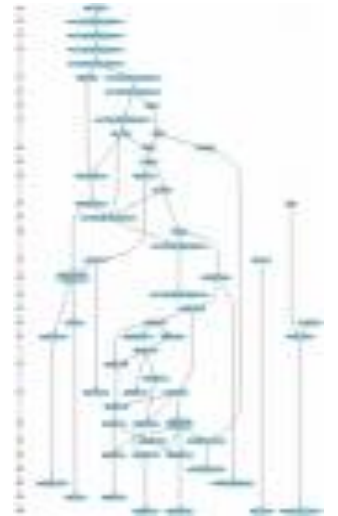
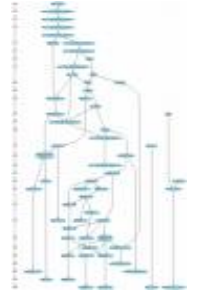


UNIX – Une Introduction

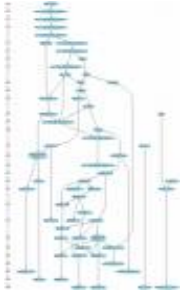
Alain NINANE – RSSI UCL





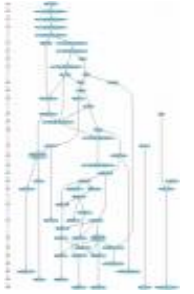
UNIX - A Definition (I)

- **Unix is a (family of) Operating System ... like ...**
 - MS-DOS (Microsoft)
 - VMS (DEC)
 - VM/CMS, VM/SP (IBM Mainframe)
 - Windows (Workgroups, 95, 98)
 - Mac OS (... , 8, 9)
 - Windows NT, XP, 2000, Vista, Seven, Eight....
 - Mac OS X (Leopard, Snow Leopard, Tiger, Lion, Mountain Lion,...)
 - Linux (Red Hat, Suse, Mandrake, Debian, Ubuntu, ...)
 - Solaris (SUN)
 - Google (ANDROID)
 - Apple (IOS)
 -



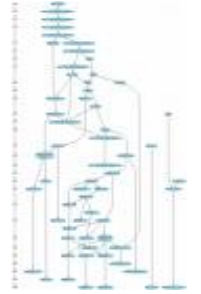
UNIX - A Definition (II)

- **UNIX is an operating system**
 - Multi user
 - Multi task
 - Multi sessions
 - Fair ressources sharing
 - Hierarchical file system
 - Simple processes communications



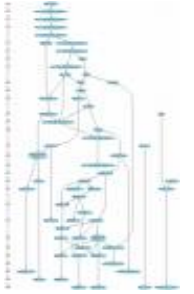
UNIX - Multi User

- Simultaneous access
- Authentications mechanisms
 - Logins/Passwords
 - Secure Cards/Certificates
- Protections
 - Files/Processes belongs to one user
 - Files/Processes belongs to one or more groups
 - Enforcement of data protection by hardware
- Security Model
 - DAC (vs MAC)



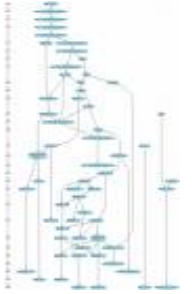
UNIX - Multi Task

- A command is the same as a user program
 - E.g: ls, who, cc, myProg, myAnalysis, ...
 - A “running” program or command is called a process
- Processes can be executed
 - Sequentially
 - Concurrently
- Batch processing
 - Locally
 - In a networked environment (e.g. GRID computing)
- Accept programs written in multiple languages
 - As long as you have a compiler ...
 - C, C++, Fortran, Pascal, Cobol, ...



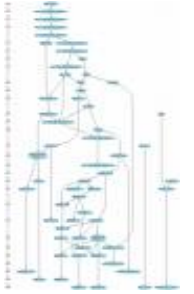
UNIX - Multi Session (I)

- Access methods to a UNIX system
 - Command line oriented (CLI)
 - Through terminals, consoles (tty)
 - Terminals as windows of a GUI
 - Command language (scripts)
 - Graphical User Interfaces (GUI)
 - X Window System (X11, X - MIT 1984)
 - X Terminals over a LAN
 - X Clients through the Internet
 - News (SUN Microsystems) ~1985
 - Postscript based
 - Aqua (Apple 1999)
 - Apple's Graphical User Interface



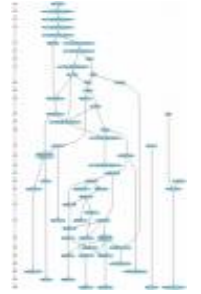
UNIX - Multi Session (II)

