

Chapter7

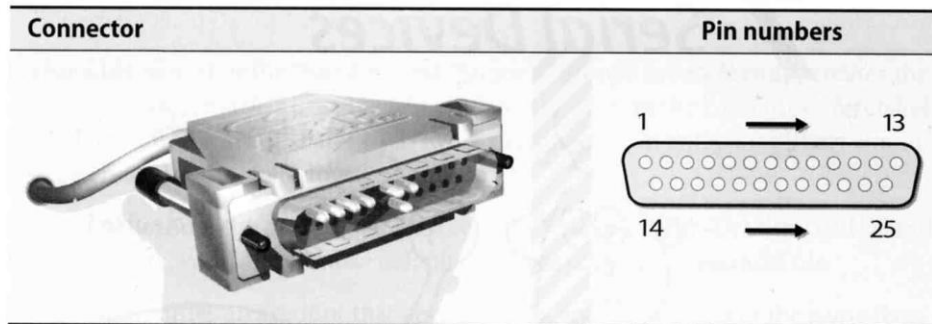
Serial Devices

Serial devices

- Terminal
- Modem
- Mice
- ...

Serial standard (1)

- RS-232 standard on DB25 connector
 - > Electrical characteristics
 - > Meaning of each signal wire
 - > Pin assignment
 - > DB25P (male)
 - > DB25S (female)
 - > DTE (Data Terminal Equipment)
 - > DCE (Data Circuit-terminating Equipment)



Serial standard (2)

- RS-232 signals and pin assignment

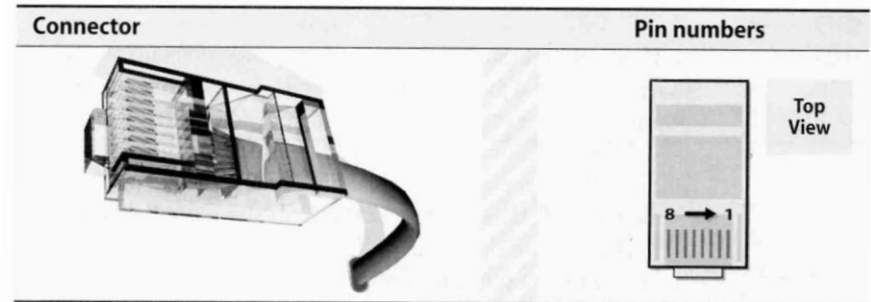
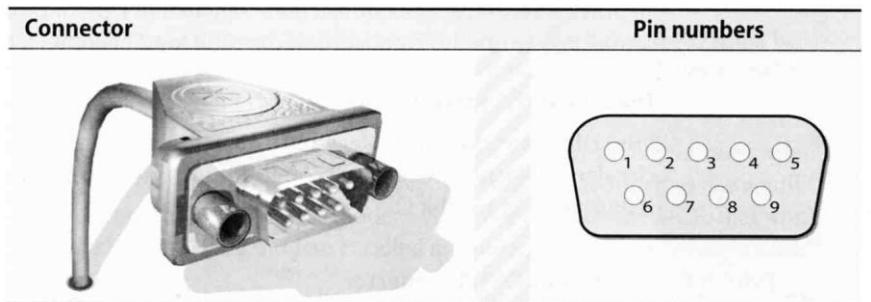
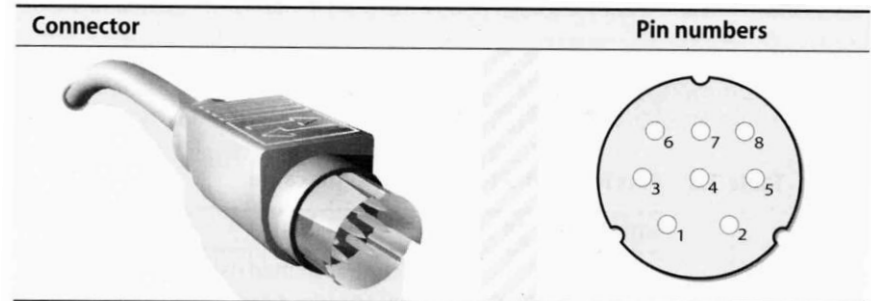
| Pin | Name | Function | Pin | Name | Function |
|-----|------|---------------------|-----|------|-------------------------|
| 1 | FG | Frame ground | 14 | STD | Secondary TD |
| 2 | TD | Transmitted data | 15 | TC | Transmit clock |
| 3 | RD | Received data | 16 | SRD | Secondary RD |
| 4 | RTS | Request to send | 17 | RC | Receive clock |
| 5 | CTS | Clear to send | 18 | - | Not assigned |
| 6 | DSR | Data set ready | 19 | SRTS | Secondary RTS |
| 7 | SG | Signal ground | 20 | DTR | Data terminal ready |
| 8 | DCD | Data carrier detect | 21 | SQ | Signal quality detector |
| 9 | - | Positive voltage | 22 | RI | Ring indicator |
| 10 | - | Negative voltage | 23 | DRS | Data rate selector |
| 11 | - | Not assigned | 24 | SCTE | Clock transmit external |
| 12 | SDCD | Secondary DCD | 25 | BUSY | Busy |
| 13 | SCTS | Secondary CTS | | | |

