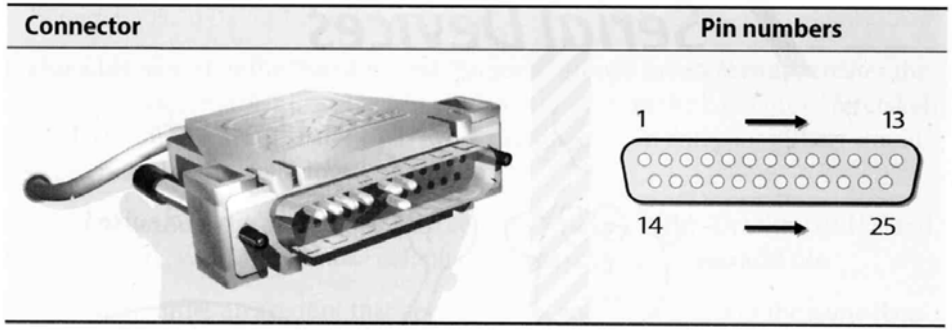
Chapter7
Serial Devices

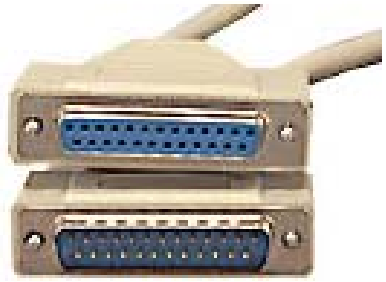
Serial devices

- Terminal
- Modem
- Mice
- ...

Serial standard (1)

- RS-232 standard on DB25 connector
  - Electrical characteristics
  - Meaning of each signal wire
  - Ping assignment
  - DB25P (male)
  - DB25S (female)





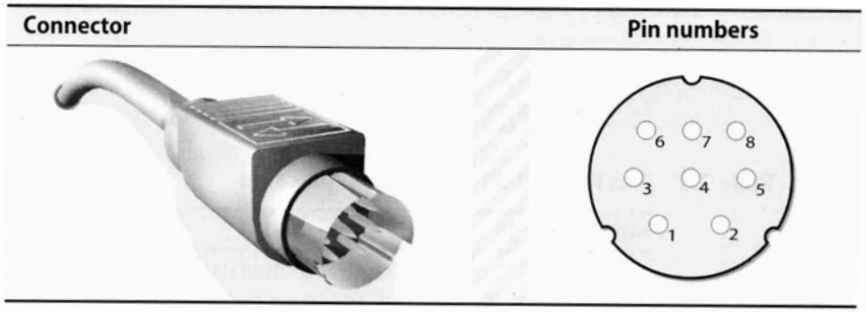
Serial standard (2)

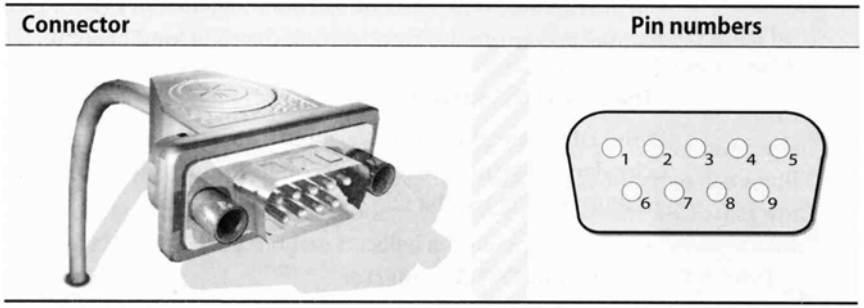
- RS-232 signals and ping assignment

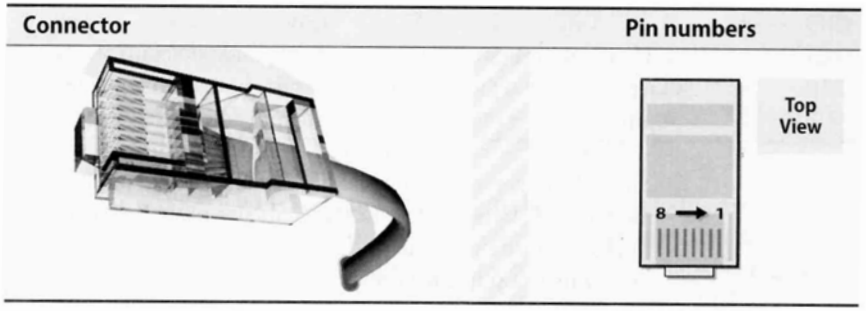
Pin	Name	Function	Pin	Name	Function
1	FG	Frame ground	14	STD	Secondary TD
2	TD	Transmitted data	15	TC	Transmit clock
3	RD	Received data	16	SRD	Secondary RD
4	RTS	Request to send	17	RC	Receive clock
5	CTS	Clear to send	18	–	Not assigned
6	DSR	Data set ready	19	SRTS	Secondary RTS
7	SG	Signal ground	20	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 situation
    - 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 ≒ 22 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]

```
chwong@sabsd:/dev> ls -al ttyd*
crw-------  1 root  wheel    28,   0 Sep 19 20:14 ttyd0
crw-------  1 root  wheel    28,   1 Sep 19 20:14 ttyd1
crw-------  1 root  wheel    28,   2 Sep 19 20:14 ttyd2
crw-------  1 root  wheel    28,   3 Sep 19 20:14 ttyd3
```

