Linux Terminal System
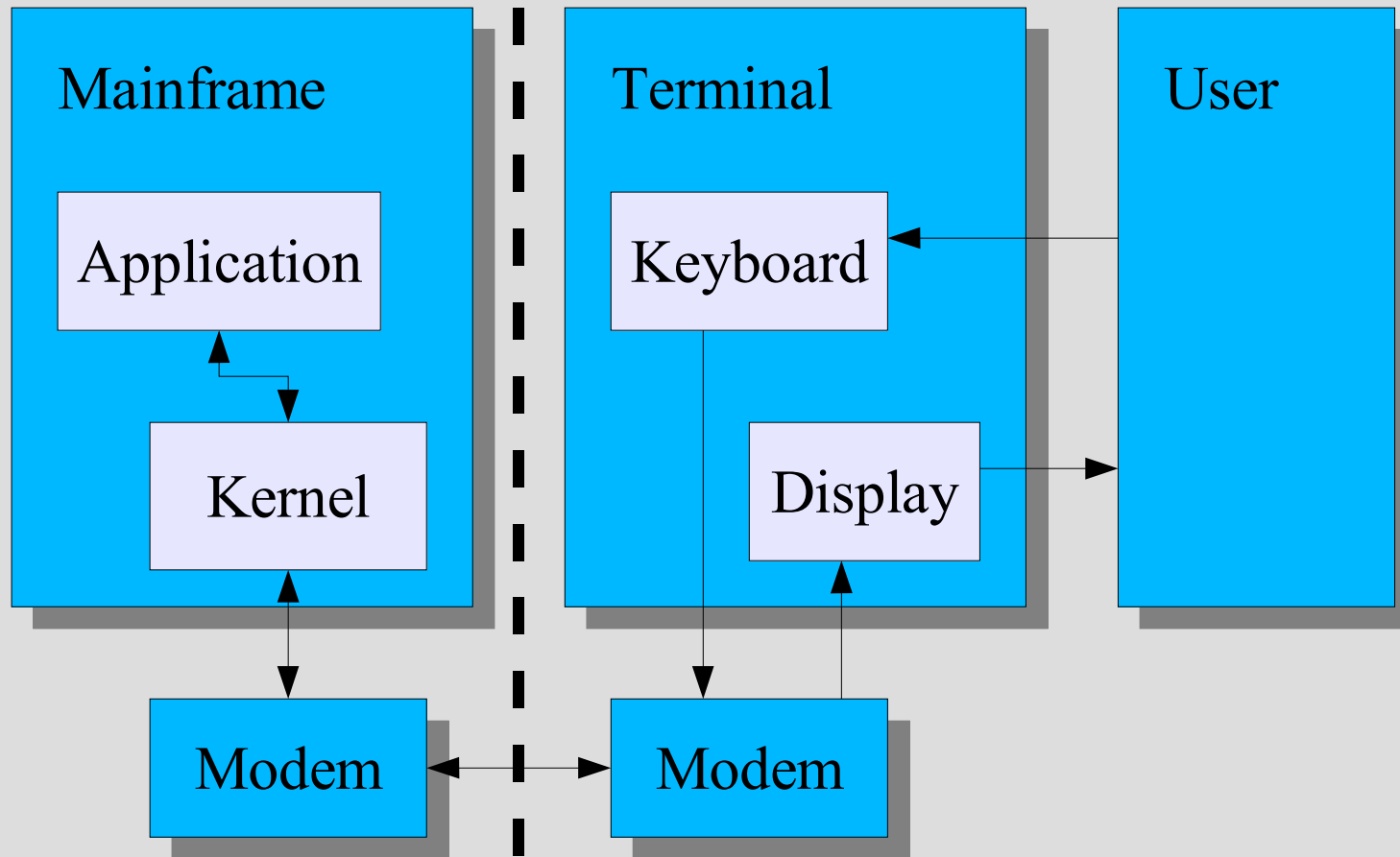
- Conceptual Linux terminal
- Terminal API
- Terminal emulators
- Graphical user interfaces
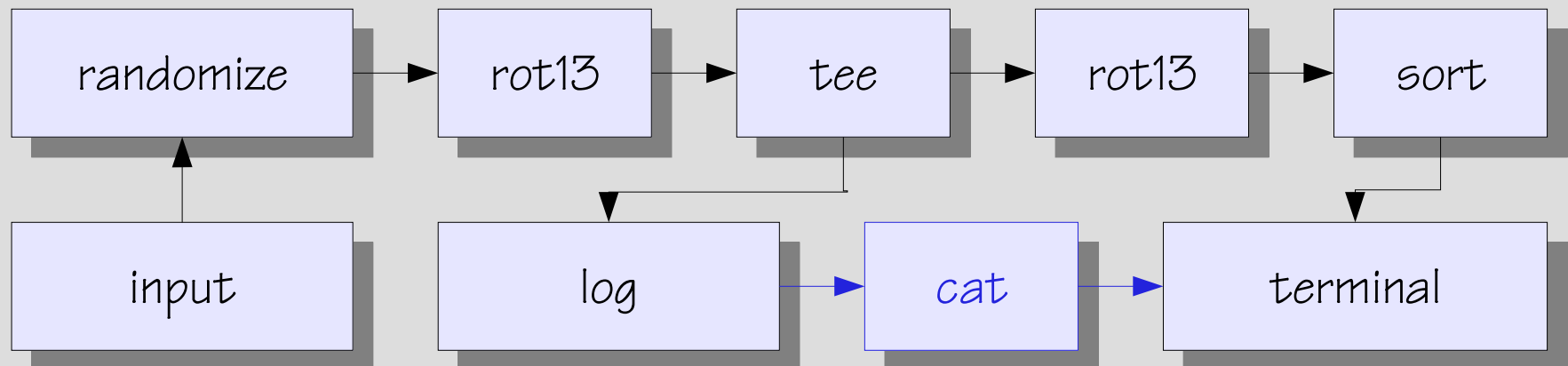
Conceptual Linux terminal