Serial standard (3)

Alternative connectors

> Since RS-232 is overkill for all real-world situations

- Mini DIN-8
- DB-9
- RJ-45



Serial standard (4)

◎ Cable Length

- > RS-232 specifies a maximum length of 75 feet at 9600 bps
 - $75 * 30.5 \approx 22 \text{ m}$
- > In reality, they hit the limit between 800 ~ 1000 feet

Serial Device File

- Serial ports are represented by device files under /dev
- The name of the device file is no big deal
 - behavior is determined by the major and minor device number

| System | Device files for the first two serial ports |
|---------|---|
| FreeBSD | /dev/ttyd[0,1] (com1, com2) |
| Red Hat | /dev/ttyS[0,1] |
| Solaris | /dev/term[a,b] |
| SunOS | /dev/tty[a,b] |

```
lucky7:~ -lwhsu- ls -al /dev/ttyd0*
crw----- 1 root  wheel   0,  33 Oct 19 20:51 /dev/ttyd0
crw----- 1 root  wheel   0,  34 Oct 19 20:51 /dev/ttyd0.init
crw----- 1 root  wheel   0,  35 Oct 19 20:51 /dev/ttyd0.lock
```

Kernel Configuration

- ◉ dmesg

- > `$ grep sio /var/run/dmesg.boot`

- ```
sio0 <16550A-compatible COM port> port 0x2f8-0x2ff irq 3 on acpi0
sio0: type 16550A
sio1 <16550A-compatible COM port> port 0x2f8-0x2ff irq 3 on acpi0
sio1: type 16550A
```

- ◉ Kernel configuration file

- > device sio

- ◉ Kernel Module

- ◉ `/boot/kernel/sio.ko`

- > `# kldload sio`

- > `/boot/loader.conf:`

- > `sio_load="YES"`

sio(4)



# Software Configuration

- ◎ Depend on the type of serial device
  - > Hardwired terminal
  - > Modem

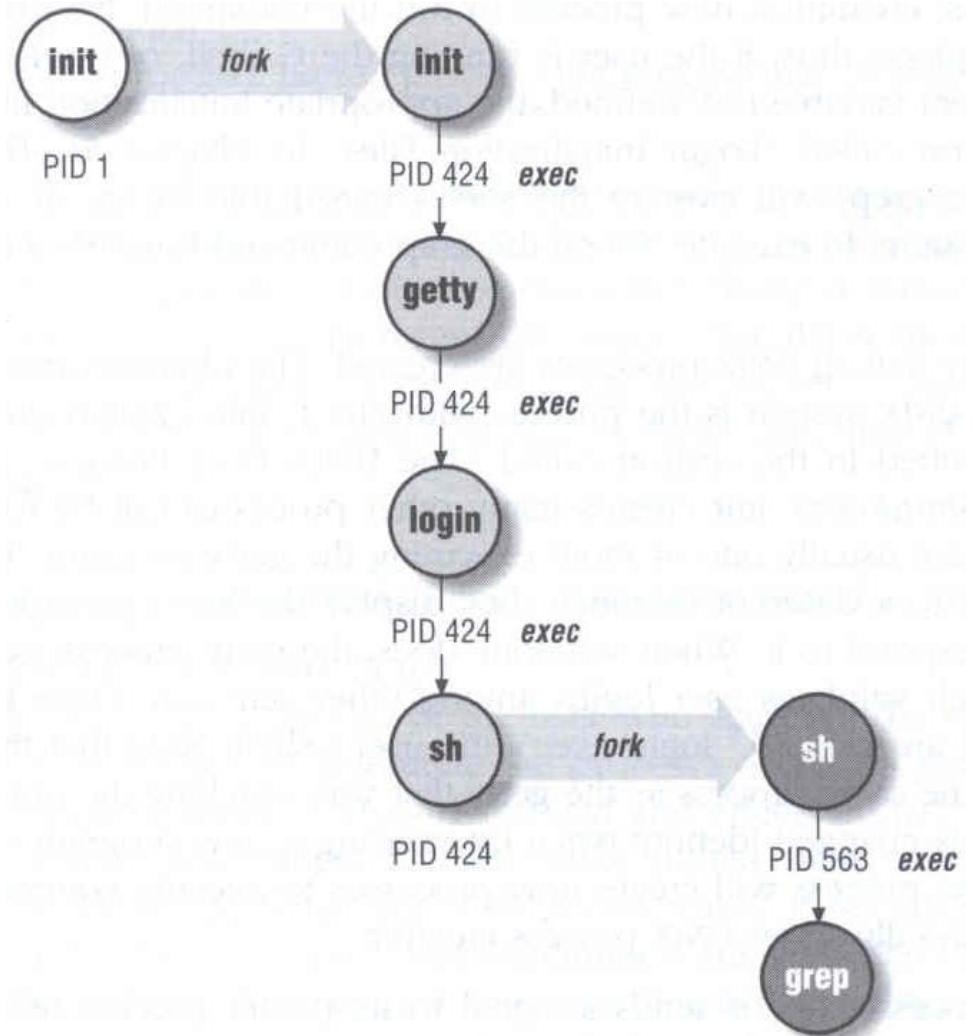
# Configuration of Hardwired Terminals (1)