Kernel Configuration

- dmesg
  - % /sbin/dmesg | grep sio

```
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
  - % kldload sio

Software Configuration

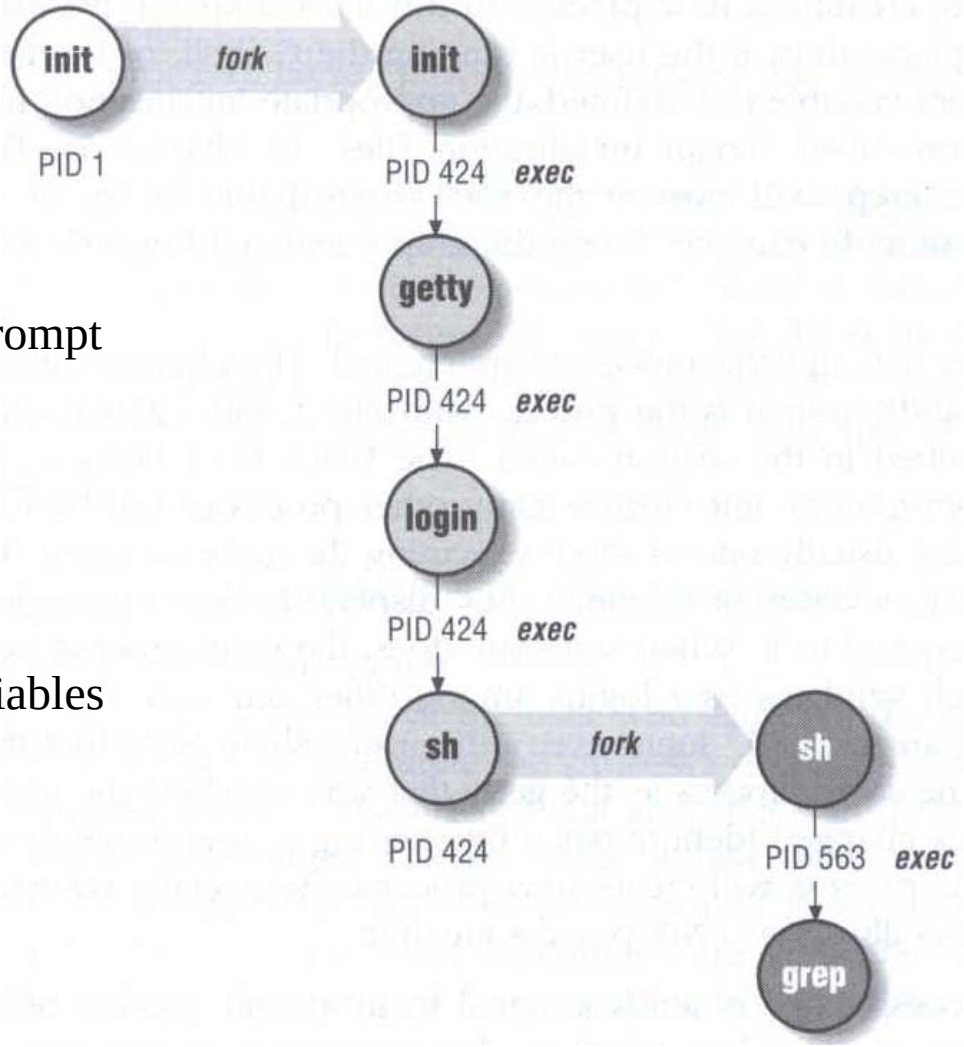
- Depend on the type of serial device
  - Hardwired terminal
  - Modem

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



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	zsmon/_pmtab	ttymon

Configuration of Hardwired Terminals (4)

- FreeBSD: /etc/ttys
  - Format

    device program termtype {on|off} [secure]
  - Restart init process
    - kill -1 1
    - kill –HUP 1

```
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

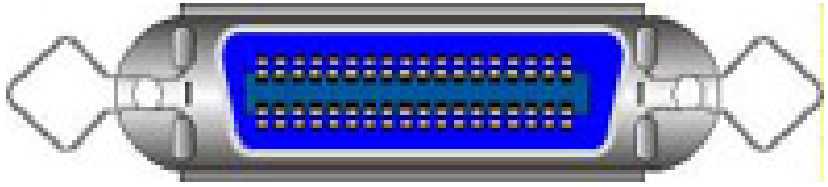
stty – Set Terminal Options

- Change and query various settings of the terminal drivers
  - There are about a zillion options
  - man tty(4) and stty(1)
- Example
  - stty intr "^C" kill "^U" erase "^H"
  - stty –a
  - reset tty
    - reset
    - stty sane

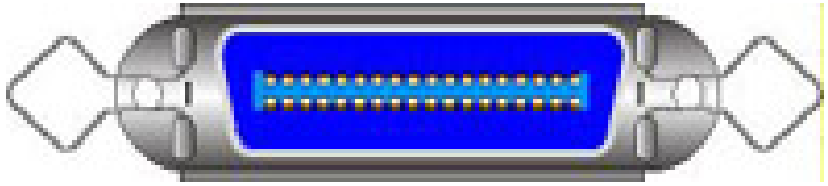
```
speed 38400 baud; 24 rows; 80 columns;
lflags: icanon isig iexten echo echoe -echok echoke -echonl echoctl
        -echoprt -altwerase -noflsh -tostop -flusho pendin -nokerninfo
        -extproc
iflags: -istrip icrnl -inlcr -igncr ixon -ixoff ixany imaxbel -ignbrk
        brkint -inpck -ignpar -parmrk
oflags: opost onlcr -ocrnl -oxtabs -onocr -onlret
cflags: cread cs8 -parenb -parodd hupcl -clocal -cstopb -crtscts -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;
```

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 ←→ 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