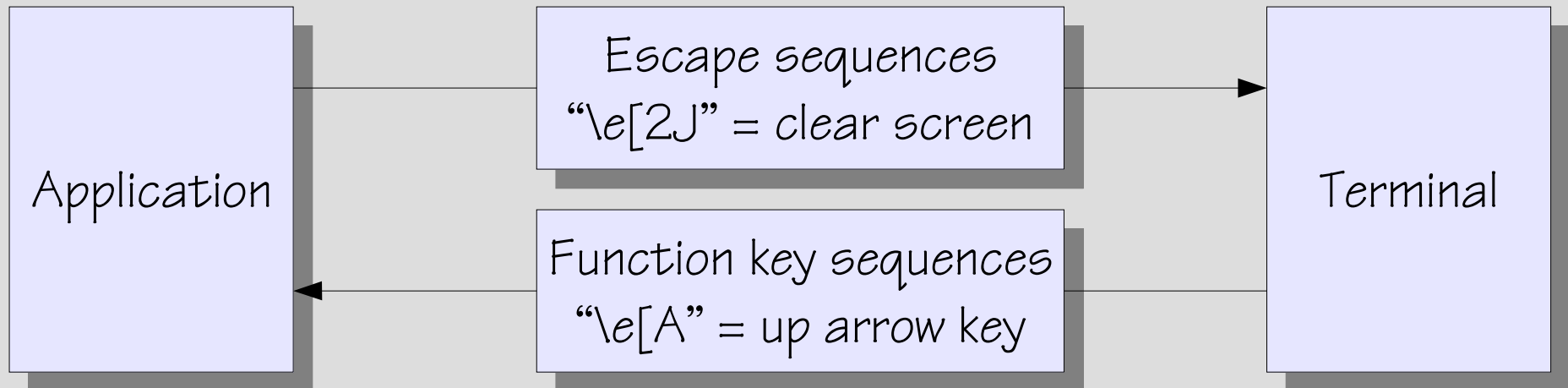| Mainframe	Terminal	User
Application	Keyboard	
Kernel	Display	
Modem	Modem	