- ◎ Two main tasks
  - > Make sure each process is attached to a terminal to accept logins
  - > Make sure that information about the terminal is available once a user login

# Configuration of Hardwired Terminals (2)

- The login process
  - > init spawn getty according to /etc/ttys
  - > getty sets the port's initial characteristics and print the prompt
  - > User enter login name
  - > getty executes login program
  - > login request password
  - > login prints /etc/motd
  - > login sets up environment variables
  - > login runs a shell for user

login(1)  
getty(8)



# Configuration of Hardwired Terminals (3)

## ◎ Terminal Configuration Files

### > On/Off

- whether the terminal should be run a getty

### > Term type

- virtual console, network, dial-in

### > Parameter

- Terminal parameters, such as speed

| System  | On/Off       | Term Type    | Parameters     | Monitor |
|---------|--------------|--------------|----------------|---------|
| FreeBSD | /etc/ttys    | /etc/ttys    | /etc/gettytab  | getty   |
| Red Hat | /etc/inittab | /etc/ttytype | /etc/gettydefs | getty   |
| SunOS   | /etc/ttytab  | /etc/ttytab  | /etc/gettytab  | getty   |
| Solaris | _sactab      | _sactab      | zsmn/_pmtab    | ttymon  |

# Configuration of Hardwired Terminals (4)

## ◎ FreeBSD: /etc/ttys

### > Format

device program termttype {on|off} [secure]

### > Restart init process

- kill -1 1
- kill -HUP 1

| #name | getty                         |  | type    | status | comments |
|-------|-------------------------------|--|---------|--------|----------|
| ttyv1 | "/usr/libexec/getty Pc"       |  | cons25  | on     | secure   |
| ttyv2 | "/usr/libexec/getty Pc"       |  | cons25  | on     | secure   |
| ttyd0 | "/usr/libexec/getty std.9600" |  | dialup  | off    | secure   |
| ttyd1 | "/usr/libexec/getty std.9600" |  | dialup  | off    | secure   |
| ttyp0 | none                          |  | network |        |          |
| ttyp1 | none                          |  | network |        |          |

# Configuration of Hardwired Terminals (5)

- ◎ FreeBSD: /etc/gettytab
  - > Associate symbolic names with port configuration information, such as speed, parity, prompt
  - > man gettytab

```
default:\
 :cb:ce:ck:lc:fd#1000:im=\r\n%s/%m (%h) (%t)\r\n\r\n:sp#1200:\
 :if=/etc/issue:
2|std.9600|9600-baud:\
 :np:sp#9600:
P|Pc|Pc console:\
 :ht:np:sp#115200:
```

# Special Characters and The terminal driver

- The terminal driver supports several special function when typing special keys

| Name    | Default | Function                                   |
|---------|---------|--------------------------------------------|
| Erase   | ^H      | Erases one character of input              |
| WErase  | ^W      | Erases one word of input                   |
| Kill    | ^U      | Erases the entire line of input            |
| EOF     | ^D      | Sends an "end of file" indication          |
| INTR    | ^C      | Interrupts the currently running process   |
| Quit    | ^\      | Kills the current process with a core dump |
| Stop    | ^S      | Stops output to the screen                 |
| Start   | ^Q      | Restarts output to the screen              |
| Discard | ^O      | Throws away pending output                 |
| Suspend | ^Z      | Suspends the current process               |
| LNext   | ^V      | Interprets the next character literally    |

