message from **piobe** that was the basis of this discussion; it is part of the PIPELINE OF FILTERS section of the mail sent by the **qdaemon** on behalf of **piobe**.

The calculation of the value associated with the **–w** flag to **piof5202** is described in ”Calculating Page Width Using Printer Colon File Escape Sequences”, on page 4-147.

The Calculation of Page Length figure depicts the stack operations (as described above) used to obtain a final numeric value for page length in lines. The following numbered steps correspond to the numbers on the left side of the columns in the figure, and provide a step–by–step description of the evaluation of the printer colon file escape sequences defining page length, in lines, for this particlular queue (**asc**), colon file, and command line.



Calculation of Page Length

1. **%Cl** – Pushes a **0** onto the stack since the **l** flag was not used on the command line.
2. **%l_l** – Calls for the evaluation of **_l.**
3. **%G_z** – Pushes a **1** onto the stack.
4. **%{1}** – Pushes a **1** onto the stack.
5. **%&** – Pops the top two values (two **1**s) off the stack, performs a bitwise AND on the two values, and pushes the resultant **1** onto the stack.
6. **%t** – Pops the **1** off the stack and, since it is a TRUE (non–zero) value, calls for the evaluation of **%GwJ**. The stack labeled **_l** is now empty.
7. **%GwJ** – Calls for the evaluation of **wJ**.
8. **%G_Q** – Calls for the evaluation of **wQ**.
9. **%GwQ** – Calls for the evaluation of **%GWu**.
10. **%GWu** – Calls for the evaluation of **Wu**.
11. **%CO** – Pushes a **0** onto the stack since the **O** flag was not used on the command line.
12. **%t** – Pops the **0** off the stack and, since it is a FALSE (zero) value, calls for the evaluation of **%G_u**. The stack labeled **Wu** is now empty.
13. **%G_u** – Pushes a **1** onto the stack.
14. **%d** – Pops the **1** off the stack and returns it, in ASCII format, to the in–progress calculation of **wQ**.
15. **%{0}** – Pushes a **0** onto the stack.
16. **%=** – Pops the **0** and **1** off the stack, compares them for equality, and pushes the resultant **0** onto the stack.
17. **%t** – Pops the **0** off the stack and, since it is a FALSE (zero) value, calls for the evaluation of **%GwU**.
18. **%GWu** – This value is already known, so a **1** is pushed onto the stack.

19. **%{1}** – Pushes a **1** onto the stack.
20. **%=** – Pops the two **1**s off the stack, compares them for equality, and pushes the resultant **1** onto the stack.
21. **%t** – Pops the **1** off the stack and, since it is a TRUE (non–zero) values, calls for the evaluation of **%Gs1**.
22. **%Gs1** – Pushes a **1** onto the stack.
23. **%d** – Pops the **1** off the stack and returns it, in ASCII format, to the in–progress calculation of **wJ**.
24. **%Pq** – Pops the **1** off the stack and stores it in the internal variable **q**.
25. **%GWu** – This value is already known, so a **1** is again pushed onto the stack.
26. **%{3}** – Pushes a **3** onto the stack.
27. **%<** – Pops the **3** and the **1** off the stack and, since **1** is less than **3**, pushes a **1** onto the stack.
28. **%t** – Pops the **1** off the stack and, since it is a TRUE (non–zero) values, calls for the evaluation of **%gq**.
29. **%gq** – Pushes the value of the internal variable **q**, a **1**, onto the stack.
30. **%{1}** – Pushes a **1** onto the stack.
31. **%=** – Pops the two **1**s off the stack, compares them for equality, and pushes the resultant **1** onto the stack.
32. **%t** – Pops the **1** off the stack and, since it is a TRUE (non–zero) values, calls for the evaluation of **%{2400}**.
33. **%{2400}** – Pushes a **2400** onto the stack.
34. **%d** – Pops the **2400** off the stack and returns it, in ASCII format, to the in–porgress calculation of **_l**.
35. **%G_v** – Pushes a **6** onto the stack.
36. **%*** – Pops the **6** and the **2400** off the stack, multiplies them together, and pushes the resultant **14400** onto the stack.
37. **%{300}** – Pushes a **300** onto the stack.
38. %/ – Pops the **300** and the **14400** off the stack, divides **14400** by **300**, and pushes the resultant **48** onto the stack.
39. **%d** – Pops the **48** off the stack and returns it, in ASCII format, to the in–progress determination of **ia**, the input data stream pipeline for ASCII jobs.

Why the Stack Language Describing Page Length Works

Going beyond the mechanical description of what happens when **piobe** resolves the reference to **%lwL**, here is a description of why the printer colon file escape sequence logic described above works.

The IBM LaserPrinter 4029 Series Technical Reference contains a figure and a table that together describe the printable and unprintable areas on a page, and the paper and envelope dimensions, in pels, for standard paper and envelope sizes. For instance, the printable area on an 8.5 x 11 (width by length) inch page is 2400 x 3200 pels (width by length). Note that if the page is rotated either 90 or 270 degrees for landscape printing, the dimensions are swapped and become 3200 x 2400 pels (width by length).

The evaluation of **%lwL** begins by checking to see if the **l** flag was used on the command line; if it was, then there are no calculations to perform. The requested value will be used. (That is not a promise that it will work, just that it will be used.) If the **l** flag was not used on the command line, then **piobe** has to figure out how long the page is under the current job environment, as determined by other command line flags and by colon file defaults.

The first item checked in the evaluation of **_l** (page length) is page orientation (**_z**). As noted above, rotating the page by odd multiples of 90 degrees flips the page dimensions. Looking at the if–then–else statement that is the beginning of the definition of **wY**, it can be seen that the value of **_z** is a switch that controls which of **wJ** and **wK** will be used for page length. If the page has a portrait orientation, then **wK** is length. If the page has a landscape orientation, then **wJ** is length. After the page length in pels is resolved, the remainder of the escape sequences in the definition of **wY** just take vertical line denisty into account while converting the number of pels to the number of lines.

wJ is selected because the page orientation is landscape. Thus far all that is known is that the dimensions have been flipped; what the dimensions actually are is still unknown. The evaluation of **wJ** begins by fetching the value (if any) of a command line usage of the **Q** flag, which is a printer–dependent value requesting a specific paper size. If the **Q** flag was used on the command line, then that value will be used to select the paper length in pels, otherwise a value for **Q** will be determined by evaluating **Wu**, which is a value for the paper source based on the attributes **_O** (type of input paper handling) and **_u** (input paper source). Note that **_Q** is defined as **%lwQ**, whose definition begins with **%lWu**.

Since **Q** was not used on the command line, the evaluation of **Wu** determines that the **O** flag wasn't used either, and so executes the else clause in the outer if–then–else statement in the definition of **Wu**, returning the default colon file value of **_u**, **1**, to the evaluation of **wQ**.

Since this is as deep as the nesting of escape sequences goes for the evaluation of **_l**, it is worth taking a closer look at the logic defining **Wu**. Keep in mind the definitions and legal values for **O**, **u**, and **Q**, which are:

- **O** – type of input paper handling – **1** (manual), **2** (continuous forms), **3** (sheet feed) – default is sheet feed.
- **u** – input paper source – **1** (primary), **2** (alternate), **3** (envelope) – default is primary.
- **Q** – paper size for input paper source – values are printer–dependent – defined by combination of **O** and **u**.

The escape sequences defining **Wu** say this:

- Case 1: If the **O** flag was not used on the command line, then return the colon file default value for **_u**. For example, if the user did not specify a type of input paper handling, then return the input paper source (either from the command line or the default from the colon file) to the evaluation of **%lwQ**.
- Case 2: If the **O** flag was used on the command line but its value was not **1**, then return the colon file's default value for **_u**. For example, if the user specified a type of input paper handling other than manual, then return the input paper source (either from the command line or the default from the colon file) to the evaluation of **%lwQ**.
- Case 3: If the O flag was used on the command line and its value was **1**, and the **u** flag was not used on the command line, then return a **0**. For example, if the user–specified manual paper handling but did not specify an input paper source, then return a **0** to the evaluation of **%lwQ**.
- Case 4: If the **O** flag was used on the command line and its value was **1**, and the **u** flag was used on the command line and its value was not greater than **2**, then return a **0**. For example, if the user specified manual paper handling and also specified either the primary or alternate input paper source, then return a **0** to the evaluation of **%lwQ**.
- Case 5: If the **O** flag was used on the command line and its value was **1**, and the **u** flag was used on the command line and its value was greater than **2**, then return a **4**, For example, if the user specified manual paper handling and also specified an input paper source of envelope, then return a **4** to the evaluation of **%lwQ**.

The definition of **wQ** is an if–then–else–then–else–then–else–then–else statement that repeatedly compares the value of **Wu** to the integers **0**, **1**, **2**, and **3**, looking for a match. The match selects the value of one of the attriubes **s0**, **s1**, **s2**, **s3**, or **s4**, respectively (**s4** is selected when there is no other match). The items these attributes define are as follows:

- **s0** – paper size for manual paper feed

- **s1** – paper size for tray 1 (upper)
- **s2** – paper size for tray 2 (lower)
- **s3** – envelope size for envelope feeder
- **s4** – envelope size for manual envelope size

In the virtual printer definition for an ASCII queue on an IBM 4029 LaserPrinter, there are only two unique values for these five attributes: **s0**, **s1**, and **s2** are all **1**, while **s3** and **s4** are both **3**.

Looking back up the nested escape sequences, you can see that the definition of **wJ** is composed of an outer if–then–else statement. Both the if and the else pieces of this statement contain a chain of if–then–else–then–else... statements. The value of **Wu** (which is a value for paper source, based on **O** and **u**) determines whether the if or the else piece of the outer statment executes; if **Wu** is **1** or **2** (less than **3**), then the if piece executes; otherwise the else piece executes. It is in the final determination of **wJ** that the page length, in pels, is fixed.

The if piece of the outer if–then–else statement defining **wJ** selects a pel value from a range of non–envelope paper sizes; the else piece of the outer if–then–else statement selects a pel value from a range of envelope paper sizes. **Wu** controls which piece of the if–then–else statement executes but, once either the if or else piece has been chosen, it is the value of **Q** that causes a pel value to be selected. The five cases listed above work like this:

Case 1: Either the command line value of **u** or the default from the colon file (**1**, primary paper tray) is returned to the evaluation of **wQ**. The remaining escape sequences in the definiton of **wQ** test the value of **Wu** and select the value of one of **s0**, **s1**, **s2**, **s3**, or **s4**. That value is in turn returned to the evaluation of **wJ**. If **u** is **1** or **2** , then **Q** will be **1** (non–envelope paper size). If **u** is **3**, then **Q** will be **3** (envelope paper size). When the evaluation of **wJ** is resumed, a **u** value of **1** or **2** will direct the process into the if piece of the outer if–then–else statement, and the **Q** value of **1** will select a page length of 2400 pels. A **u** value of **3** will direct the process into the else piece of the outer if–then–else statement, and the **Q** value of **3** will select an envelope page length of 1087 pels.