stdin/stdout

- Low-level calls: read(), write(), fd's
- High-level calls: fread(), fwrite(), FILE*'s
- Formatted I/O: fscanf(), fprintf(), FILE*'s
- Redirection: dup2(), pipes "|", redir ">"

```
$ randomize < input | rot13 | tee log | rot13 | sort
$ cat log
```

Escape sequences & function keys

Application	Escape sequences "\e[2J" = clear screen	Terminal
	Function key sequences "\e[A" = up arrow key	

- Many incompatible escape sequences and terminal capabilities
- $TERM identifies terminal type
- termcap/terminfo defines terminal types

ioctls and termios

- ioctls give very low-level access
- termios standardizes interface
- ioctls/termios can adjust canonical (cooked) and non-canonical (raw) modes
- Linux terminal provides font, etc. ioctls
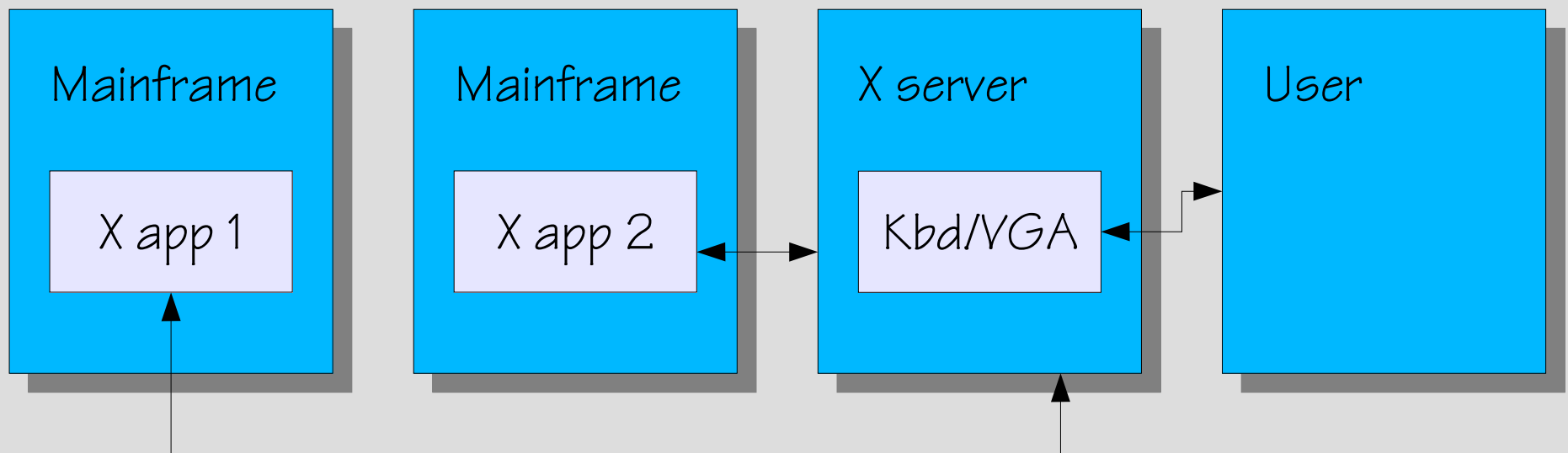- Serial ports have baud rate, etc. ioctls

curses, ncurses, and S-Lang

- Wrapper libraries hide complexity of terminal programming
- Provides portable interface to many terminal types
- curses: cursor control library
- ncurses: new curses
- S-Lang: contains terminal control library