- Allows many users to work on the system
 - Locally
 - Through a local area network
 - Through the internet
- Sessions
 - CLI
 - GUI



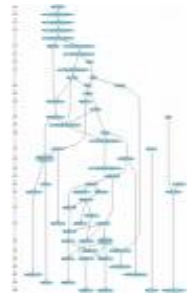
UNIX - Multi Session (III)

- CLI - Network access to a UNIX system
 - telnet host132.bigcompany.com (tcp port 23)
 - Non-secure protocol
 - Not limited to the UNIX world (e.g. Router, printer, configuration)
 - rlogin host132.bigcompany.com (tcp port 513)
 - Non-secure protocol
 - Unix world
 - ssh host132.bigcompany.com (tcp port 22)
 - Secure protocol (based on ssl)
 - Unix world but expanding to Windows (putty, winscp...)



UNIX - Ressources Sharing (I)

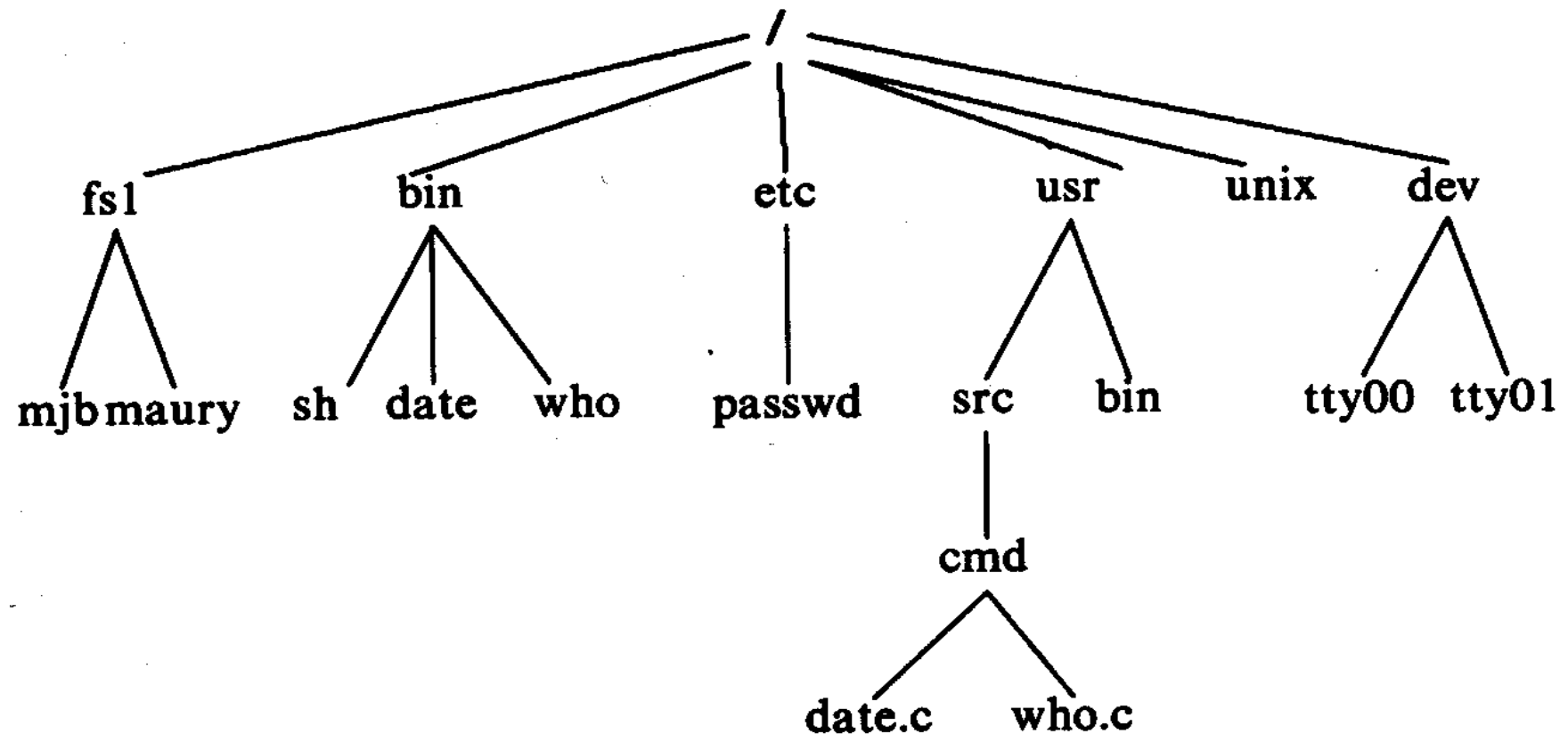
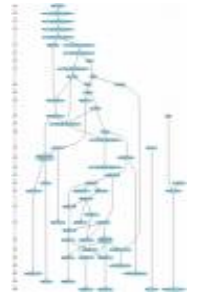
- UNIX shares
 - CPU: one second is divided in equal-sized “slices”
 - one slice is allocated to a process (user or system)
 - UNIX is a time sharing system (TS suffix)
 - RAM: memory is divided into equal-sized “pages”
 - pages are allocated to a process (user or system)
 - DISKS: space is divided into equal-sized “blocks”
 - blocks are allocated to files or directories

