

Chapter 23

Printing

Basic terms (1)

- **spooler**
 - > Printer server
 - > Receive, store, priority print jobs
 - > Send print jobs to printer
- **dpi**
 - > dots per inch
 - > Such as 300 x 600 dpi
- **Bitmap**
 - > Set of data that specify how dots are filled
 - > Compression: JPEG, PNG, TIFF, ...
- **Filters**
 - > Programs that modify print jobs between spooler and printer

Basic terms (2)

◎ **PDL**

- > Page Description Language
- > Describe where and how the image is placed on the page
- > PDLs: PostScript and Printer Command Language (PCL)

◎ **PostScript**

- > PDL developed by Adobe
- > %!PS starting

◎ **PCL**

- > HP's alternative to PostScript

◎ **RIP**

- > Raster Image Processor
- > PDLs-to-bitmap conversion

Types of Printer

- Serial and Parallel Printer

- > Parallel printer is simple and faster than serial printer

- USB Printer

- Network printer

- > Printer with NIC

- > Two kinds of network printer

- Printer that can do jobs queuing and scheduling
- Printer that does not know above, the NIC is nothing more than a channel to transfer printing data, just like serial or parallel port

BSD Printing System (1)

- ◎ Printer server

- > lpd

- Responsible for accepting jobs, processing them and sending them to an actual printer
- Control by `/etc/printcap`

- > Enable lpd in FreeBSD

- Edit `rc.conf`
 - `lpd_enable="YES"`
 - `lpd_flags="-l" #log print request`

BSD Printing System (2)

- ◉ When we want to print ...
 - > Using lpr command
 - `lpr -PPhp4350 mydocument.txt`
 - > Printer selection
 - 1.If there is `-P` option, use that printer
 - 2.If there is "PRINTER" variable, use that printer
 - 3.Use the default printer defined in `/etc/printcap`
 - 4.If there is no default printer, use the first entry defined in `/etc/printcap`

BSD Printing System (3)

◉ When lpd receives the jobs ...

- > Put the job in spool directory
 - cf file (control file)
 - Information about the jobs
 - Ex: cfA023ntserv
 - df file (data file)
 - Actual data that is going to be printed
 - Ex: dfA023ntserv
- > Send the first queued job to printer
 - lpd creates a series of UNIX pipes between spool and printer to let system invokes filter to modify the job or something else
 - Local or remote printer

cf file

```
H140.113.235.1
Plwhsu
JEdit2*
ldfA023140.113.235.1
UdfA023140.113.235.1
NEdit2*
```

BSD Printing System (4)

- What client can do ?
 - > lpr **to send the job**
 - > lpq **to list the queued jobs**
 - > lprm **to remote the job**
- What administrator can do ?
 - > lpq, lprm
 - > lpc **to change the printing environment**

lpr(1), lpq(1), lprm(1)

BSD Printing System

lpr command

- lpr: submit the jobs

- > \$ lpr -Pprinter-name file

- Ex: `lpr -PPhp4350 hwk2.doc`

- > \$ lpr -Pprinter-name -#N file

- Produce N copies of file

- Ex: `lpr -PPhp4350 -#3 hwk2.doc`

- Ex: `lpr -PPhp4350 -#3 hwk2.c hwk2.h Makefile`

- Ex: `cat hwk2.c hwk2.h Makefile | lpr -PPhp4350 -#3`

BSD Printing System

lpq command

- lpq: view the printing queue
 - > % lpq -Pprinter-name

- **If the first record is not “active” , no printing daemon is running on the printer**
 - Using lpc → start hp4050

```
sysadm:~ -lwhsu- lpq -Php4050
Rank   Owner   Job    Files          Total Size
Active lwhsu   1      /etc/printcap  324 bytes
1st    lwhsu   2      /etc/hosts     131 bytes
2nd    lwhsu   3      /etc/group     423 bytes
```

BSD Printing System

lprm command

◎ lprm: remote print jobs

- > \$ lprm -Pprinter-name jobid
 - Remote single printing job with certain id
 - Ex: `lprm -Php4350 121`
- > \$ lprm -Pprinter-name user
 - Remote all jobs owned by user
 - Ex: `lprm -Php4350 lwhsu`
- > \$ lprm -Pprinter-name
 - Remove the active job if the job is owned by user
- > \$ lprm -Pprinter-name -
 - Remote jobs you submitted
 - Remote all jobs when root execute it

BSD Printing System

lpc command (1)