Case 2: Same as case 1.

Case 3: The user–specified manual paper handling on the command line but did not specify a paper source so **Wu** is assigned the value **0**, and that value is returned to the evaluation of **wQ**. The **0** will cause **wQ** to be assigned the value of **s0** (the paper size for manual paper feed, a **1**). When the evaluation of **wJ** is resumed, the **u** value of 0 will direct the process into the if piece of the outer if–then–else statement, and the **Q** value of **1** (**s0**) will select a page length of 2400 pels.

Case 4: The user specified manual paper handling on the command line and also used the **u** flag to specify either the primary or alternate paper source (but definitely not envelopes). As with case 3, a page length of 2400 pels will be chosen.

Case 5: The user–specified manual paper handling on the command line and also used the **u** flag to specify an envelope paper source so **Wu** is assigned the value **4**, and that value is returned to the evaluation of **wQ**. The 4 will cause **wQ** to be assigned the value of **s4** (the envelope size for manual envelope size, a **3**). When the evaluation of **wJ** is resumed, the **u** value of **4** will direct the process into the else piece of the outer if–then–else statement, and the **Q** value of **3** will select an envelope length of 1087 pels.

Our example is case 1: neither the **O** nor the **u** flags were used on the command line, so **Wu** is assigned a value of **1**, the default **_u** value for this colon file. When the evaluation of **wQ** resumes, the match occurs on **s1**, and a **1** is returned to the evaluation of **wJ**. The **u** value of **1** direct the process into the if piece of the outer if–then–else statement, and the **Q** value of **1** selects a page length of 2400 pels. This value is returned to the evaluation of **_l**.

The remaining printer colon file escape sequences defining **_l** reason that if there are 2400 pels available (vertically), and if we want six lines per inch, and if there are 300 pels per inch (the resolution of the printer), then 48 lines can be printed on a page. The value **48** is returned to the evaluation of **ia**. That's basically where the **–l48** in the PIPELINE OF FILTERS came from.

Calculating Page Width Using Printer Colon File Escape Sequences

The printer colon file for an ASCII queue on an IBM 4029 LaserPrinter defines page width, in characters, with the work attribute **wW**. As formatted by the **lsvirprt** command, **wW** is defined as follows:

```
Page Width In Characters, Using Width From Data Base (used in
pipelines)
wW = %?%Cw%t%f!w%e%I_w%;

 %?             <IF>
     %Cw        PUSH: (1 If -w Flag on Command Line; Otherwise 0)
 %t             <THEN>
     %f!w       For Each Flag x on Command Line: "-xArgument" ->
OUTPUT
 %e             <ELSE>
     %I_w       INCLUDE: (COLUMNS per page)
 %;             <END>
```

The **%Cw** checks to see if the **w** flag was used on the command line; if it was, then a **1** is pushed onto the stack, else a **0** is pushed onto the stack. In this case, the **w** flag was not used on the command line so a **0** is pushed onto the stack. The **%t** checks for a true (non–zero) value on the stack and, not finding one, executes the **%e** (else) construct **%I_w**.

_w is defined as **%lwX**, shown below as formatted by the **lsvirprt** command.

```
Default Page Width (characters)
wX =
%?%G_z%{1}%&%t%GwK%e%GwJ%;%?%G_p%{17}%=%t%{171}%e%G_p%{10}%*%;%*%
?%G_W%t%{6000}%e%{3000}%;%/%d
```

```
 %?             <IF>
     %G_z       PUSH: (Page ORIENTATION)
     %{1}       PUSH: (Integer Constant 1)
     %&         PUSH: (pop2 & pop1) -- Bitwise AND
 %t             <THEN>
     %GwK       PUSH: (Primary Page Length (-z 0) or Secondary
Page Width (-z
                1), in pels)
 %e             <ELSE>
     %GwJ       PUSH: (Primary Page Width (-z 0) or Secondary Page
Length (-z
                1), in pels)
 %;             <END>
 %?             <IF>
     %G_p       PUSH: (PITCH (characters per inch))
     %{17}      PUSH: (Integer Constant 17)
     %=         PUSH: (pop2 = pop1 ?)
 %t             <THEN>
     %{171}     PUSH: (Integer Constant 171)
 %e             <ELSE>
     %G_p       PUSH: (PITCH (characters per inch))
     %{10}      PUSH: (Integer Constant 10)
     %*         PUSH: (pop2 * pop1)
 %;             <END>
 %*             PUSH: (pop2 * pop1)
 %?             <IF>
     %G_W       PUSH: (DOUBLE-WIDE print?)
 %t             <THEN>
     %{6000}    PUSH: (Integer Constant 6000)
 %e             <ELSE>
     %{3000}    PUSH: (Integer Constant 3000)
 %;             <END>
 %/             PUSH: (pop2 / pop1)
 %d             POP -> ASCII String -> OUTPUT
```

The calculation of **_w** begins by pushing the value of **_z**, page orientation, onto the stack. The job submission command being used in this example, `qprt -a1 -Pasc -fp -p12 -scourier -C -N3 /etc/motd`, specifies a **z** value of **1**, so a **1** is pushed onto the stack. The **%{1}** pushes another **1** onto the stack, after which the **%&** pops the top two values (both**1**s) off the stack and performs a bitwise AND with the two values. The result of the bitwise AND, a **1**, is pushed onto the stack.

Note: The test is a bitwise AND instead of a simple test for equality because the legal values for the **z** flag are **0**, **1**, **2**, and **3**, corresponding to the legal number of 90 degree rotations that can be applied to a printed page.

The next **%t** finds a true (non–zero) value on the stack and so the then clause, **%GwK**, is resolved before any more work is done resolving **_w**.

As formatted by **lsvirprt**, **wK** is defined as follows:

```
Primary Page Length (-z 0) or Secondary Page Width (-z 1), in
pels
wK =
%G_Q%Pq%?%GWu%{3}%<%t%?%gq%{1}%=%t%{3200}%e%gq%{2}%=%t%{4100}%e%g
q%{3}%=%t%{2935}%e%gq%{4}%=%t%{3407}%e%{3050}%;%e%?%gq%{1}%=%t%{2
150}%e%gq%{2}%=%t%{2562}%e%gq%{3}%=%t%{2750}%e%gq%{4}%=%t%{2498}%
e%gq%{5}%=%t%{2604}%e%{2852}%;%;%d
```

```
 %G_Q           PUSH: (PAPER SIZE override for input paper source)
 %Pq            POP -> Internal Variable q
 %?             <IF>
     %GWu       PUSH: (Calculate value for paper source based on
_O and _u.)
     %{3}       PUSH: (Integer Constant 3)
```

```
    %<        PUSH: (pop2 < pop1 ?)
%t            <THEN>
    %?        <IF>
        %gq   PUSH: (Internal Variable q)
        %{1}  PUSH: (Integer Constant 1)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{3200}  PUSH: (Integer Constant 3200)
    %e        <ELSE>
        %gq   PUSH: (Internal Variable q)
        %{2}  PUSH: (Integer Constant 2)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{4100}  PUSH: (Integer Constant 4100)
    %e        <ELSE>
        %gq   PUSH: (Internal Variable q)
        %{3}  PUSH: (Integer Constant 3)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{2935}  PUSH: (Integer Constant 2935)
    %e        <ELSE>
        %gq   PUSH: (Internal Variable q)
        %{4}  PUSH: (Integer Constant 4)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{3407}  PUSH: (Integer Constant 3407)
    %e        <ELSE>
        %{3050}  PUSH: (Integer Constant 3050)
    %;        <END>
%e            <ELSE>
    %?        <IF>
        %gq   PUSH: (Internal Variable q)
        %{1}  PUSH: (Integer Constant 1)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{2150}  PUSH: (Integer Constant 2150)
    %e        <ELSE>
        %gq   PUSH: (Internal Variable q)
        %{2}  PUSH: (Integer Constant 2)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{2562}  PUSH: (Integer Constant 2562)
    %e        <ELSE>
        %gq   PUSH: (Internal Variable q)
        %{3}  PUSH: (Integer Constant 3)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{2750}  PUSH: (Integer Constant 2750)
    %e        <ELSE>
        %gq   PUSH: (Internal Variable q)
        %{4}  PUSH: (Integer Constant 4)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{2498}  PUSH: (Integer Constant 2498)
    %e        <ELSE>
        %gq   PUSH: (Internal Variable q)
        %{5}  PUSH: (Integer Constant 5)
        %=    PUSH: (pop2 = pop1 ?)
    %t        <THEN>
        %{2604}  PUSH: (Integer Constant 2604)
    %e        <ELSE>
        %{2852}  PUSH: (Integer Constant 2852)
    %;        <END>
%;            <END>
```

```
%d              POP -> ASCII String -> OUTPUT
```

The calculation of **wK** begins by pushing the value of **_Q**, the paper size override for the input paper source, onto the stack. The value of **_Q** is defined as **%lwQ**. At this point in the calculation of **Wk**, we are exactly where we were in the calculation of **wJ**, that is, trying to determine a value for **wQ** and **Wu**. Within the context of a single job submission command, the final values of **wQ** and **Wu** are not going to change just because a final value was requested from a different attribute calculation. Thus we'll use the previously calculated values of **1** for **wQ** and **1** for **Wu**.

The **1** returned to the in–progress calculation of **wK** is the value of **_Q**, and is pushed onto the stack. It is immediately popped back off the stack and stored in the internal variable **q**. **Wu**, already determined to be **1**, is again pushed onto the stack. **%{3}** pushes a **3** onto the stack, then the **%<** pops the top two values (a **3** and a **1**) off the stack and checks to see if the second value popped is less than the first value popped. **1** is less than **3** today, so a **1** is pushed onto stack. The **%t** find the **1** and so enters the if–then–else–then–else–then–else... sequence looking for an integer to pair with the paper size value calculated for **_Q**.