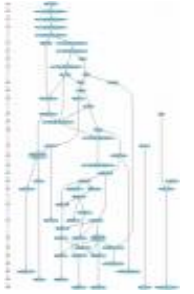


UNIX - Ressources Sharing (II)

- UNIX shares ressources fairly
 - CPU
 - Ressource allocated on a priority base
 - User commands and programs at the same level
 - MEMORY
 - Allocated on a priority base
 - Unused pages saved back on disk
 - DISK
 - Allocated as far as disk space is available
 - Quotas can be implemented

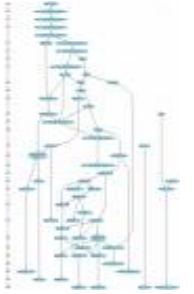
UNIX - Hierarchical FS (I)





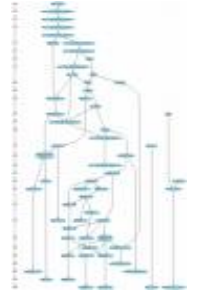
UNIX - Hierarchical FS (II)

- Hierarchy seems natural
 - but VM/CMS had a flat name space (no dir !)
- Filesystem Hierarchy Standard
 - <http://www.pathname.com/fhs/>
 - fhs-2.3.pdf
- Implementation is vendor dependent
 - List of UNIX (and other) file systems
 - http://en.wikipedia.org/wiki/Comparison_of_file_systems
 - local
 - ext2, **ext3**, **ext4**, ufs, hfs, advfs, reiserfs, **zfs**, ...
 - with or without journaling, versioning
 - case dependent, large file support (> 2GB)
 - networked
 - nfs, afs, ...



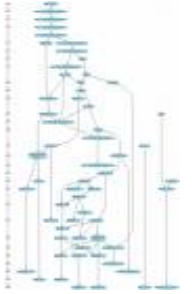
UNIX - Hierarchical FS (III)

- The UNIX filesystem hierarchy holds
 - Directories
 - Files
 - Regular
 - Collection of data (bytes)
 - Data, program, executable
 - No predefined structure
 - Suffix is irrelevant (use magic characters)
 - Special
 - peripherals (/dev)
 - processes (/proc)
 - Named pipes, some sockets, ...



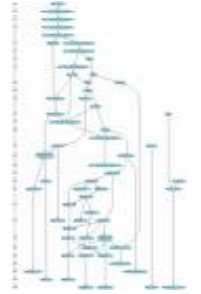
UNIX - Process Communication

- Process communication made easy
 - Standard input and output
- Simple Data redirection
 - `myProc1 > myOutput1`
 - `myProc2 < myOutput1 > myOutput2`
- Pipes
 - `myProc1 | myProc2 > myOutput2`
- Advanced IPC
 - Shared memory
 - Synchronization
 - Locking
 - ...



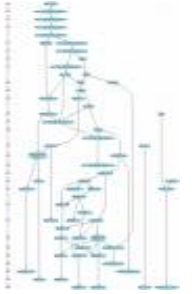
UNIX - A Portable OS

- Written in a high level language (C - 1973)
 - Widely diffused
 - You “just” need a C compiler on a platform to run UNIX on it.
 - Assembly code needed just for the bootstrap process
 - Runs on PCs, μ P, MACs (PPC/Intel), mainframes, ...
- Become a *de facto* IEEE standard
 - Portable Operating System Interface (POSIX)
 - IEEE 1003.x



