Ken Thompson – Bell Labs, UNIX
Dennis Ritchie – Bell Labs, UNIX, C
Brian Kernighan – Bell Labs, UNIX, C
Bill Joy – Berkeley, Vi, Sun
Linus Torvalds – Linux
UNIX Epoch 2038 – 32 bit counter
Post rollover year will be 1901

Single, monolithic kernel
         Loadable modules
Micro-kernel

Hardware
Kernel
Shell {Bourne, C, Bash, Korn, Ash, Z}
Applications/Utilities

CLI vs. GUI
Window and Desktop Managers (eat resources)
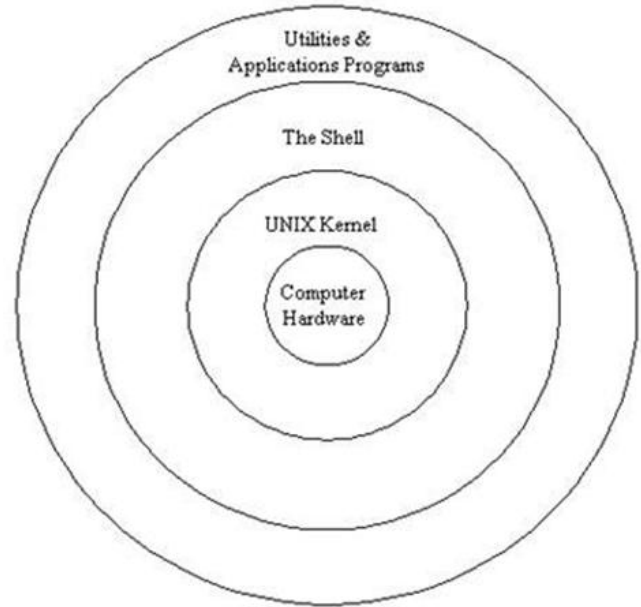
Network virtualization distinguishes logical from physical networking
Network devices operate across these logical planes:
- Data
- Control
- Management
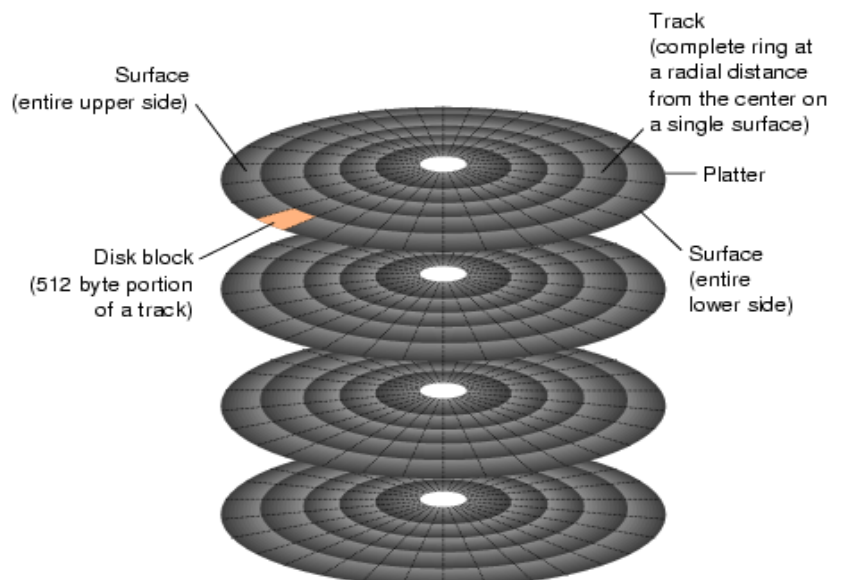
SAN Storage Area Network (e.g. virtualized)
A virtual machine is a Guest of the hypervisor
Cloud environments may be deployed over infrastructures
- Private
- Public
- Hybrid

Virtualization slide 5, 6, 44, 45

File Systems slide 4

MBR: Master Boot Record
Superblock is a boot record
Big-endian machine stores most significant byte first
Little-endian machine stores least significant byte first
Run level Linux (single, assorted multi-user levels)
Run level Windows (normal, safe)