- lpc: make administrative changes

```
sysadm:~ -lwhsu- lpc
lpc> ?
Commands may be abbreviated.  Commands are:

abort          exit           quit           setstatus     up
bottomq       disable        restart        stop           ?
clean          down           start          tclean        xtopq
enable         help           status         topq
lpc>
```

BSD Printing System

lpc command (2)

- lpc commands
 - > help [command]
 - One-line description of that command
 - > enable/disable **printer**
 - **Start or stop spooling**
 - > start/stop **printer**
 - **Start of stop printing, the active job will be finished**
 - > abort **printer**
 - **Stop printing, the active job will be suspended until start printing again**
 - > up/down **printer**
 - **Start or stop “spooling and printing” at the same time**
 - > clean **printer**
 - **Remove all jobs, including active jobs, but it will be finished**

BSD Printing System

lpc command (3)

- > **topq printer [jobid | username]**
 - **Move the jobs to top of queue**
- > **restart printer**
 - **Restart the printer; restart will fail if the printer still has a filter running**
- > **status printer**
 - **Whether spooling**
 - **Whether printing**
 - **Number of jobs in queue**
 - **Printer status**

```
lpc> status hp4050
hp4050:
    queuing is enabled
    printing is disabled
    2 entries in spool area
    printer idle
lpc>
```

/etc/printcap file

- How & where to process printing jobs
 - > Configuration format
 - Separated by “:”
 - Three option format
 - xx (enable/disable option)
 - xx=string (string type option)
 - xx#number (numeric type option)

```
hp6mp|HP LaserJet 6MP:\
:sh:\
:rw:\
:mx#0:\
:sd=/var/spool/lpd/hp6mp:\
:lp=/dev/lpt0:\
:if=/usr/libexec/lpr/lpf:\
:lf=/var/spool/lpd/hp6mp/log:
```

Printer name

Configuration options

/etc/printcap file
printer name

- Multiple names separated by “|”
 - The record has “lp” will be the default printer**

```
hp6mp|HP LaserJet 6MP:\  
:sh:\  
:rw:\  
:mx#0:\  
:sd=/var/spool/lpd/hp6mp:\  
:lp=/dev/lpt0:\  
:if=/usr/libexec/lpr/lpf:\  
:lf=/var/spool/lpd/hp6mp/log:
```

```
hp4050|lp|HP LaserJet 4100:\  
:sh:\  
:rw:\  
:mx#0:\  
:sd=/var/spool/lpd/hp4050:\  
:lp=/dev/null:\  
:rm=hp4050:\  
:if=/usr/libexec/lpr/lpf:\  
:lf=/var/spool/lpd/hp4050/log:
```


/etc/printcap file

configuration options (1)

- **sd**: spool directory
 - > Where to put the print jobs before sending to printer
 - > Ideal path: under /var/spool/lpd/
 - > Permission with 755 and owner, group owner with "daemon"
 - Ex: sd=/var/spool/lpd/hp4050

- **lf**: error log file
 - > Where to put the error message
 - > Ideal path: under spool directory with name "log"
 - Ex: lf=/var/spool/lpd/hp4050/log
 - > lpd mind sends error messages to syslog, check both

- **mx**: file size limit
 - > Size of data that can be spooled at one time in block
 - > Ex: mx#5000 (limit of 5000*1024bytes)
 - > Ex: mx#0 (no limit)

/etc/printcap file configuration options (2)

- **lp**: device name
 - > **Local: the device file under /dev**
 - > **Remote: /dev/null**
 - Ex: lp=/dev/lpt0
 - Ex: lp=/dev/null
- **rm**: remote machine
 - > **Which host to send the print job if this printer is a remote one**
 - Ex: rm=csduty
- **rp**: remote printer
 - > **Which printer to send if this remote host has several printer**
 - Ex: rm=csduty
 - Ex: rp=ps

/etc/printcap file

configuration options (3)

- ◎ **if, of**: printing filters
 - > **shell scripts mostly**
 - > **Three basic jobs**
 - **Accept printing job from standard in**
 - **Transform data**
 - **Send the result to standard output**
 - > **Another usage of filters**
 - **Accounting**
 - **Access control to “user” level**
 - **Auditing**

- ◎ **af**: accounting file
 - > **Tell filters where to append the auditing records**

Adding a Printer in FreeBSD

Local Printer Through parallel port (1)

- ◎ Hardware Setup
 - > Connect the cable
- ◎ Software Setup
 1. Configure the kernel
 2. Set the communication mode
 3. Test
 4. Set up LPD

Adding a Printer in FreeBSD

Local Printer Through parallel port (2)