The **%gq** fetches the stored value of **_Q** from the internal variable **q**, and pushes it onto the stack. The **%{1}** pushes a **1** onto the stack. The **%=** pops the top two values (two **1**s) off the stack and, checking them for equality, succeeds; a **1** is pushed onto the stack. The **%t** finds the **1** and so evaluates the **%{3200}**, which pushes a **3200** onto the stack. The calculation of **wK** then falls through all but the last line of the remaining printer colon file escape sequences defining **wK**. The last escape sequence, **%d**, pops the top value, **3200**, off the stack and returns it, in ASCII format, to the in–progress calculation of **wX**.

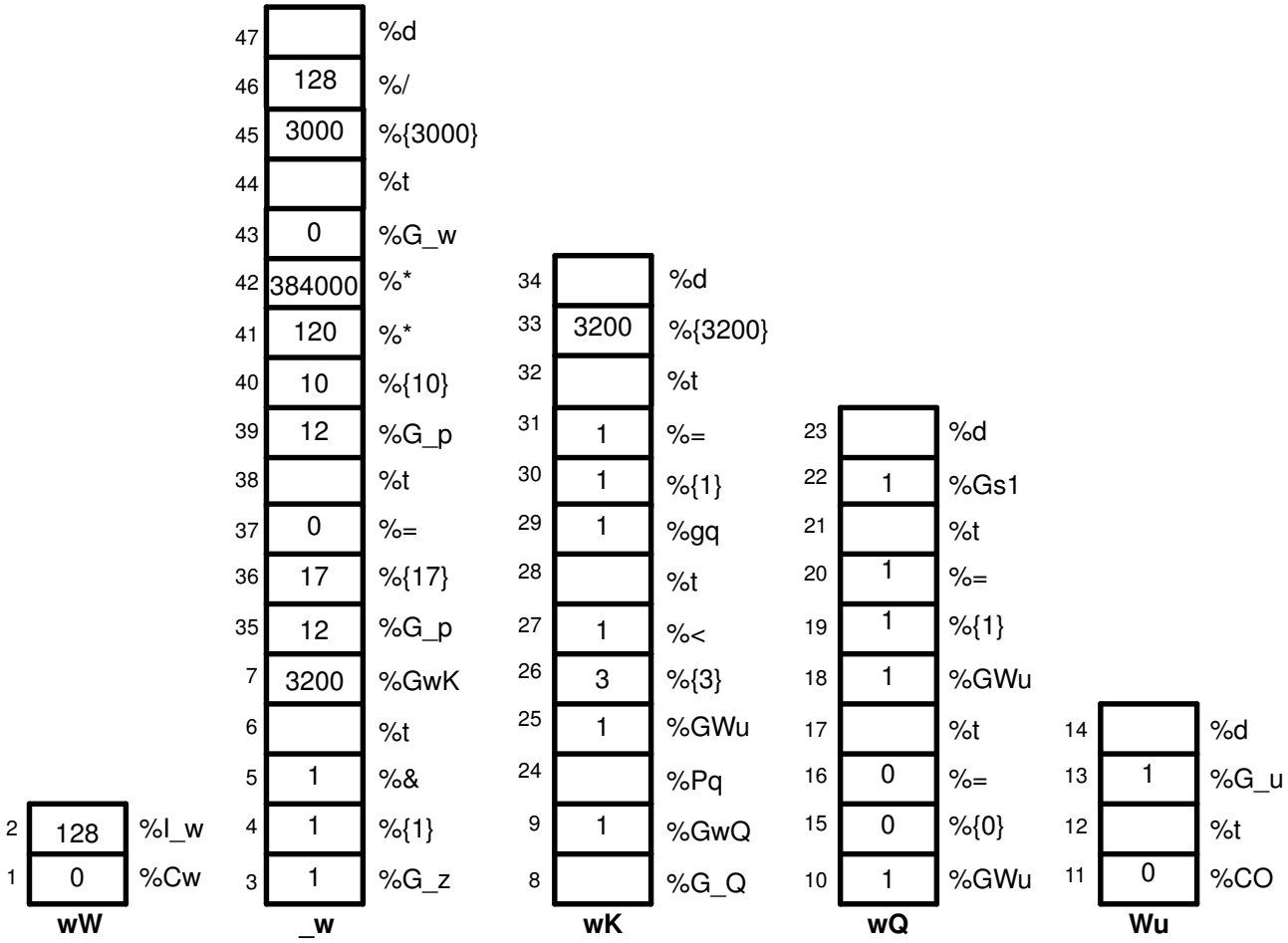
The **3200** returned to the in–progress calculation of **wX** is the value of **wK**, and is pushed onto the stack. The **%GwJ** in the else clause is skipped and the **%;** terminates the if–then–else sequence. At this point in the calculation of **wJ**, the remainder of the attribute definition dealt with factors that affected page length (in lines), such as vertical line density. In the calculation of page width, however, we will be interested in pitch and in whether or not double–wide printing was selected.

The next escape sequence evaluated is **%G_p**. This fetches the value of the **_p** attribute, which defines the pitch in characters per inch for this queue. The default value for this queue is **10** but the command line being used in this example specified a pitch of **12** (**–p12**), so a **12** is pushed onto the stack. The **%{17}** pushes a **17** onto the stack. The **%=** pops the top two values (a **17** and a **12**) off the stack and, checking them for equality, fails; a **0** is pushed onto the stack. The **%t** finds the **0** (a false value) and the following else clause is evalutated. **%G_p** again pushes a **12** onto the stack. The **%{10}** pushes a **10** onto the stack. The **%*** pops the top two values (a **12** and a **10**) off the stack and multiplies them together; the resulting **120** is pushed onto the stack. The **%;** terminates this if–then–else sequence.

The following **%*** pops the top two values (a **120** and a **3200**) off the stack and multiplies them together; the resulting **384000** is pushed onto the stack. The **%G_W** fetches the value of **_W** and pushes it onto the stack; **_W** is a yes (**1**) or no (**0**) question concering whether or not double–wide printing is needed. The default value is **0** and we did not override it on the command line, so a **0** is pushed onto the stack. The **%t** finds the **0** and so executes the else clause. The **%{3000}** pushes a **3000** onto the stack. The **%;** terminates this if–then–else sequence. The following **%/** pops the top two values (a **3000** and a **384000**) off the stack and divides the second value popped by the first value popped; the resulting **128** is pushed onto the stack. The **%d** pops the top value, **128**, off the stack and returns it, in ASCII format, to the in–progress calculation of **wW**.

The **128** returned to the in–progress calculation of **wW** is the value of **_w**. The value of **wW** was originally referenced in the determination of the value of the **ia** attribute, the input datastream pipeline for ASCII jobs. The number **128** replaces the **%lwW** in that determination, so the value of the **–!** flag to **pioformat** becomes `/usr/lib/lpd/pio/fmtrs/piof5202 -l48 -w128`. The **–w128** can be seen in the original diagnostic message from **piobe** that was the basis of this discussion; it is part of the **PIPELINE OF FILTERS** section of the mail sent by the **qdaemon** on behalf of **piobe**.

The Calculation of Page Width figure depicts the stacks operations (as described above) used to obtain a final numeric value for page width in characters. The following numbered steps correspond to the numbers on the left side of the columns in the figure, and provide a step–by–step description of the evaluation of the printer colon file escape sequences defining page width, in characters, for this particular queue (**asc**), colon file, and command line.



Calculation of Page Width

1. **%Cw** – Pushes a **0** onto the stack since the **w** flag was not used on the command line.
2. **%I_w** – Calls for the evaluation of **_w**.
3. **%G_z** – Pushes a **1** onto the stack.
4. **%{1}** – Pushes a **1** onto the stack.
5. **%&** – Pops the top two values (two **1**s) off the stack, performs a bitwise AND on the two values, and pushes the resultant **1** onto the stack.
6. **%t** – Pops the **1** off the stack and, since it is a TRUE (non–zero) value, calls for the evaluation of **%GwK**.
7. **%GwK** – Calls for the evaluation of **wK**.
8. **%G_Q** – Calls for the evaluation of **_Q**.
9. **%GwQ** – Calls for the evaluation of **wQ**.
10. **%GWu** – Calls for the evaluation of **Wu**.

11. **%CO** – Pushes a **0** onto the stack since the **O** flag was not used on the command line.
12. **%t** – Pops the **0** off the stack and, since it is a FALSE (zero) value, calls for the evaluation of **%G_u**. The stack labeled **Wu** is now empty.
13. **%G_u** – Pushes a **1** onto the stack.
14. **%d** – Pops the **1** off the stack and returns it, in ASCII format, to the in–progress calculation of **wQ**.
15. **%{0}** – Pushes a **0** onto the stack.
16. **%=** – Pops the **0** and **1** off the stack, compares them for equality, and pushes the resultant **0** onto the stack.
17. **%t** – Pops the **0** off the stack and, since it is a FALSE (zero) value, calls for the evaluation of **%GWu**.
18. **%GWu** – This value is already known, so a **1** is pushed onto the stack.
19. **%{1}** – Pushes a **1** onto the stack.
20. **%=** – Pops the two **1**s off the stack, compares them for equality, and pushes the resultant **1** onto the stack.
21. **%t** – Pops the **1** off the stack and, since it is a TRUE (non–zero) values, calls for the evaluation of **%Gs1**.
22. **%Gs1** – Pushes a **1** onto the stack.
23. **%d** – Pops the **1** off the stack and returns it, in ASCII format, to the in–progress calculation of **wK**.
24. **%Pq** – Pops the **1** off the stack and stores it in the internal variable **q**.
25. **%GWu** – This value is already known, so a **1** is pushed onto the stack.
26. **%{3}** – Pushes a **3** onto the stack.
27. **%<** – Pops the top two values off the stack (a **3** and a **1**) and, since **1** is less than **3**, pushes a **1** onto the stack.
28. **%t** – Pops the **1** off the stack and, since it is a TRUE (non–zero) value, calls for the evaluation of **%pq**.
29. **%pq** – Pushes the value of the internal variable **q**, a **1**, onto the stack.
30. **%{1}** – Pushes a **1** onto the stack.
31. **%=** – Pops the top two values (two **1**s) off the stack, compares them for equality, and pushes the resultant **1** onto the stack.
32. **%t** – Pops the **1** off the stack and, since it is a TRUE (non–zero) value, calls for the evaluation of **%{3200}**.
33. **%{3200}** – Pushes a **3200** onto the stack.
34. **%d** – Pops the **3200** off the stack and returns it to the in–progress calculation of **_w**.
35. **%G_p** – Pushes a **12** onto the stack.
36. **%{17}** – Pushes a **17** onto the stack.
37. **%=** – Pops the top two values (a **17** and a **12**) off the stack, compares them for equality, and pushes the resultant **0** onto the stack.
38. **%t** – Pops the **0** off the stack and, since it is a FALSE (zero) value, calls for the evaluation of **%G_p**.
39. **%G_p** – Pushes a **12** onto the stack.
40. **%{10}** – Pushes a **10** onto the stack.