Terminal emulators

- Consumer computer systems have integrated human interface hardware, so terminal functionality must be emulated
- Dumb terminal: works like a teletype
- Linux vt100: VGA + keyboard + buzzer
- GNU screen: display multiplexing
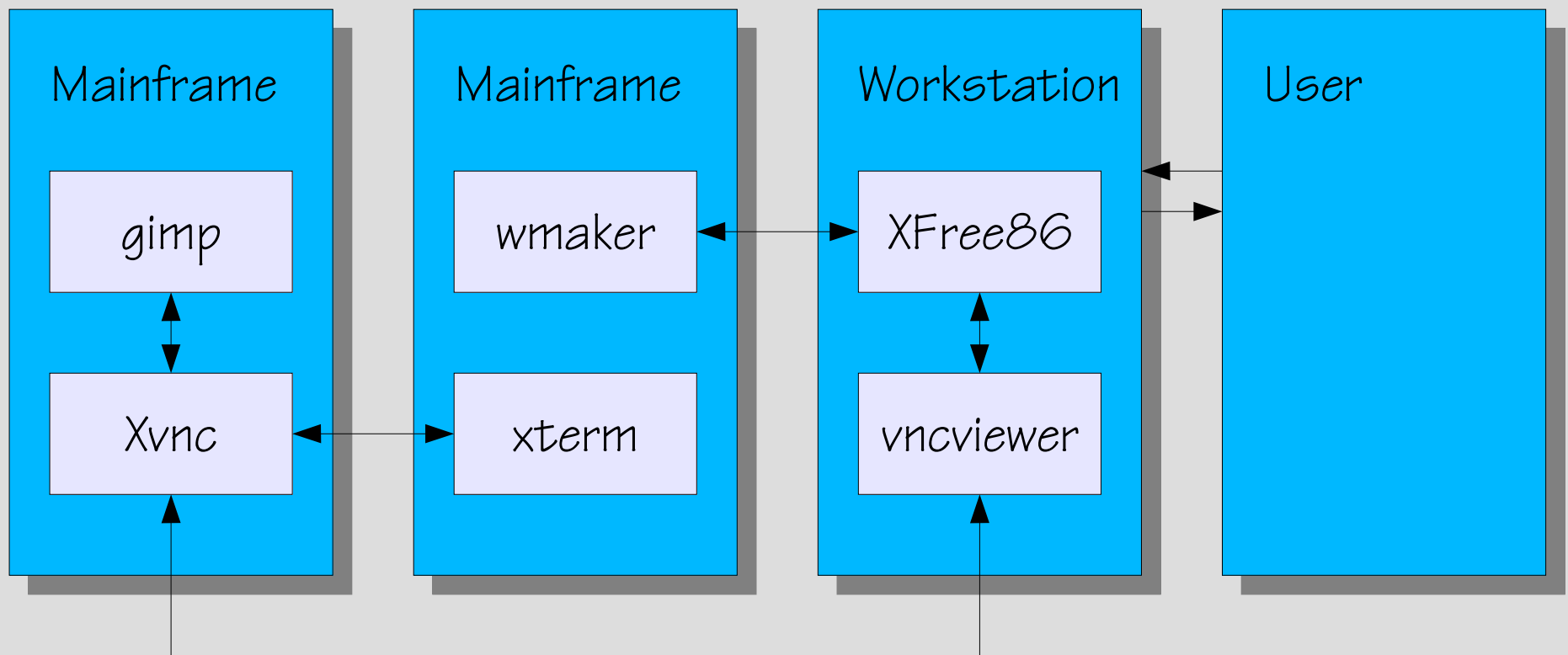- xterm: text terminals in graphical display

X Window System

- X server gives programs access to keyboard, mouse, and display hardware
- Client apps tell the server what to draw
- User sits in front of X server