# stty – Set Terminal Options

- ◉ Change and query various settings of the terminal drivers
  - > There are about a zillion options
- ◉ Example
  - > stty intr "^C" kill "^U" erase "^H"
  - > stty -a
  - > reset tty
    - reset
    - stty sane

```
speed 38400 baud; 24 rows; 80 columns;
lflags: icanon isig iexten echo echoe -echok echoke -echonl echoctl
 -echoprt -altwerase -noflsh -tostop -flusho pendin -nokerninfo
 -extproc
iflags: -istrip icrnl -inlcr -igncr ixon -ixoff ixany imaxbel -ignbrk
 brkint -inpck -ignpar -parmrk
oflags: opost onlcr -ocrnl -oxtabs -onocr -onlret
cflags: cread cs8 -parenb -parodd hupcl -clocal -cstopb -crtcts -dsrflow
 -dtrflow -mdmbuf
cchars: discard = ^O; dsusp = ^Y; eof = ^D; eol = <undef>;
 eol2 = <undef>; erase = ^?; erase2 = ^H; intr = ^C; kill = ^U;
 lnext = ^V; min = 1; quit = ^\; reprint = ^R; start = ^Q;
 status = ^T; stop = ^S; susp = ^Z; time = 0; werase = ^W;
```

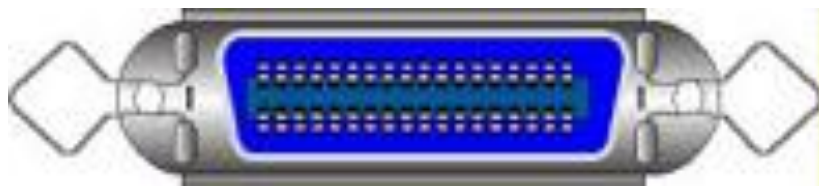
tty(4)  
stty(1)



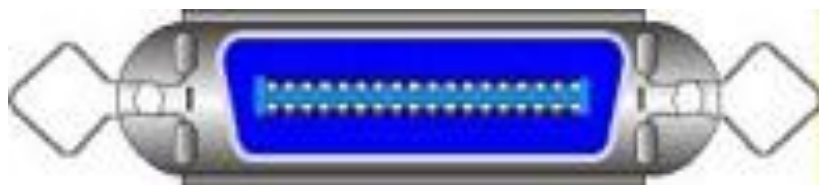
# Other Common I/O ports (1)

- ◎ Parallel ports

- > Similar to serial ports in concept, but parallel ports transfer 8 bits of data at once
- > IEEE-1284 standard
- > Male DB25  $\leftrightarrow$  male Centronics connector



Female Centronics connector



Male Centronics connector

# Other Common I/O ports (2)

- ◎ USB – Universal Serial Bus
  - > Up to 127 devices can be connected
  - > Standardized connectors
  - > Devices can be connected and disconnected without powering down
  - > Up to 12Mb/s
- ◎ USB 2.0
  - > Up to 480Mb/s

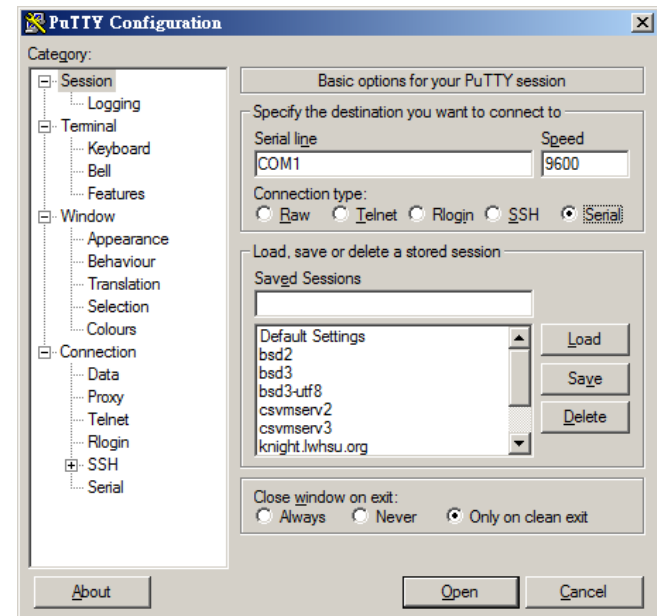
# Serial Console

- ◎ /boot/loader.conf:
  - > console="vidconsole,comconsole"



- ◎ Connect

- > PuTTY
- > tip(1)
- > comms/minicom



<http://www.freebsd.org/doc/en/books/handbook/serialconsole-setup.html>