41. **%*** – Pops the top two values (a**10** and a **12**) off the stack, multiplies them together, and pushes the resultant **120** onto the stack.

42. **%*** – Pops the top two values (a **120** and a **3200**) off the stack, multiplies them together, and pushes the resultant **384000** onto the stack.

43. **%G_w** – Pushes a **0** onto the stack.

44. **%t** – Pops the **0** off the stack and, since it is a FALSE (zero) value, calls for the evaluation of **%{3000}**.

45. **%{3000}** – Pushes a **3000** onto the stack.

46. **%/** – Pops the top two values (a **3000** and a **384000**) off the stack, divides the second value popped by the first value popped, and pushes the resultant **128** onto the stack.

47. **%d** – Pops the **128** off the stack and returns it, in ASCII format, to the in–progress calculation of **ia**, the input data stream pipeline for ASCII jobs.

Why the Stack Language Describing Page Width Works

Going beyond the mechanical description of what happens when **piobe** resolves the reference to **%wW**, here is a description of why the printer colon file escape sequence logic described above works.

The IBM LaserPrinter 4029 Series technical reference contains a figure and a table that together describe the printable and unprintable areas on a page, and the paper and envelope dimensions, in pels, for standard paper and envelope sizes. For instance, the printable area on an 8.5 x 11 (width by length) inch page is 2400 x 3200 pels (width by length). Note that if the page is rotated either 90 or 270 degrees for landscape printing, the dimensions are swapped and become 3200 x 2400 pels (width by length).

The evaluation of **%lwW** begins by checking to see if the **w** flag was used on the command line; if it was, then there are no calculations to perform. The requested value will be used. (That is not a promise that it will work, just that it will be used.) If the **w** flag was not used on the command line, then **piobe** has to figure out how wide the page is under the current job environment, as determined by other command line flags and by colon file defaults.

The first item checked in the evaluation of **_w** (page width) is page orientation (**_z**). As noted above, rotating the page by odd multiples of 90 degrees flips the page dimensions. Looking at the if–then–else statement that is the beginning of the definition of **wK**, it can be seen that the value of **_z** is a switch that controls which of **wJ** and **wK** will be used for page width. If the page has a portrait orientation, then **wJ** is width. If the page has a landscape orientation, then **wK** is width. After the page width in pels is resolved, the remainder of the escape sequences in the definition of **wK** just take pitch and character–width (double wide or not) into account while converting the number of pels to the number of characters.

wK is selected because the page orientation is landscape. Thus far all that is known is that the dimensions have been flipped; what the dimensions actually are is still unknown. The evaluation of **wK** begins by fetching the value (if any) of a command line usage of the **Q** flag, which is a printer–dependent value requesting a specific paper size. If the **Q** flag was used on the command line, then that value will be used to select the paper width in pels, otherwise a value for **Q** will be determined by evaluating **Wu**, which is a value for the paper source based on the attributes **_O** (type of input paper handling) and **_u** (input paper source). Note that **_Q** is defined as **%lwQ**, whose definition begins with **%lWu**.

Since **Q** was not used on the command line, the evaluation of **Wu** determines that the **O** flag wasn't used either, and so executes the else clause in the outer if–then–else statement in the definition of **Wu**, returning the default colon file value of **_u**, **1**, to the evaluation of **wQ**.

Since this is as deep as the nesting of escape sequences goes for the evaluation of **_w**, it is worth taking a closer look at the logic defining **Wu**. Keep in mind the definitions and legal values for **O**, **u**, and **Q**, which are:

- **O** – type of input paper handling – **1** (manual), **2** (continuous forms), **3** (sheet feed) – default is sheet feed.

- **u** – input paper source – **1** (primary), **2** (alternate), **3** (envelope) – default is primary.
- **Q** – paper size for input paper source – values are printer–dependent – defined by combination of **O** and **u**.

The escape sequences defining **Wu** say this:

- Case 1: If the **O** flag was not used on the command line, then return the colon file default value for **_u**. For example, if the user did not specify a type of input paper handling, then return the input paper source (either from the command line or the default from the colon file) to the evaluation of **%lwQ**.
- Case 2: If the **O** flag was used on the command line but its value was not **1**, then return the colon file's default value for **_u**. For example, if the user–specified a type of input paper handling other than manual,then return the input paper source (either from the command line or the default from the colon file) to the evaluation of **%lwQ**.
- Case 3: If the O flag was used on the command line and its value was **1**, and the **u** flag was not used on the command line, then return a **0**. For example, if the user–specified manual paper handling but did not specify an input paper source, then return a **0** to the evaluation of **%lwQ**.
- Case 4: If the **O** flag was used on the command line and its value was **1**, and the **u** flag was used on the command line and its value was not greater than **2**, then return a **0**. For example, if the user–specified manual paper handling and also specified either the primary or alternate input paper source, then return a **0** to the evaluation of **%lwQ**.
- Case 5: If the **O** flag was used on the command line and its value was **1**, and the **u** flag was used on the command line and its value was greater than **2**, then return a **4**. For example, if the user–specified manual paper handling and also specified an input paper source of envelope, then return a **4** to the evaluation of **%lwQ**.

The definition of **wQ** is an if–then–else–then–else–then–else–then–else statement that repeatedly compares the value of **Wu** to the integers **0**, **1**, **2**, and **3**, looking for a match. The match selects the value of one of the attriubes **s0**, **s1**, **s2**, **s3**, or **s4**, respectively (**s4** is selected when there is no other match). The items these attributes define are as follows:

- **s0** – paper size for manual paper feed
- **s1** – paper size for tray 1 (upper)
- **s2** – paper size for tray 2 (lower)
- **s3** – envelope size for envelope feeder
- **s4** – envelope size for manual envelope size

In the virtual printer definition for an ASCII queue on an IBM 4029 LaserPrinter, there are only two unique values for these five attributes: **s0**, **s1**, and **s2** are all **1**, while **s3** and **s4** are both **3**.

Looking back up the nested escape sequences, you can see that the definition of **wK** is composed of an outer if–then–else statement. Both the if and the else pieces of this statement contain a chain of if–then–else–then–else... statements. The value of **Wu** (which is a value for paper source, based on **O** and **u**) determines whether the if or the else piece of the outer statement executes; if **Wu** is **1** or **2** (less than **3**), then the if piece executes, otherwise the else piece executes. It is in the final determination of **wK** that the page width, in pels, is fixed.

Case 1: Either the command line value of **u** or the default from the colon file (**1**, primary paper tray) is returned to the evaluation of **wQ**. The remaining escape sequences in the definiton of **wQ** test the value of **Wu** and select the value of one of **s0**, **s1**, **s2**, **s3**, or **s4**. That value is in turn returned to the evaluation of **wK**. If **u** is **1** or **2** , then **Q** will be **1** (non–envelope paper size). If **u** is **3**, then **Q** will be **3** (envelope paper size). When the evaluation of **wK** is resumed, a **u** value of **1** or **2** will direct the process into the if piece of the outer if–then–else statement, and the **Q** value of **1** will select a page width of 3200 pels.

A **u** value of **3** will direct the process into the else piece of the outer if–then–else statement, and the **Q** value of **3** will select an envelope page width of 2750 pels.

Case 2: Same as case 1.

Case 3: The user–specified manual paper handling on the command line but did not specify a paper source so **Wu** is assigned the value **0**, and that value is returned to the evaluation of **wQ**. The **0** will cause **wQ** to be assigned the value of **s0** (the paper size for manual paper feed, a **1**). When the evaluation of **wK** is resumed, the **u** value of 0 will direct the process into the if piece of the outer if–then–else statement, and the **Q** value of **1** (**s0**) will select a page width of 3200 pels.

Case 4: The user–specified manual paper handling on the command line and also used the **u** flag to specify either the primary or alternate paper source (but definitely not envelopes). As with case 3, a page width of 3200 pels will be chosen.

Case 5: The user–specified manual paper handling on the command line and also used the **u** flag to specify an envelope paper source so **Wu** is assigned the value **4**, and that value is returned to the evaluation of **wQ**. The 4 will cause **wQ** to be assigned the value of **s4** (the envelope size for manual envelope size, a **3**). When the evaluation of **wK** is resumed, the **u** value of **4** will direct the process into the else piece of the outer if–then–else statement, and the **Q** value of **3** will select an envelope width of 2498 pels.

- Our example is case 1: neither the **O** nor the **u** flags were used on the command line, so **Wu** is assigned a value of **1**, the default **_u** value for this colon file. When the evaluation of **wQ** resumes, the match occurs on **s1**, and a **1** is returned to the evaluation of **wK**. The **u** value of **1** direct the process into the if piece of the outer if–then–else statement, and the **Q** value of **1** selects a page width of 3200 pels. This value is returned to the evaluation of **_w**.

The remaining printer colon file escape sequences defining **_w** reason that if there are 3200 pels available (horizontally), and if we want 12 characters per inch, and if the resolution of printer is 300 pels per inch, then 128 characters can be printed across the page. Both the pitch and the printer resolution are multiplied by 10 to account for the possibility of a 17–pitch being specified. A 17–pitch is actually 17.1, so multiplying both the numerator and the denominator by 10 causes the .1 to be accounted for in the final calculation of page width. The value **128** is returned to the evaluation of **ia**. That's basically where the **–128** in the PIPELINE OF FILTERS came from.

Spooler Job Header and Trailer Pages

The pipelines for generating header and trailer pages are defined by the system administation attributes **sh** (header pages) and **st** (trailer pages). The printing of header and trailer pages are separate processes from the spooler print jobs they accompany, even though they are not shown in the output of queue status queries.