File systems: FAT32 NTFS EXT4 SWAP
Block vs Character devices
Journaling tracks changes during last file sessions
ACID (atomicity, consistency, isolation, durability)
Joliet combined Romeo and ISO 9660
Partitions can contain different file and operating systems
RAID (Redundant Array of Inexpensive Disks)
- RAID   0 Striping
- RAID   1 Mirroring
- RAID   5 Parity across disks
JBOD – Just a bunch of disks
NAS - Network Attached Storage vs SAN Storage Area
Tera Peta Exa Zetta Yotta

proc – pseudo file system
On a UNIX system, everything is a file
If something is not a file, it is a process
File system comprised of user data and metadata
PID Process Identifier
Inodes (Index node) – info about a file system object
absolute vs relative addressing
~ Your home directory
.. The parent directory
. The current directory
rwx ugo

Basic Utilities
- Directory/File management: cd, ls, pwd, mkdir, rmdir, cp, mv, rm, find, du, file
- File viewing/editing: touch, more, less, ed, vi, emacs
- User management: passwd, chmod, chown, su, who
- Process management: kill, killall, ps
- Documentation: man, info, /usr/share/doc
- Networking: lynx

shell is a command line interpreter
A command can be:
- built-in shell command
- an executable shell script
- a source compiled, object code file

Common shells:
- bourne, c, bash, ash, korn

bash prompts for user, root $ #

hashbang in a script

Virtual memory extends amount of Physical memory

Linux: Total Memory = swap + RAM

Swapping
- Moving pages to and from memory
- Page – block (unit) of RAM

Page fault – data requested not in cache memory

Kernel handles process management

Process may have multiple threads

Processes created by forking

daemons are processes running in background

init – first process to run (PID 1)

Runlevel describes state of OS
- Single user, multiuser, GUI, reboot

Command to change runlevels – telinit [n]

crontab – is a job scheduler

Most Servers run as daemons

Typically end in 'd'
- named, dhcpd, httpd, ntpd, syslogd

Many run out of inetd
- When request arrives, inetd will fork
- Child process handles the request

The two basic mechanisms in DHCP are IP address allocation and configuration parameters delivery.

Relay agents avoid the need for a DHCP/BOOTP server on each subnet (broadcast space).

DHCP provides:
- IP address, lease time, routing (gateway) IP, subnet mask, DNS server(s) IP, optional parameters (cool stuff)

DHCP Messages DORA: Discover, Offer, Request, Acknowledge   (and Release, Decline, Nack)

All interactions are initiated by a client
- Server only replies

Server listens on UDP port 67

Client listens on UDP port: 68

DNS: Domain Name Service

A (1)hierarchical (2)distributed naming system for computers, services, or any resource connected to the Internet or a private network

DNS provides the translation function between the two Internet namespaces:
- The domain name hierarchy
- The Internet Protocol (IP) address space

It Resolves domain names to IP addresses

DNS replaced a central hosts.txt file
- Local hosts.txt file still used today
- windows/system32/drivers/etc/hosts.txt

Default UDP port 53

FQDN – Fully.Qualified.Domain.Name. vs. dotted-quad xxx.xxx.xxx.xxx

Right-most label is the Top Level Domain (TLD)

Internet Corporation for Assigned Names and Numbers ICANN (Policy)

Internet Assigned Numbers Authority IANA (Technical)

Regional Internet Registries

AfriNIC.net African Internet Address Registry

APNIC.net   Asian Pacific Internet Address Registry

ARIN.net   American Registry for Internet Numbers

LACNIC.net Latin American and Caribbean Internet Address Registry

RIPE.net   Réseaux IP Européens

NTP keeps Coordinated Universal Time (UTC) GMT

UTC source is atomic clock

Leap seconds correct for Earth rotation issues (e.g. mean solar time – aka UT0)

Clock Drift - ever-widening gap in perceived time

Clock skew – variance between two clocks

Applying continuous adjustments to clock is disciplining the clock

Offset - The difference between the time reported by a clock and the true time as defined by UTC

A truechimer is a clock that maintains timekeeping accuracy to a previously published (and trusted) standard

A falseticker is a clock that does not

Test Samba configurations via testparm

Package management

Manage dependency checking

CLI Package manager – APT

Common GUI for APT - Synaptic

1989 Tim Berners-Lee wrote first web server

Apache is currently most common webserver

Five attributes of a good web server
- Correctness
- Reliability
- Scalability
- Stability
- Speed

A firewall implements policy

Firewalls can be:
- Stateless
- Statefull
- Application