1. Configure the kernel

- > grep boot message first
 - \$ grep ppc /var/log/dmesg.today

```
sysadm:~ -lwshsu- dmesg | grep ppc
ppc1: <Standard parallel printer port> port 0x378-0x37f irq 7 on acpi0
ppc1: Generic chipset (NIBBLE-only) in COMPATIBLE mode
ppbus0: <Parallel port bus> on ppc1
sysadm:~ -lwshsu- dmesg | grep lpt
lpt0: <Printer> on ppbus0
lpt0: Interrupt-driven port
```

- > If found nothing, recompile the kernel
 - Modify kernel config
 - device ppc
 - device ppbus # Parallel port bus
 - device lpt # Printer
 - Or just load kernel module
 - kldload ppc
 - kldload lpt

Adding a Printer in FreeBSD

Local Printer Through parallel port (3)

- > Check whether there is /dev/lpt0, ...
 - Parallel port : /dev/ppc0, /dev/ppc1, ...
 - Printer device file: /dev/lpt0, /dev/lpt1, ...

```
• crw----- 1 root wheel 16, 0 7 28 17:07 lpt0
• crw----- 1 root wheel 16, 1 7 28 17:07 lpt1
```

Adding a Printer in FreeBSD

Local Printer Through parallel port (4)

2. Set the communication mode

- > using `lptcontrol(8)`
 - `$ lptcontrol -i -d /dev/lpt0`
(interrupt-driven mode)
 - `$ lptcontrol -p -d /dev/lpt0` (polled mode)
 - Put in `/etc/rc.local`
- > using device hint (`/boot/device.hints`)
 - Interrupt driven mode – `hint.ppc.0.irq="7"`
 - Polled mode – `hint.ppc0.irq=""`

⦿ Communication mode

- > Interrupt-driven
 - OS use IRQ line to determine when the printer is ready for data
- > Polled
 - OS will repeatedly ask the printer whether it is ready for data

Adding a Printer in FreeBSD

Local Printer Through parallel port (5)

3. Test

- > Using lptest as root
 - \$ lptest > /dev/lpt0
- > Using PostScript program if it understands
 - \$ cat test-printer > /dev/lpt0

Content of test-printer file

```
%!PS
100 100 moveto 300 300 lineto stroke
310 310 moveto /Helvetica findfont 12 scalefont setfont
(Is this thing working?) show
showpage
```


Adding a Printer in FreeBSD

Local Printer Through parallel port (6)

4. Setup LPD

- > Edit the `/etc/printcap` file
 - Naming the Printer
 - Suppressing Header (sh)
 - Making the Spooling Directory (sd)
 - Identifying the print device (lp)
 - Input filter (if)
 - Turn on lpd
 - Test with lpr

Adding a Printer in FreeBSD

Local Printer Through parallel port (7)

> Detail steps

- `$ mkdir /var/spool/lpd/hp6mp`
- `$ chown daemon:daemon /var/spool/lpd/hp6mp`
- `$ chmod 770 /var/spool/lpd/hp6mp`

- `$ mkdir /etc/print`
- (Edit `/etc/print/if-simple`)
- `$ chmod 555 /etc/print/if-simple`

- Edit `rc.conf` with `lpd_enable="YES"`

Adding a Printer in FreeBSD

Local Printer Through parallel port (8)

◉ Content of /etc/printcap

```
sysadm:~ -lwhsu- less printcap
hp6mp|HP LaserJet 6MP:\
    :sh:\
    :sd=/var/spool/lpd/hp6mp:\
    :lp=/dev/lpt0:\
    :if=/etc/print/if-simple:
```

◉ Content of /etc/print/if-simple

```
#!/bin/sh
#
# Simply copies stdin to stdout.
# Ignores all filter arguments.
printf "\033&k2G" && cat && printf "\033&l0H" && exit 0
exit 2
```

Adding a Printer in FreeBSD

Network printer (1)

- ◉ Access a printer attached to a remote host
- ◉ Access a printer attached to a network
 - > Printer understand LPD protocol
 - It can queue and schedule jobs from remote hosts
 - It is like access to a printer attached to a host
 - > Printer supports only data stream network connection
 - We need a host to spool jobs and send them to the printer

Adding a Printer in FreeBSD

Network printer (2)

- > Remote printer understanding LPD directly attached on the network
 - Set our /etc/printcap with “**rm**” option
 - Don’ t forget to create spooling directory with right access mode

```
hp4050|lp|HP LaserJet 4100:\
:sh:\
:rw:\
:mx#0:\
:sd=/var/spool/lpd/hp4050:\
:lp=/dev/null:\
:rm=hp4050:\
:if=/usr/libexec/lpr/lpf:\
:lf=/var/spool/lpd/hp4050/log:
```

