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
- PDL
  - Page Description Language
  - Describe where and how the image is placed on the page
  - PDLs: PostScript and Printer Command Language (PCL)
- Bitmap
  - Set of data that specify how dots are filled
  - Compression: JPEG, PNG, TIFF, …

Basic terms (2)

- RIP
  - Raster Image Processor
  - PDLs-to-bitmap conversion
- Filters
  - Programs that modify print jobs between spooler and printer
- PostScript
  - PDL developed by Adobe
  - **%!PS** starting
- PCL
  - HP’s alternative to PostScript

Type of Printer

- Serial and Parallel Printer
  - Parallel printer is simple and faster than serial 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 –Php4200 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: cfA023ntserv2**
    - df file (data file)
      - **Actual data that is going to be printed**
      - **Ex: dfA023ntserv2**
  - 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
Ptytsai
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

BSD Printing System
lpr command

- lpr: submit the jobs
  - **% lpr –P***printer-name file*
    - *Ex: % lpr –Php4200 hwk2.doc*
  - **% lpr –P***printer-name* -#N file
    - Produce N copies of file
    - *Ex: % lpr –Php4200 -#3 hwk2.doc*
    - *Ex: % lpr –Php4200 -#3 hwk2.c hwk2.h Makefile*
    - *Ex: % cat hwk2.c hwk2.h Makefile | lpr –Php4200 -#3*

BSD Printing System
lpq command

> lpq: view the printing queue
- **% lpq –P**printer-name
  - If the first record is not “active” , no printing daemon is running on the printer
    > **Using lpc -> start hp4050**

```
tytsai@tybsd:/etc> lpq -Php4050
Rank    Owner   Job     Files                   Total Size
active  tytsai  1       /etc/printcap           324 bytes
1st     tytsai  2       /etc/hosts              131 bytes
2nd     tytsai  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 –Php4200 121*
  - **% lprm –P**printer-name **user**
    - **Remote all jobs owned by user**
    - *Ex: % lprm –Php4200 tytsai*
  - **% 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

```
tytsai@tybsd:/etc> 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=ccduty
- **rp**: remote printer
  - Which printer to send if this remote host has several printer
    - Ex: rm=ccduty
    - 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**

```
tytsai@tybsd:/var/log> sudo grep ppc dmesg.today
ppc0: <Standard parallel printer port> port 0x3bc-0x3be irq 7 on acpi0
ppc0: Generic chipset (NIBBLE-only) in COMPATIBLE mode
ppbus0: <Parallel port bus> on ppc0
```

   - **If found nothing, recompile the kernel**
     - **device ppc**
     - **device ppbus # Parallel port bus**
     - **device lpt # Printer**

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**

- **If not found, using MAKEDEV script to generate it**

  > % cd /dev

  > % ./MAKEDEV lpt0

Adding a Printer in FreeBSD

Local Printer Through parallel port (4)

> 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

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 kernel configuration**
  - device ppc0 at isa? irq N (interrupt-driven mode)
  - device ppc0 at isa? (polled mode)

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 (sp)
     - 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

```
tytsai@tybsd [11:50am] /etc> 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 steam 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
  - **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)

- Serial printer
  - **Use /usr/local/libexec/psif**
- Parallel printer
  - **Use the following script as filter**

```
#!/bin/sh

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

if [ "$first_two_chars" = "%!" ]; then
    echo "$first_line" && cat && printf "\004" && exit 0
    exit 2
else
    ( 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
```