



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**

- *Ex: lpr -Php4350 myfile.doc*

- **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
Pch Wong
JEdit2*
ldfA023140.113.235.1
UdfA023140.113.235.1
NEdit2*
```

CF meanings: man lpd

BSD Printing System (4)

❑ What client can do ?

- `lpr` **to send the job**
- `lpq` **to list the queued jobs**
- `lprm` **to remove the job**

❑ What administrator can do ?

- `lpq`, `lprm`
- `lpc` **to change the printing environment**

BSD Printing System

lpr command

❑ lpr: submit the jobs

- % `lpr -Pprinter-name file`
 - *Ex: % lpr -Php4350 hwk2.doc*
- % `lpr -Pprinter-name -#N file`
 - **Produce N copies of file**
 - *Ex: % lpr -Php4350 -#3 hwk2.doc*
 - *Ex: % lpr -Php4350 -#3 hwk2.c hwk2.h Makefile*
 - *Ex: % cat hwk2.c hwk2.h Makefile | lpr -Php4350 -#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

```
sabsd [/etc] -chwong- lpq -Php4050
```

Rank	Owner	Job	Files	Total Size
active	chwong	1	/etc/printcap	324 bytes
1st	chwong	2	/etc/hosts	131 bytes
2nd	chwong	3	/etc/group	423 bytes

BSD Printing System

lprm command

❑ lprm: remote print jobs

- % lprm -P**printer-name** jobid
 - Remote single printing job with certain id
 - *Ex: % lprm -Php4350 121*
- % lprm -P**printer-name** user
 - Remote all jobs owned by user
 - *Ex: % lprm -Php4350 ch Wong*
- % lprm -P**printer-name**
 - Remove the active job if the job is owned by user
- % lprm -P**printer-name** -
 - Remote jobs you submitted
 - Remote all jobs when root execute it

BSD Printing System

lpc command (1)

- ❑ lpc: make administrative changes

```
sabsd [/etc] -chwong- 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:\n:sh:\n:rw:\n:mx#0:\n:sd=/var/spool/lpd/hp6mp:\n:lp=/dev/lpt0:\n:if=/usr/libexec/lpr/lpf:\n:lf=/var/spool/lpd/hp6mp/log:
```

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

```
sabsd [/etc] -chwong- 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
sabsd [/etc] -chwong- 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

```
sabsd [/etc] -chwong- 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)

```
sabsd [/etc] -chwong- 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