Adding a Printer in FreeBSD

Network printer (3)

- > Remote printer that support data stream connection only
 - The network interface card of printer is used to let you send data to it just like serial / parallel port
 - Have to develop a communication program called by filter

```
#!/bin/sh
#
# diablo-if-net - Text filter for Diablo printer `scrivener' listening
# on port 5100.  Installed in /usr/local/libexec/diablo-if-net
#
exec /usr/libexec/lpr/lpf "$@" | /usr/local/libexec/netprint scrivener 5100
```

Adding a Printer in FreeBSD

Network printer (4)

```
#!/usr/bin/perl
#
# netprint - Text filter for printer attached to network
# Installed in /usr/local/libexec/netprint
#
$#ARGV eq 1 || die "Usage: $0 <printer-hostname> <port-number>";

$printer_host = $ARGV[0];
$printer_port = $ARGV[1];

require 'sys/socket.ph';

($ignore, $ignore, $protocol) = getprotobyname('tcp');
($ignore, $ignore, $ignore, $ignore, $address)
    = gethostbyname($printer_host);

$sockaddr = pack('S n a4 x8', &AF_INET, $printer_port, $address);

socket(PRINTER, &PF_INET, &SOCK_STREAM, $protocol)
    || die "Can't create TCP/IP stream socket: $!";
connect(PRINTER, $sockaddr) || die "Can't contact $printer_host: $!";
while (<STDIN>) { print PRINTER; }
exit 0;
```

Restricting Printer Usage

- Multiple Copies
 - > To disable: sc option
- Group access
 - > rg option
- Control size of jobs
 - > mx option
- Remote access
 - > /etc/hosts.lpd
 - Hosts in file are allowed to access the printer

```
hp4050|lp|HP LaserJet 4100:\
:sh:\
:rw:\
:mx#0:\
:sd=/var/spool/lpd/hp4050:\
:sc:\
:rg=csie:\
:mx#5000:\
:lp=/dev/null:\
:rm=hp4050:\
:if=/usr/libexec/lpr/lpf:\
:lf=/var/spool/lpd/hp4050/log:
```


filters

- Three kinds
 - > Text filters (input filter)
 - Handle regular text printing
 - `/usr/libexec/lpr/lpf`
 - > Conversion filter
 - Convert a specific file format into another
 - > Output filter
 - Used if there is no text filter
- Return value
 - > `exit 0`
 - successfully
 - > `exit 1`
 - Failed to print, but want LPD to print the file again
 - > `exit 2`
 - Failed to print, and does not want to print the file anymore

filters

plaintext on PostScript Printers (1)

- Postscript printing jobs
 - > **Start with %!PS**
 - > **If this job start with “%!PS”,**
 - let it goes to printer directory
 - > **Else**
 - convert the text into Postscript and print the result
- Using text filter “lprps”
 - > /usr/ports/print/lprps-a4

filters

plaintext on PostScript Printers (2)

```
sysadm:~ -lwshu- cat /usr/share/examples/printing/psif
#!/bin/sh
#
# psif - Print PostScript or plain text on a PostScript printer
# Script version; NOT the version that comes with lprps
# Installed in /usr/local/libexec/psif
#

read first_line
first_two_chars=`expr "$first_line" : '\(..\)'`

if [ "$first_two_chars" = "%!" ]; then
#
# PostScript job, print it.
#
echo "$first_line" && cat && printf "\004" && exit 0
exit 2
else
#
# Plain text, convert it, then print it.
#
( echo "$first_line"; cat ) | /usr/local/bin/textps && printf "\004" && exit 0
exit 2
fi
```

filters

non-PostScript printer

- Simulating PostScript on non-PostScript printer
 - > Using “ghostscript”
 - > Under /usr/ports/print/ghostscript-gnu

```
#!/bin/sh
printf "\033&k2G" || exit 2

IFS="" read -r first_line
first_two_chars=`expr "$first_line" : '\(..\)'`

if [ "$first_two_chars" = "%!" ]; then
    /usr/local/bin/gs -dSAFER -dNOPAUSE -q -sDEVICE=lj5gray \
        -sOutputFile=- - && exit 0
else
    echo "$first_line" && cat && printf "\033&l0H" &&
exit 0
fi

exit 2
```

Chinese printing

- ◎ `bg5ps`

- > `/usr/ports/chinese/pg5ps`
- > Transform document into ps using TTF

- ◎ `enscript`

- > `/usr/ports/chinese/enscript`
- > Transform document into ps using CID-font