UNIX - A philosophy

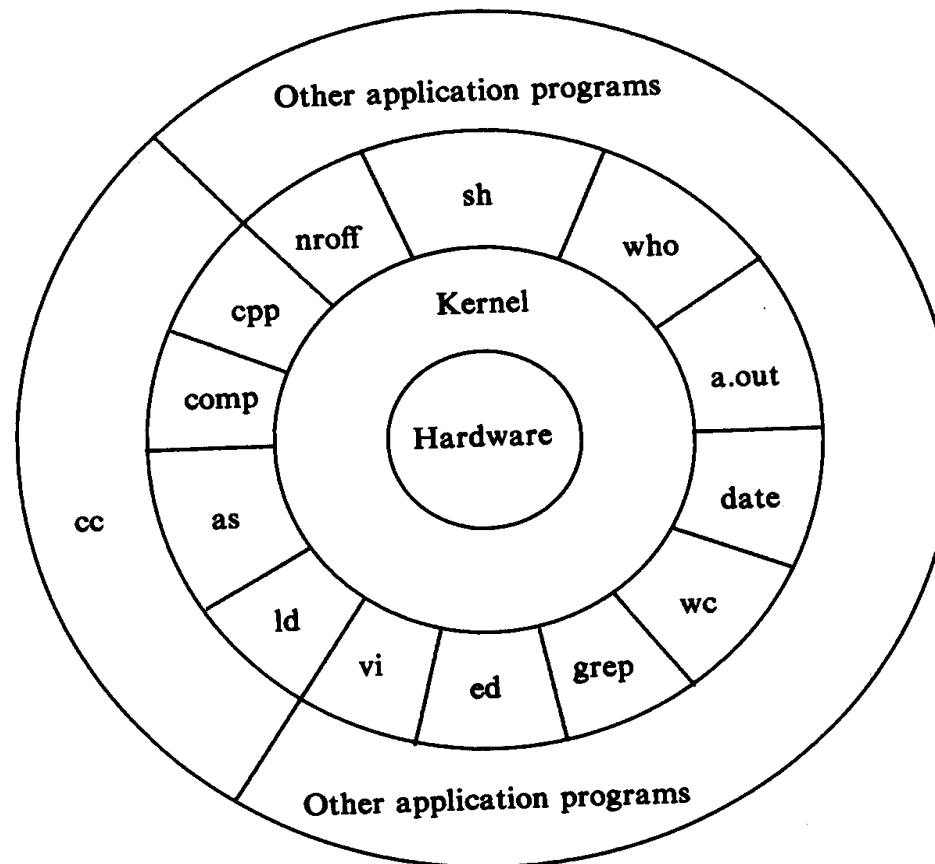
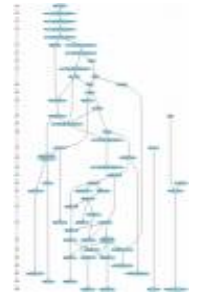
- **Simplicity**
 - Small number of powerful concepts and utilities
 - pipes, redirections, consistent access to resources
 - cat, sort, awk, uniq, grep, wc, head, tail, ...
 - Simple communication between utilities
 - Scripts combining simple utilities
- **Regularity**
 - very few exceptions
 - e.g. network socket not in the filesystem
- **Flexibility**
 - easy to adapt to special needs

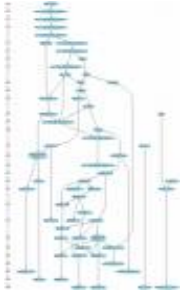


UNIX - A spirit :-)

- Conceptors of UNIX had a sense of humour
 - Command “dd”
 - Copy and convert tapes from EBCDIC to ASCII
 - “cc” already taken as the C compiler ... -> “dd”
 - Command “biff”
 - “biff” allows you to be warned when a mail arrive
 - Biff was the name of the dog ...
 - Drawback
 - Makes the language cryptic, obscure

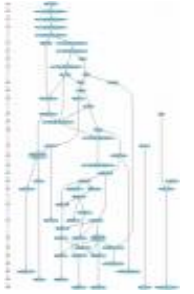
UNIX - Architecture (I)





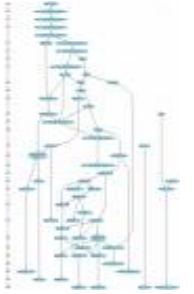
UNIX - Architecture (II)

- Kernel mode (space)
 - All protected operations
 - Non preemptible
 - Standard UNIX cannot provide Hard Real-Time capabilities
- User mode (space)
 - All non-protected operations
- Systems Calls
 - Allows user level process to enter the kernel
 - System calls are +/- standardized within the UNIX family
 - `read()`, `write()`, `fork()`, `exec()`, `wait()`,



UNIX - A Proprietary OS

- UNIX is **NOT** Open Software
- Original source code was available since the beginning for a “small” fee
 - License, Royalties, ...
 - Source code not redistributable as is ...
- UNIX ownership
 - BELL Labs
 - AT&T
 - Novell
 - Santa Cruz Operating System (SCO)
 - ... ??? ...