Header and Trailer Page Pipelines

Below is the **sh** attribute used to define the pipeline for header page generation and printing for an extended ASCII queue on an IBM 4029 LaserPrinter. The attribute is shown as formatted by the **lsvirprt** command. See ”Viewing, Formatting, or Modifying Virtual Printer Definitions”, on page 4-129 for a further explanation.

```
Pipeline for Header Page
sh = %Ide/pioburst %F[H] %Idb/H.ascii | %Ide/pioformat
-@%Idd/%Imm -!%Idf/piof52
02 -L! -J! %IsH -u%IuH

 %Ide           INCLUDE: (Directory Containing Miscellaneous
Modules)
 ’/pioburst ’
 %F[H]          If ”-H] Argument” on Command Line, ”-# Argument”
-> OUTPUT
 ’ ’
 %Idb           INCLUDE: (Directory Containing Header and Trailer
Text Files)
 ’/H.ascii | ’
 %Ide           INCLUDE: (Directory Containing Miscellaneous
Modules)
 ’/pioformat -@’
 %Idd           INCLUDE: (Directory Containing Digested Data Base
Files)
 ’/’
 %Imm           INCLUDE: (File Name Of (Digested) Data Base; Init.
By
                ”piodigest” (mt.md.mn.mq:mv))
 ’ -!’
 %Idf           INCLUDE: (Directory Containing Loadable Formatter
Routines)
 ’/piof5202 -L! -J! ’
 %IsH           INCLUDE: (FORMATTING FLAGS for header page)
 ’ -u’
 %IuH           INCLUDE: (Input PAPER TRAY for header page)
```

During spooler job processing, the value of the **sh** attribute is determined to be:

```
/usr/lib/lpd/pio/etc/pioburst /usr/lib/lpd/pio/burst/H.ascii |
/usr/lib/lpd/pio/etc/pioformat
-@/var/spool/lpd/pio/@local/ddi/ibm4029.asc.lp1.asc:lp1
-!/usr/lib/lpd/pio/fmtrs/piof5202 -L! -J! -u1
```

pioburst processes the header page template and pipes its output to the device–independent formatter, **pioformat**, which in turn loads the digested version of the colon file for this virtual printer (the argument to the **–@** flag) and the device–dependent formatter, **piof5202** (the argument to the **–!** flag). There are three flags to **piof5202**:

1. **–L!** – Long lines should not be wrapped.
2. **–J!** – The printer should be restored to the state it was in before the header page was printed.
3. **–u1** – The header page should be drawn from paper tray 1.

The value of the **st** definition is similar to the value of the **sh** definition.

Custom Header Pages

The root user can create custom header pages for users by modifying the definiton of the **sh** attribute. Since the spooler processes have access to the environment of the user that submitted the job to the spooler, the root user can modify the portion of the **sh** attribute definition that specifies which header page template to process.

For example, the `H.ascii` in the above definition specifies which header page template should be processed and printed. It can be replaced with a user environment variable of your choice, such as `$MYHEADER`, as shown below.

```
 %Ide           INCLUDE: (Directory Containing Miscellaneous
Modules)
 '/pioburst '
 %F[H]          If "-H] Argument" on Command Line, "-# Argument"
-> OUTPUT
 ' '
 %Idb           INCLUDE: (Directory Containing Header and Trailer
Text Files)
 '/$MYHEADER | '
 %Ide           INCLUDE: (Directory Containing Miscellaneous
Modules)
 '/pioformat -@'
 %Idd           INCLUDE: (Directory Containing Digested Data Base
Files)
 '/'
 %Imm           INCLUDE: (File Name Of (Digested) Data Base; Init.
 By
                "piodigest" (mt.md.mn.mq:mv))
 ' -!'
 %Idf           INCLUDE: (Directory Containing Loadable Formatter
Routines)
 '/piof5202 -L! -J! '
 %IsH           INCLUDE: (FORMATTING FLAGS for header page)
 ' -u'
 %IuH           INCLUDE: (Input PAPER TRAY for header page)
```

To enable the user susan to get custom header pages with this queue, the root user could use the following procedure:

- `cp /usr/lib/lpd/pio/burst/H.ascii /usr/lib/lpd/pio/burst/H.susan`
- Edit `H.susan` to Susan's taste in header pages.
- Set the environment variable `MYHEADER` in Susan's environment to `H.susan`. (for instance, in the Korn shell, use `export MYHEADER=H.susan`).

When the user `susan` submits a job to this queue, the **sh** attribute's reference to a header page template will resolve to `/usr/lib/lpd/pio/burst/H.susan`, and the user `susan` will receive a custom header page. The problem with this scenario is that the environment variable `MYHEADER` must be defined for anyone that uses the queue associated with this virtual printer, else the virtual printer cannot resolve the reference to `/usr/lib/lpd/pio/burst/$MYHEADER`. An error will result if `$MYHEADER` is undefined; the job might print, but the header page will be recyclable at best.

To avoid the problem of everyone that uses this queue having to have `MYHEADER` defined, you can integrate some shell code into the **sh** attribute definition to examine the user environment before the header page pipeline is created. One method for doing this is shown below.

```
Pipeline for Header Page
sh = { if test X"$MYHEADER" = X ; then %Ide/pioburst %F[H]
%Idb/H.ascii | %Ide/pioformat -@%Idd/%Imm -!%Idf/piof5202 -L! -J!
%IsH -u%IuH; else %Ide/pioburst %F[H] %Idb/$MYHEADER |
%Ide/pioformat -@%Idd/%Imm -!%Idf/piof5202 -L! -J! %IsH -u%IuH;
fi; }
```

```
 '{ if test X"$MYHEADER" = X ; then '
 %Ide          INCLUDE: (Directory Containing Miscellaneous
Modules)
 '/pioburst '
 %F[H]         If "-H] Argument" on Command Line, "-# Argument"
-> OUTPUT
 ' '
 %Idb          INCLUDE: (Directory Containing Header and Trailer
Text Files)
 '/H.ascii | '
 %Ide          INCLUDE: (Directory Containing Miscellaneous
Modules)
 '/pioformat -@'
 %Idd          INCLUDE: (Directory Containing Digested Data Base
Files)
 '/'
 %Imm          INCLUDE: (File Name Of (Digested) Data Base; Init.
By
               "piodigest" (mt.md.mn.mq:mv))
 ' -!'
 %Idf          INCLUDE: (Directory Containing Loadable Formatter
Routines)
 '/piof5202 -L! -J! '
 %IsH          INCLUDE: (FORMATTING FLAGS for header page)
 ' -u'
 %IuH          INCLUDE: (Input PAPER TRAY for header page)
 '; else '
 %Ide          INCLUDE: (Directory Containing Miscellaneous
Modules)
 '/pioburst '
 %F[H]         If "-H] Argument" on Command Line, "-# Argument"
-> OUTPUT
 ' '
 %Idb          INCLUDE: (Directory Containing Header and Trailer
Text Files)
 '/$MYHEADER | '
 %Ide          INCLUDE: (Directory Containing Miscellaneous
Modules)
 '/pioformat -@'
 %Idd          INCLUDE: (Directory Containing Digested Data Base
Files)
 '/'
 %Imm          INCLUDE: (File Name Of (Digested) Data Base; Init.
By
               "piodigest" (mt.md.mn.mq:mv))
 ' -!'
 %Idf          INCLUDE: (Directory Containing Loadable Formatter
Routines)
 '/piof5202 -L! -J! '
 %IsH          INCLUDE: (FORMATTING FLAGS for header page)
 ' -u'
 %IuH          INCLUDE: (Input PAPER TRAY for header page)
 '; fi; } '
```

The original **st** definition is repeated twice in the new **st** definition. The shell code checks to see if `MYHEADER` is defined; if `MYHEADER` is not defined, then the header page template `H.ascii` is used, else the header page template `$MYHEADER` is used.

Modifying the mo Virtual Printer Attribute

All virtual printer definitions contain an attribute named **mo**. The **mo** attribute specifies the command string to invoke the device driver interface program. The device driver interface program is the last process in the input data stream processing pipeline and, in the case of local spooler queues with **piobe** as the backend, is usually **pioout**. It is named the device driver interface program because, as the last process in the pipeline, it generally opens the device driver for writing and then writes the processed input data stream to the device driver. See the Datastream Flow for Common Print Jobs figure, on page 3-13 and the related text for additional information.

One of the useful features of the AIX spooler is that its design allows the root user to replace pieces of the input data stream processing pipeline with user–written code. In this article an example of redefining the **mo** attribute, whose default value is the full path of **pioout**, to the full path of a user–written delivery program will be discussed. You may want to see ”Overview of Backend Processing”, on page 3-12 .

Handling Unsupported, IP–Addressable Terminal Servers

Suppose that you have an IP–addressable terminal server attached to your Ethernet network. The terminal server has some number of asynchronous ports to which you can attach ASCII terminals, modems, printers, or other asynchronous devices. Further suppose that the terminal server vendor supplied you with a program, named `ts_print` , that has the following properties:

- It will read from stdin.
- It accepts a **–A** flag to specify an IP address.
- It accepts a **–P** flag to specify a port number.

(Clearly this is not a particularly hypothetical scenario.)

To turn this into a specific example, suppose that you have an IBM 4029 LaserPrinter that you want to attach to port 11 on the terminal server and that the terminal server’s IP address is 9.19.129.101. Your goal is have a queue on a print server to which users can submit ASCII jobs and have them printed on the 4029 on the terminal server. Though you can use `ts_print` from the command line, you would prefer to make use of the formatter filter’s ability to perform extensive manipulation of both the printer’s mode and the input data stream. Providing true serial access to the printer is also a goal.

There is more than one way to accomplish this goal. The easiest way involves making a local ASCII queue on a normal file, instead of on a character–special file in the /**dev** directory. After you create the queue and the associated virtual printer, you can modify the virtual printer to use `ts_print` .

To begin the queue creation process, type the SMIT fast path **smit mkquedev**. A menu similar to the following displays:

```
                        Add a Print Queue

Move cursor to desired item and press Enter. Use arrow keys to
scroll.

# ATTACHMENT TYPE        DESCRIPTION
    local                Printer Attached to Local Host
    remote               Printer Attached to Remote Host
    xstation             Printer Attached to Xstation
    ascii                Printer Attached to ASCII Terminal
    hpJetDirect          Network Printer (HP JetDirect)
    file                 File (in /dev directory)
    other                User Defined Backend
```

Choose the **file** option, then choose a printer type. After you choose the IBM 4029 LaserPrinter (or whatever is correct for your situation), provide the name of an existing file in the /**dev** directory. This is the file to which processed jobs submitted to the queue you are creating are written. The name of the file can be anything that adheres to AIX naming conventions. A reasonable action is to create a file just for the purpose of being the target of file queues. For instance, the root user can issue the command **touch** /**dev**/**lxx** to create a file named **lxx** in the /**dev** directory.