Mainframe	Mainframe	X server	User
X app 1	X app 2	Kbd/VGA	

VNC: Virtual Network Computing

- Cross between GNU screen and X
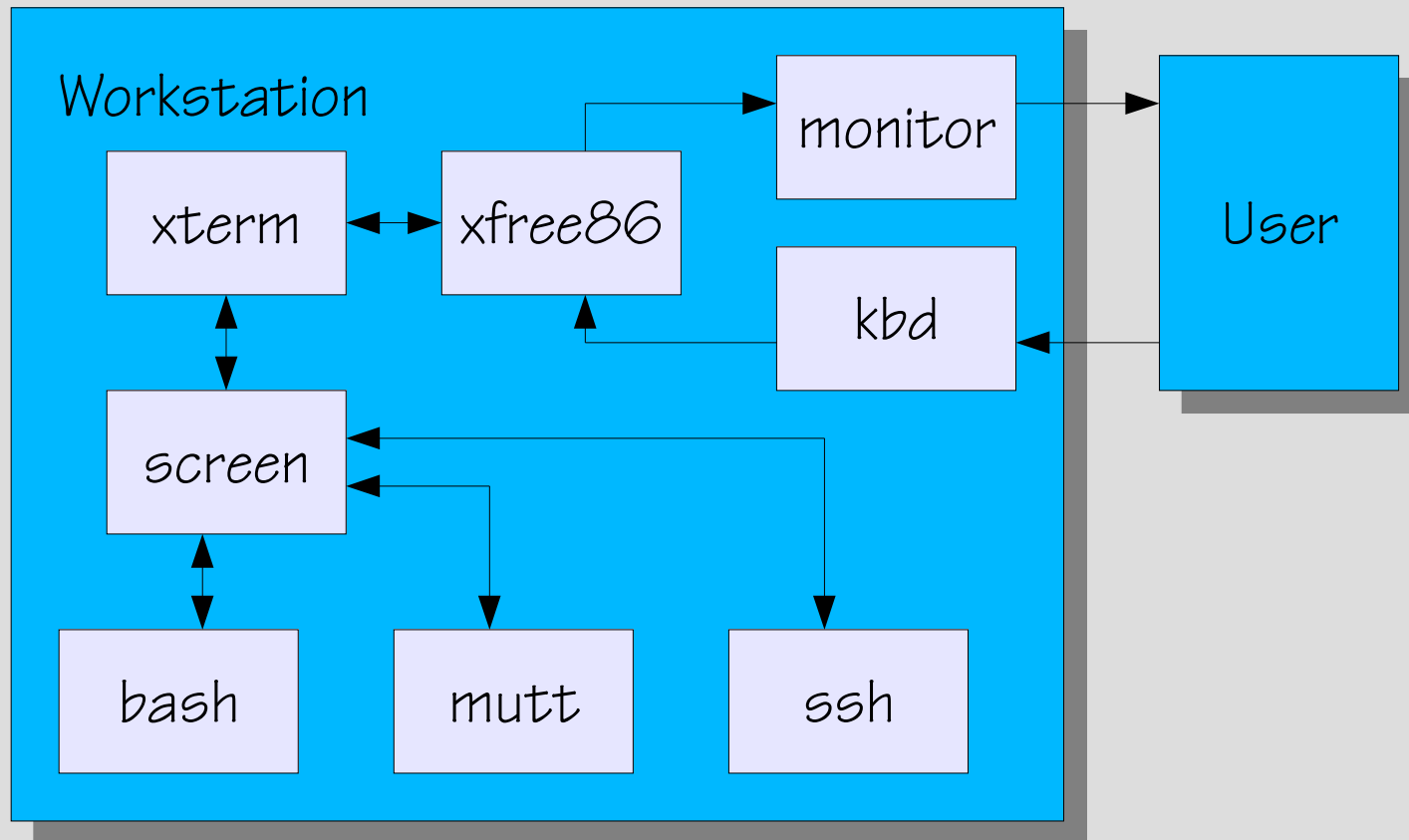- User sits in front of VNC client ("viewer")