After you provide the name of a file in the /**dev** directory, choose a queue name for each input data stream supported by the printer type you selected earlier. In this example, suppose the name **asc** was chosen for an ASCII queue. An entry like the following would appear in /**etc**/**qconfig**:

```
asc:
        device = lxx
lxx:
        file = /dev/lxx
        header = never
        trailer = never
        access = both
        backend = /usr/lib/lpd/piobe
```

Any print job submitted to the spooler queue **asc** is processed by the pipeline set up by **piobe**. The processed data stream is written to /**dev**/**lxx**. This is not what you want to happen. Since the goal is to have `ts_print` write the output to port 11 on the terminal server, there should in fact not even be a file associated with this queue. To this end, edit the new stanza pair in /**etc**/**qconfig** and change the value of the **file** parameter to **FALSE**, like this:

```
asc:
        device = lxx
lxx:
        file = FALSE
        header = never
        trailer = never
        access = both
        backend = /usr/lib/lpd/piobe
```

If you use this queue in this state, you do not see anything written to a file or printed anywhere, except maybe for error messages. When the **qdaemon** sets the backend, **piobe**, into execution, it passes **piobe** an open file descriptor based on the value of the **file** parameter in /**etc**/**qconfig**. When that value is set to **FALSE**, the file descriptor is not passed. The eventual recipient and user of the file descriptor is whatever program is pointed to by the **mo** attribute. The default program pointed to by the **mo** attribute is **pioout** and, when jobs are put on the queue when it is in this state, **pioout** will not have a valid value for stdout, and the processed job will simply vanish.

At this point, you can use **lsvirprt** to select the **asc** virtual printer definition for modification. A prompt similiar to the following displays:

```
To LIST attributes, enter AttributeName1 ... (* for all
attributes)
To CHANGE an attribute value, enter AttributeName=NewValue
To FORMAT and EDIT an attribute value, enter AttributeName~v
To EDIT the attribute file, enter ~v
To terminate, press Enter:
```

Assuming the `ts_print` program was installed in /**usr**/**bin**, enter the following at the prompt:

```
mo=/usr/bin/ts_print -A 9.19.129.101 -P 11
```

Jobs submitted to the **asc** queue will now be processed as if they were local jobs but, when the end of the pipeline is reached, the `ts_print` program will deliver the output data stream to port 11 on the terminal server instead of **pioout** delivering it to a device driver.

In general, the **mo** attribute in the virtual printer definition for a queue with **piobe** as the backend can be redefined to deliver a processed data stream to any file or device the user chooses, provided the you can write the code to do it.

Filters

Virtual printer definitions in both Version 3.2.5 and AIX Version 4. contain predefined and *open* (undefined) filter attributes; AIX Version 4. offers a richer set of filter attributes. For instance, an AIX Version 4. ASCII queue on an IBM 4029 LaserPrinter offers the following filter attributes:

- f1, f2, f3, f4, and f5 – open, user–defined filters
- fb – bidi filter for Hebrew/Arabic.
- fc – cifplot filter
- fd – TeX (DVI) filter
- ff – FORTRAN filter
- fg – plot filter
- fl – passthru filter
- fn – ditroff filter
- fp – **pr** filter
- fv Raster image filter

A similar Version 3.2.5 virtual printer definition offers the following filter attributes:

- fc, fd, ff, fg, fl, fn ,ft, fv – open, user–defined filters
- fp – **pr** filter

Filters are the first programs in the input data stream processing pipeline set up by piobe that have an opportunity to selectively manipulate the data stream. A particular filter can be selected from the command line on a per job basis, or permanently selected by modifying the virtual printer definition.

The **qprt** command uses the **–f** flag to select a particular filter on a per–job basis. The argument to the **–f** flag is the second letter of the two letters that name the filter attribute in the virtual printer definition. For instance, to select the **pr** filter for a job on an ASCII queue named **asc** on an IBM 4029 LaserPrinter, you could issue this command:

```
qprt –Pasc –fp /etc/motd
```

The filter attribute that selects the **pr** filter is named **fp**, so the argument to the –**f** flag is just **p**, the second letter.

To permanently select the **pr** filter, use **lsvirprt** to edit the virtual printer definition and set the value of the **_f** attribute to **p**. The **_f** attribute selects a filter that will be used to pre–process any job submitted to the queue associated with this virtual printer definition.

Since **lp**, **lpr**, and **qprt** are all just front ends to the **enq** command, the true entry point to the spooler, you would suppose that **enq** must support the **–f** flag. If you issue the **enq** command with the **–f** flag, however, you will receive an error message; **enq** does not support the **–f** flag. This is a situation where the previously described technique of mounting /**bin**/**echo** over /**bin**/**enq** proves useful.

The root user can issue these commands from a shell prompt:

1. **mount /bin/echo /bin/enq**
2. **qprt –Pasc –fp /etc/motd**
3. **umount /bin/enq**

After the second command is issued, the following appears in the display element defined by your TERM environment variable:

```
–P asc –o –f –o p /etc/motd
```

These are the arguments **qprt** tried to pass to **enq**. You get to see them because **qprt** found **echo** instead of **enq**. The following command is equivalent to the command shown in step 2 above:

```
enq -P asc -o -f -o p /etc/motd
```

The **–o** option specifies that flags specific to the backend should be passed to the backend. The **–o** option can be thought of as a free pass through the syntax checking that occurs before the **enq** command builds a job description file and notifies the **qdaemon** of the existence of a new job.

To continue with this side discussion of the **–o** flag before we return to a discussion of filters, suppose that you want to set up a queue than will print a range of lines from an ASCII file. For instance, suppose you read /**usr**/**lpp**/**bos**/**README** and find 35 lines that you want to print so you can fax them to someone or tack them to your wall for reference. You could edit /**etc**/**qconfig** and add the following lines:

```
partial:
        device = partial
partial:
        file = FALSE
        backend = /usr/bin/partial
```

The file /**usr**/**bin**/**partial** could be a shell script with ownership of `root.printq` and with permissions of `755` . Its contents could be as follows:

```
#!/bin/ksh
BEGIN=$1
END=$2
let DIFF=END-BEGIN+1
FILE=$3
/usr/bin/head -${END} ${FILE} | tail -${DIFF} | /usr/bin/qprt
-Pasc
```

Note that in Version 3.2.5, **head** and **tail** are in /**usr**/**ucb**, not /**usr**/**bin**, and that **qprt** is in /**bin**, not /**usr**/**bin**.

If you wanted to print lines 189 through 223 of /**usr**/**lpp**/**bos**/**README**, you could use the **partial** queue as follows:

```
qprt -Ppartial -o 189 -o 223 /usr/lpp/bos/README
```

When the backend executes, **BEGIN** is assigned 189, **END** is assigned 223, and **DIFF** is assigned 35, which is the number of chosen lines. **FILE** is assigned /**usr**/**lpp**/**bos**/**README**. The **head** command truncates /**usr**/**lpp**/**bos**/**README** immediately after the last requested line. The output is piped to the **tail** command, which selects the last 35 lines of the truncated file and pipes them to **qprt**, which will take input from stdin. **qprt** submits the lines to the queue named **asc**.

A Filter that Maps Linefeeds to Carriage Returns and Linefeeds

Many users have written or purchased applications that prepare data streams to fill in the blanks on pre–printed checks, invoices, bills–of–lading, or other forms. Printing these data streams requires precise control of the physical printer. It is often the case that the job processing pipeline created by **piobe** inserts or deletes enough data from the original data stream that the output data no longer falls at the proper position on the pre–printed form.

The root user can frequently use **lsvirprt** to set the value of the **_d** attribute in the virtual printer definition to **p**. On an ASCII queue on an IBM 4029 LaserPrinter, this would cause **piobe** to select the **ip** pipeline to process the job. The **ip** pipeline is for passthru printing, which means the formatter filters uses the **passthru()** routine to simply pass the input data stream through to the printer without modification.

This frequently removes all the printer control problems that existed, but adds one new one. When the formatter filter operates in passthru mode, the mapping of linefeeds to carriage returns and linefeeds is disabled. The forms still don't print correctly.

Supposing that the application does not allow the insertion of carriage returns into the data stream, you can fix this problem with a simple filter, as follows:

```
#include <stdio.h>

main(int argc, char **argv)
{
int ch ;


while (EOF != (ch = fgetc(stdin)))
 {
  switch (ch)
   {
    case 10: fputc(ch,stdout) ;
             fputc(0x0D,stdout) ;
             break ;
    default: fputc(ch,stdout) ;
             break ;
   }
 }
}
```

Compile this and name it `cr_mapper` . and install it somewhere accessible, such as /**usr**/**lib**/**lpd**. Assign it ownership of `root.printq` and permissions `555` .

Assuming you have an ASCII queue named **asc** on an IBM 4029 LaserPrinter, in AIX 4 you can use **lsvirprt** to select the **asc** queue and then format the **f1** filter attribute. You should see something like the following:

```
User defined filter 1
f1 =
```

As the **f1** attribute has a null default value, the definition is sparse.

Edit the **f1** attribute so its definition appears as follows:

```
User defined filter 1
f1 =
 '/usr/lib/lpd/cr_mapper'
```

When you save the new definition of **f1**, you can again format it with **lsvirprt**; you should see something like the following:

```
User defined filter 1
f1 = /usr/lib/lpd/cr_mapper
 '/usr/lib/lpd/cr_mapper'
```

The **f1** filter can now be used from the command line by using commands such as:

qprt -Pasc -f1 `filename`

enq -Pasc -o -f -o 1 `filename`

If the _d attribute wasn't set to p, the –dp flag and argument would have to be added to the commands.

qprt -Pasc -dp -f1 `filename`

enq -Pasc -o -d -o p -o -f -o 1 `filename`

The `cr_mapper` program reads characters from stdin and writes them to stdout. Whenever it reads and writes a linefeed (a hex A, or decimal 10), it writes out a carriage return (a hex D).

Editing /etc/qconfig

The /**etc**/**qconfig** configuration file can be edited with your text editor of choice. There are unenforced rules concerning when you can and cannot edit /**etc**/**qconfig** without halting or otherwise corrupting the operation of the spooler.

Modifying /etc/qconfig While Jobs are Processing

/**etc**/**qconfig** should never be edited when jobs are processing. This is especially true when your system has a large number (greater than 25) of printers that are generally pretty busy. When the **qdaemon** receives notification from **enq** that a new Job Description File (JDF) exists, the **qdaemon** examines the dates on both /**etc**/**qconfig** and /**etc**/**qconfig.bin**, the binary version of /**etc**/**qconfig**. If /**etc**/**qconfig** is younger than /**etc**/**qconfig.bin**, the **qdaemon** doesnot accept any new jobs, including the one that caused it to examine the aforementioned files, until all currently running jobs have finished processing. When the jobs have finished processing, the **qdaemon** creates a new version of /**etc**/**qconfig.bin**.

If you cause the **qdaemon** to go into this state while jobs are processing, it is possible for the spooler to hang. If you modify /**etc**/**qconfig** under these conditions, and if any printers are still generating output, your best option is to leave the system alone and see if it comes back to life after all the jobs have finished processing. If zero printers are producing output or the spooler appears to be hung, see ”Cleaning Up and Starting Over” section of Spooler Troubleshooting, on page 5-14.

> **Attention:** It is worth repeating. Do not cause a change to /**etc**/**qconfig** while jobs are processing. Aside from editing /**etc**/**qconfig** and writing a new version of the file to disk with a text editor, you can cause the same effect by using **smit** to change a queue property or a parameter value.

Creating Queue With an Editor

The root user can edit /**etc**/**qconfig** and define queues with a text editor. One situation where this should not be done is when the backend for the spooler queue is **piobe**. Queues that use **piobe** as backend must have an associated virtual printer definition. In this situation, the root user should use **smit** to create the queue. Using **smit** will run several programs that create the virtual printer definition.

Chapter 5. Troubleshooting the AIX Spooler

Use the information in the following checklists to help resolve printing problems.

- Troubleshooting the AIX Spooler
- Local Printer Checklist
- Inoperative Printer Checklist
- Remote Printer Checklist
- Adapter Considerations
- Terminal–Attached Printer Checklist
- Considerations for 8–Bit Printer Attached to 7–Bit Interface
- qdaemon Checklist
- Queueing System Problems
- Testing the qdaemon
- Testing the Spooler Queue
- Copying Spooled Jobs
- Cleaning Up and Starting Over

Troubleshooting the AIX spooler can be done by tracking a spooler job through the spooler. A job submitted to the AIX spooler moves from one spooler component to another in a predictable fashion. The movement is entirely dependent upon the spooler queue configuration, especially the spooler queue backend.

Note: To perform serious spooler troubleshooting, root authority is required. Users running without root authority are limited to:

- Submitting jobs to the spooler
- Sending data directly to the device driver entry point in the /dev directory
- Querying the status of spooler queues
- Changing the status (including cancelling) of spooler jobs owned by the user

Note: This troubleshooting information assumes that you have access to a shell prompt. There are a number of front–ends to the AIX spooler itself on the market; troubleshooting in this environment is still very possible, but if the problem lies in the command or method used to actually submit a job to the spooler, the application must provide a method for precisely determining the command or method used to submit the job to the spooler.

Local Printer Checklist

- Verify that the **qdaemon** is running. Make sure there are no forked processes running from the **qdaemon**.
- Make sure the system date is correct. The **qdaemon** automatically rebuilds the **qconfig.bin** file when the **qconfig** file changes. If the date on the **qconfig** file is earlier than the date on the **qconfig.bin** file, the **qconfig** file is not digested, even if it was just modified.
- If the dates on the **qconfig.bin** file and the **qconfig** file are correct, and changes to the **qconfig** file are correct, the /**etc**/**qconfig** file is no longer linked to the /**usr**/**lpd**/**qconfig** file.
- Check that the /**tmp** directory is not full. The /**tmp** directory may be full if you receive a message such as `No Virtual Printers Defined` or if your are unable to print from InfoExplorer.
- If no other user except root can print, check the permissions of the /**tmp** directory. Also, check the permissions of the print commands being used (including **enq**).
- Check for obsolete queue names in the /**var**/**spool**/**lpd**/**qdir** file. A problem with the installation of a new /**etc**/**qconfig** file occurs when a queue is removed from the new /**etc**/**qconfig** file and a print request is made using the obsolete queue name. The **qdaemon** logs an error message. You must determine if the message refers to an old queue. If so, the problem will exist until you remove the obsolete queue entries from the /**var**/**spool**/**lpd**/**qdir** file.
- If operator–attention messages requested by print commands are not being received, make sure the socket is connected and the host name can be **ping**ed.
- Operator–attention messages from print commands are routed through the **writesrv** command of the TCP/IP subsystem. If messages are not being received, check to see if **writesrv** is running by entering the command:

  ```
  lssrc –s writesrv
  ```

  If **writesrv** is not running, start it with the following command:

  ```
  startsrc –s writesrv
  ```

  Finally, make sure that **writesrv** is listed in the output of one of the following commands:

  ```
  netstat –a | pg
  ```

  OR

  ```
  netstat –a | grep writesrv
  ```

Inoperative Printer Checklist

Check the following items for locally attached printers that have never worked:

- Run the test pattern for the printer with only the power cable attached to the printer.
- Verify that you have the correct cable for the printer.
- Make sure the cable is securely plugged in.
- Verify that you have created a device for the printer (with Devices, SMIT, or at the command line).
- Try the following command immediately after a reboot or when you have not tried to send anything to the printer since a reboot.

  ```
  echo Does the printer work? > /dev/lpn
  ```

  where `lpn` is the name of the printer device you are testing. If the message prints at the printer, set up the virtual printer definition for the printer. If the statement hangs or returns an error message, the problem is not the operating system or the queueing system. It is one or more of the following:

  – The cable.

  – The setup such as baud rate, handshaking, and port number. The printer and the computer must have the same settings.

  – A bad port on the computer.

  – A broken printer.

- If you have trouble getting a serial printer to work on an 8–port, 16–port, or 64–port adapter or on a modem, try to get the printer working on S1 or S2 directly on the computer. Once the printer works on S1 or S2, move the printer to the desired port. If S1 and S2 are unavailable, try moving the printer to any other port.

Remote Printer Checklist

Check the following items for the host acting as the remote print server:

- Make sure that all client machines (foreign hosts) are listed in the **/etc/hosts.lpd** file.
- Make sure that the TCP/IP subsystem is running.
- Check for the existence of the **/usr/spool/lpd** directory.
- Make sure that the **/etc/locks/lpd** directory does not exist if the **lpd** daemon is not running.
- Make sure that both the **lpd** daemon and the **qdaemon** are running.
- Check the ”Local Printer Checklist”, on page 5-2.

Check the following items for hosts printing to a remote print server:

- Verify that the queue name and server name for the remote print server are correct in the **/etc/qconfig** file.
- Make sure that the TCP/IP subsystem is running.
- Make sure that the **qdaemon** daemon is running.

Adapter Considerations

The 16–port RS–232 adapter does not support clear to send (CTS). A printer connected to this adapter will not finish printing a job if the printer is powered off while the job is printing. You must restart the job or delete it manually.

Resource Considerations

Printing generates processes. Printing a job might take up anywhere from one to five processes in most instances. As with any other activity, it is possible to exhaust the number of processes on the system. This can happen by submitting a single print job on a very actively used system, or by submitting large numbers of jobs on a system with little other activity.

Running out of processes can cause erratic behavior on your system. If you experience erratic behavior on your system, we recommend that you check your resources to determine if you are running out of processes.

Terminal–Attached Printer Checklist

Check the following items when the printer attached to an ASCII terminal does not produce output:

- Verify that the AUX port on the terminal is configured with the same settings as your printer. To do this, consult your terminal documentation for information about setting values for the AUX port. Consult your printer documentation for information about configuring the printer's serial interface. Relevant values include those for baud rate, parity, data bits, stop bits, and XON/XOFF.
- If your terminal is emulating a terminal of a different type, you may need to set the **PIOTERM** environment variable.

  ```
  export PIOTERM=TerminalTypeEmulated
  ```

- Verify that you have the correct cable for the printer.
- Make sure the cable is securely plugged into the terminal's auxiliary port.
- Make sure the print queue is READY:

  ```
  lpstat
  ```

If the status for the terminal–attached printer queue does not read READY, enter the following commands to cancel all jobs on the queue and restart it:

```
qadm -Xqname
qadm -Uqname
```

where `qname` is the name of the terminal–attached printer queue. You must resubmit your print jobs.

- Verify that the **pioout** command has the correct permissions:

  ```
  /usr/lib/lpd/pio/etc/pioout -r-sr-xr-x
  ```

  To reset permissions, enter the following command:

  ```
  chmod 4555 /usr/lib/lpd/pio/etc/pioout
  ```

- Check "Local Printer Checklist", on page 5-2 .
- Sometimes printer control codes conflict with the terminal's control codes. If the previous checklist items do not produce output, reconfigure your virtual printer as an ASCII Printer. See "Configuring a Virtual Printer and Print Queue", on page 2-26 .

If echoes of keyboard input are mixed with printer output, check the following:

- Adjust the virtual printer attributes specific to terminal–attached printers. To do this, use the SMIT fast path command:

  ```
  smit chvirprt
  ```

- Resubmit the print request and avoid typing while the request is printing.
- If the ASCII terminal locks, turn the terminal off and on.

Considerations for 8–Bit Printer Attached to 7–Bit Interface

Some printers assume an 8–bit (8 bits per byte) interface to the host. Although an 8–bit printer may print when attached to a 7–bit interface, the printed output may not be acceptable. To determine if your printer assumes an 8–bit interface, consult your printer manual.

Incorrect printed output can be produced in the following situations:

- Printer command sequences may contain 8–bit values.

  If an 8–bit printer must be attached to a 7–bit interface, follow this procedure to prevent incorrect printed output.

  a. Enter the smit fast path `smit lsvirprt`.

  b. Select the print queue and type:

  `j=!j=!`

  c. Press the Enter key to exit.

  This prevents print file initialization strings, which may contain 8–bit command sequences, from being sent to the printer.

Note: This also bypasses printer initialization. So, depending on the pitch, line spacing, and other attributes left by the previous print file, the output may not print correctly.

- Printer character code points may be 8–bit values where each graphical character is represented by an 8–bit integer value causing the wrong character to be printed. To avoid this problem, all the characters in the print files should be in the portable ASCII character set.
- Printed graphic files are affected when a 7–bit interface is used because some of the data points are lost.

qdaemon Checklist

Under normal circumstances, the **qdaemon** command starts when the system starts, runs until the system shuts down, and requires no attention from you. Sometimes, however, the **qdaemon** command may stop running or be unable to perform its function. The following article explains what you need to do under these conditions.

Any of the following conditions indicates that the **qdaemon** command needs maintenance:

- The **enq** command requests return the following message:

  ```
  cannot awaken qdaemon (request accepted anyway)
  ```

- The **qdaemon** command detects serious inconsistencies within itself and displays an error message.
- The **ps –ef** command (the process status command that gives a full listing of all processes) does not show a process named /**usr**/**sbin**/**qdaemon** or **qdaemon**.

To start the **qdaemon** command, issue the following command:

```
startsrc -s qdaemon
```

Generally, only users with root privilege can use this command. The new **qdaemon** command goes through an initialization process.