Conclusion

- Archetypical Linux terminal system
- Program input and output
- Terminal API, low- and high-level
- Terminal emulators
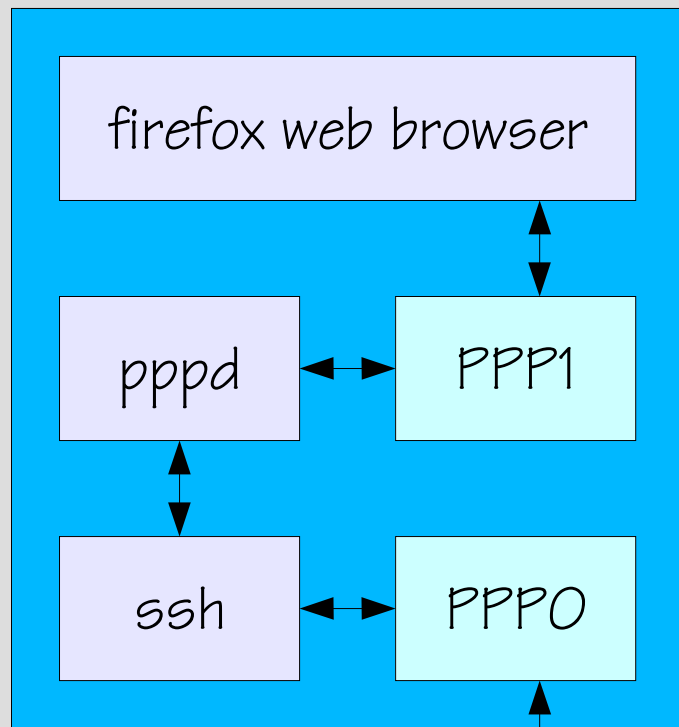- Graphical user interfaces

Slides available online:

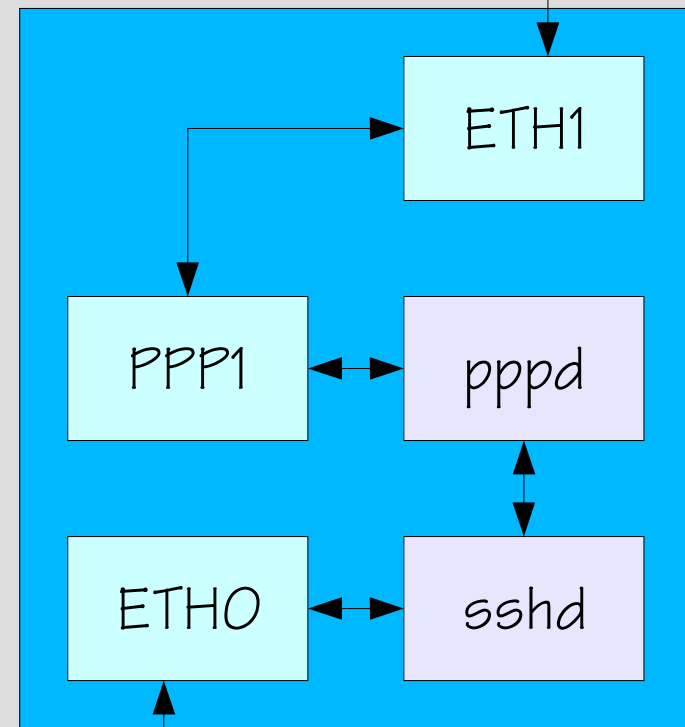http://ioioio.net/school/terminal/slides.pdf

GNU screen

VPN over SSH

Home network

firefox web browser

pppd ↔ PPP1

ssh ↔ PPP0

Corporate network

ETH1

PPP1 ↔ pppd

ETH0 ↔ sshd

Internet / WAN