If the **qdaemon** command does not continue running, make sure that both the **qdaemon** command and the **enq** command have the appropriate permissions. The person with root authority owns both the **qdaemon** command and the **enq** command. The **qdaemon** command and the **enq** command must run as if they are run by the user who owns them. The permission bit **s** sets the effective owner (user ID) of a process to that of the nominal owner. The appropriate permissions for these two commands are:

qdaemon –r–sr–s––

To check these permissions, enter `aclget /usr/sbin/qdaemon`.

To reset permissions, enter: `tcbck -y /usr/sbin/qdaemon`. You must have root user authority to reset these permissions.

enq –r–sr–sr–x

To check these permissions, enter `aclget /usr/bin/enq`.

To reset permissions, enter: `tcbck -y /usr/bin/enq`. You must have root user authority to reset these permissions.

If you continue to have problems with the **qdaemon** command, you can use the following procedure to reinitialize the entire queuing system:

1. If the **qdaemon** command is running (use the **ps –ef** command to find out), end it by entering `stopsrc -s qdaemon`.
2. If any backends are running, use the **kill** command to stop them.
3. Delete the contents of the following directories:
   - **/var/spool/lpd/stat**
   - **/var/spool/lpd/qdir**

   Note: All jobs currently queued for printing are canceled and must be resubmitted.
4. Restart the **qdaemon** command by entering `startsrc -s qdaemon`.

Queuing System Problems

When the queuing system shows one or more queues in **DEV_WAIT** and you have verified that the queue is not waiting on the printer because the printer is offline, out of paper, jammed, or the cable is loose, bad, or wired incorrectly, and it has not changed to DOWN within the TIMEOUT period, use the following method to clear and restart the queuing system. This method stops the **qdaemon**, removes all queued jobs, and restarts the **qdaemon**. You must have root authority.

```
stopsrc -s qdaemon
ps -e | fgrep qd
kill -9 PIDNumbers
```

where *PIDNumbers* are any PIDs resulting from the **ps** command.

```
ps -e | fgrep pio
kill -9 PIDNumbers
```

```
rm /var/spool/lpd/stat/_dev_DEVICE
```

where *DEVICE* is the device that is showing DEV_WAIT.

```
rm /var/spool/lpd/stat/s.QUEUE.DEVICE
```

where *QUEUE* is the queue and DEVICE that is showing DEV_WAIT.

```
mkdir /tmp QDIR
mv /var/spool/lpd/qdir/NNUSER:QUEUE /tmp QDIR
```

where *NN* is a number, *USER* is the user who queued the job and *QUEUE* is the queue that is showing DEV_WAIT.

```
startsrc -s qdaemon
```

After the queueing system has been cleared and appears to be functioning properly, you will need to stop the qdaemon, copy the jdf files from /tmp/QDIR to /var/spool/lpd/qdir, and then restart the qdaemon.

Testing the qdaemon

Scenario: Submitting jobs to the spooler causes no discernible spooler activity; this is a well–known scenario in Version 3.2.5. Assume a local ASCII print queue named **asc**.

Is the **qdaemon** running?

Issue the command **enq –Pasc /etc/motd**. If the **qdaemon** is not active, a variant of the following message will be displayed:

```
enq: (WARNING): Cannot awaken qdaemon. (request accepted anyway)
enq: errno = 2:  No such file or directory
enq: (WARNING): Cannot awaken qdaemon. (request accepted anyway)
enq: errno = 2:  No such file or directory
```

Use the command **ps –ef | grep qdaemon** to verify that the **qdaemon** is not active. If the **qdaemon** is not active, you should see, at the most, a line of output representing the **grep** itself. It should look something like this:

```
root  2992 18792   0 12:46:39  pts/2  0:00 grep qdaemon
```

If the **qdaemon** is active, which it almost certainly will not be, you will see a variant of the following line:

```
root  2980 3652    0 12:41:25   -   0:00 /usr/sbin/qdaemon
```

If the **qdaemon** is not active, issue the command **startsrc –s qdaemon** to restart the **qdaemon**. If the **qdaemon** died, it should have been restarted automatically by the **srcmstr** process, but it doesn't always work, so restart it manually. You should see a variant of this message:

```
0513-059 The qdaemon Subsystem has been started. Subsystem PID is
3000.
```

Wait one minute or so and re–issue the command **ps –ef | grep qdaemon**. Is the **qdaemon** still active or did it just start and then die?

If the **qdaemon** is no longer active, despite the fact that you just restarted it and received a message stating the **qdaemon**'s process id (PID) and that it was active, check for the existence of the file named **/var/spool/lpd/stat/pid**. You can do this by issuing the command **cat /var/spool/lpd/stat/pid**. This file contains the PID of an active **qdaemon**. When the **qdaemon** is not active, the file is *supposed* to be removed.

If the **cat** command prints a number on your display, that *should* be the pid of an active **qdaemon**. If you have already determined that the **qdaemon** is not active, remove the file **/var/spool/lpd/stat/pid** because a previous instance of the **qdaemon** somehow died without causing this file to be removed. If the file does not exist, you should see a message like:

```
cat: cannot open /var/spool/lpd/stat/pid
```

If the **qdaemon** was inactive, you restarted it, it died again, the file **/var/spool/lpd/stat/pid** existed, and you removed that file, then again restart the **qdaemon** using the command **startsrc –s qdaemon**. Wait one minute or so and again issue the command **ps –ef | grep qdaemon** to see if the **qdaemon** remained active. You can also again issue the command **cat /var/spool/lpd/stat/pid** to see the file was re–created and now contains a valid PID.

If the answer to the original question, *Is the qdaemon running?*, was *yes, it is*, then it is possible that the **qdaemon** is waiting on all currently running jobs to complete before it shows any signs of accepting new jobs. This scenario often occurs when a machine running AIX has a large number (greater than 25) of printers attached to asynchronous adapters, such as 64–port or 128–port adapters.

To check to see if the **qdaemon** is waiting on a job to complete before it runs any more jobs, use **lpstat** to see if any jobs have a status of **RUNNING**. If so, physically examine the

printers that show **RUNNING** jobs and verify that at least one job is actually running. If one or more printers are showing **DEV_WAIT** because of paper jams or because they are out of paper, fix the problem and see if the printer begins printing. If it does begin printing, again use **lpstat** to see if the queue status is **RUNNING**. In any of these circumstances, the point is to verify that at least one printer is actually printing even though the **qdaemon** is not starting new jobs.

Now submit a new job to the spooler with the command **enq –Pasc /etc/motd**.

Use **lpstat** to examine the queue status. If the new job has a job number of **NEW**, then the **qdaemon** is for some reason focused on a running job(s) and will not start any new jobs until the currently running job(s) complete. You can only wait. You can't even cancel the job(s) that are running, because job cancellation requests are just jobs as well, and the **qdaemon** isn't taking new jobs.

Note: A job will only have the job number **NEW** in Version 3.2.5; this does not occur in AIX Version 4. The job number **NEW** appears when **enq** has created a JDF but the **qdaemon** has not read the JDF. This event can not occur in AIX Version 4.

Testing a Spooler Queue

When spooling jobs from an application, it's often not clear if a job is actually getting to the spooler. Again assume you are having problems with a queue named **asc**.

Issue the command **disable asc** to disable the spooler queue. Issue the command **lpstat –pasc** to verify that the queue is **DOWN**. Now submit a job to the queue using the application.

Use **lpstat** to verify that the job is on the **asc** queue (as long as the queue status is in a temporary **DOWN** state, the **qdaemon** will put a job on the queue but will not allow it to be processed.) If the job is not on the queue, use personal knowledge, application documentation, or application technical support to determine what might be wrong. If possible, determine exactly what job submission command or method is being used by the application and try it from the command line. It's possible that the application is hiding error messages being returned by either **enq** or the **qdaemon**.

Copying Spooled Jobs

Particularly in a remote spooling environment, it can be useful to make a copy of a spooled print job. When a job is submitted to the spooler, a job description file (JDF) is created and stored in **/var/spool/lpd/qdir**. If the queue is a remote queue, with something like **rembak** as the backend, the job will be transferred to the print server, where **enq** will make another JDF and put the job onto the specified print server queue.

If jobs seem to be vanishing at the print server, disable the print server queue (**disable asc**, for the ASCII queue example), and resubmit the job. Since the **asc** is down, **lpstat** should show the job as queued, but the queue will be **DOWN** and so the job will just sit there. Look in **/var/spool/lpd/qdir** for the JDF for this job. The last line of the JDF is the full path name to the spooled copy of the input data stream. Copy that file to some temporary file, such as `/tmp/myfile`. When you copy the file, you lose all of the flags that were associated with the job; all you are copying is the input data stream itself.

Enable the **asc** queue (**enable asc**) and allow the job to be processed. If it vanishes, submit the copy you made `(enq -Pasc /tmp/myfile)`. If this job also vanishes, then you need to examine the input datastream for errors, as the printer for some reason does not want to print it. If the copy prints, then you probably have a problem with flags associated with the original job.

Cleaning Up and Starting Over

This procedure completely clears and restarts the spooler system. All jobs currently queued for processing are deleted and must be resubmitted. Use it when you cannot troubleshoot an inoperative spooler. You must be the root user to perform this task.

1. Stop the **qdaemon** and associated processes:

   ```
   stopsrc –s qdaemon

   ps–ef | grep qd
   ```

2. kill –9 `PIDNumbers`

   where `PIDNumbers` are PIDs resulting from the **ps** command. You may find **qdfork**.

   ```
   ps –ef | grep pio

   kill –9 PIDNumbers
   ```

   where `PIDNumbers` are PIDs resulting from the **ps** command. You may find **pioformat** or **pioout**.

3. Clean out the queue and device status directory.

   ```
   rm /var/spool/lpd/stat/*_dev_*

   rm /var/spool/lpd/stat/s*
   ```

   The file **/var/spool/lpd/stat/numfile** contains an integer representing the last job number that was assigned. If you don't care if the job numbering scheme restarts, you can just enter:

   ```
   rm /var/spool/lpd/stat/*
   ```

4. Remove spooled jobs:

   ```
   rm /var/spool/lpd/qdir/*

   rm /var/spool/qdaemon/*
   ```

5. Restart the qdaemon.

   ```
   startsrc –s qdaemon
   ```

While issuing the **ps** commands, you may find a process whose parent process ID (PPID) is `1`. If these processes cannot be killed by **kill –9**, you must re–boot the system to get rid of these processes.

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Nº Reférence / Reference Nº : 86 A2 37JX 02

Daté / Dated : November 1999

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