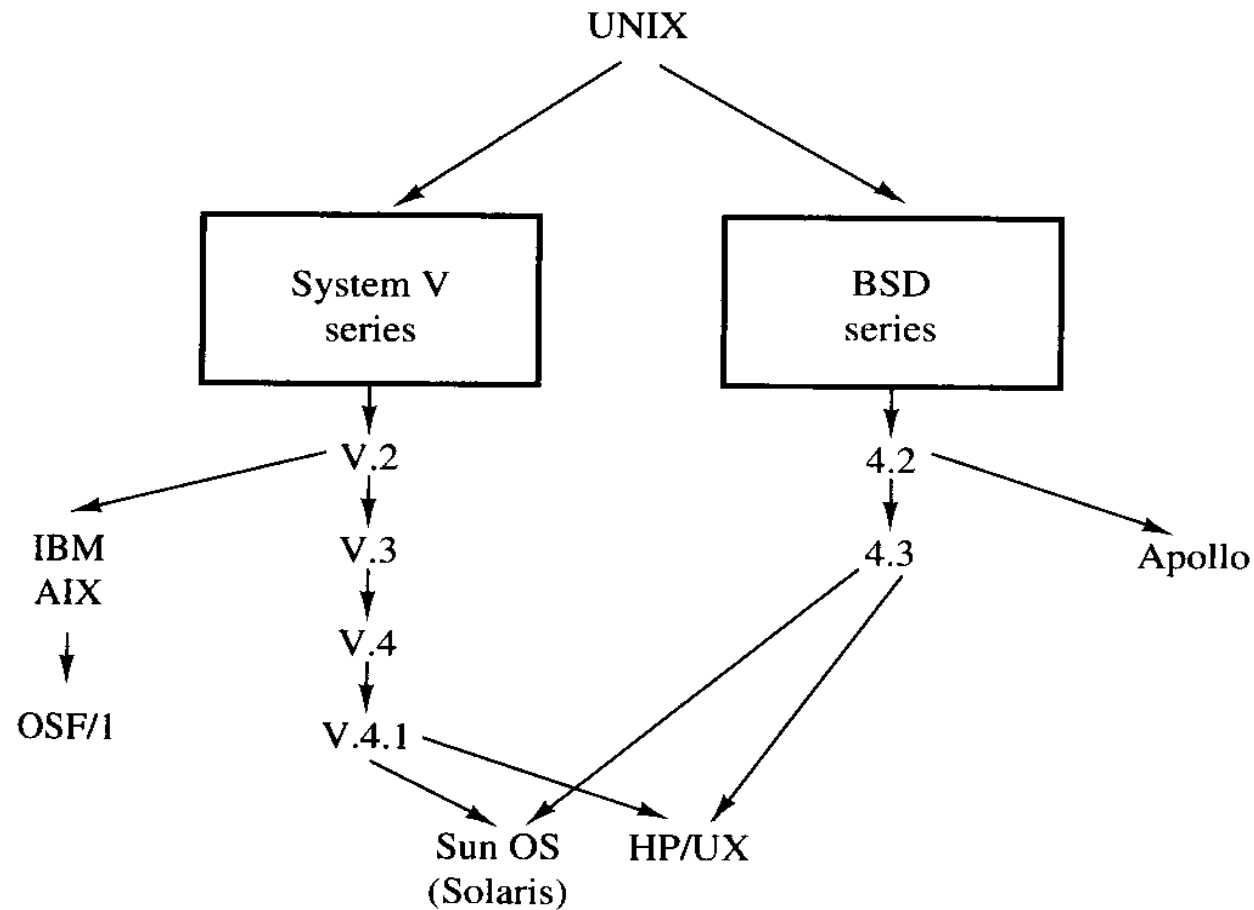
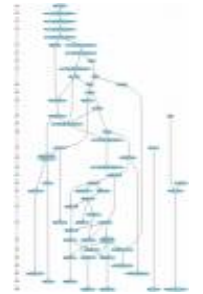


UNIX - A Family of OS (I)

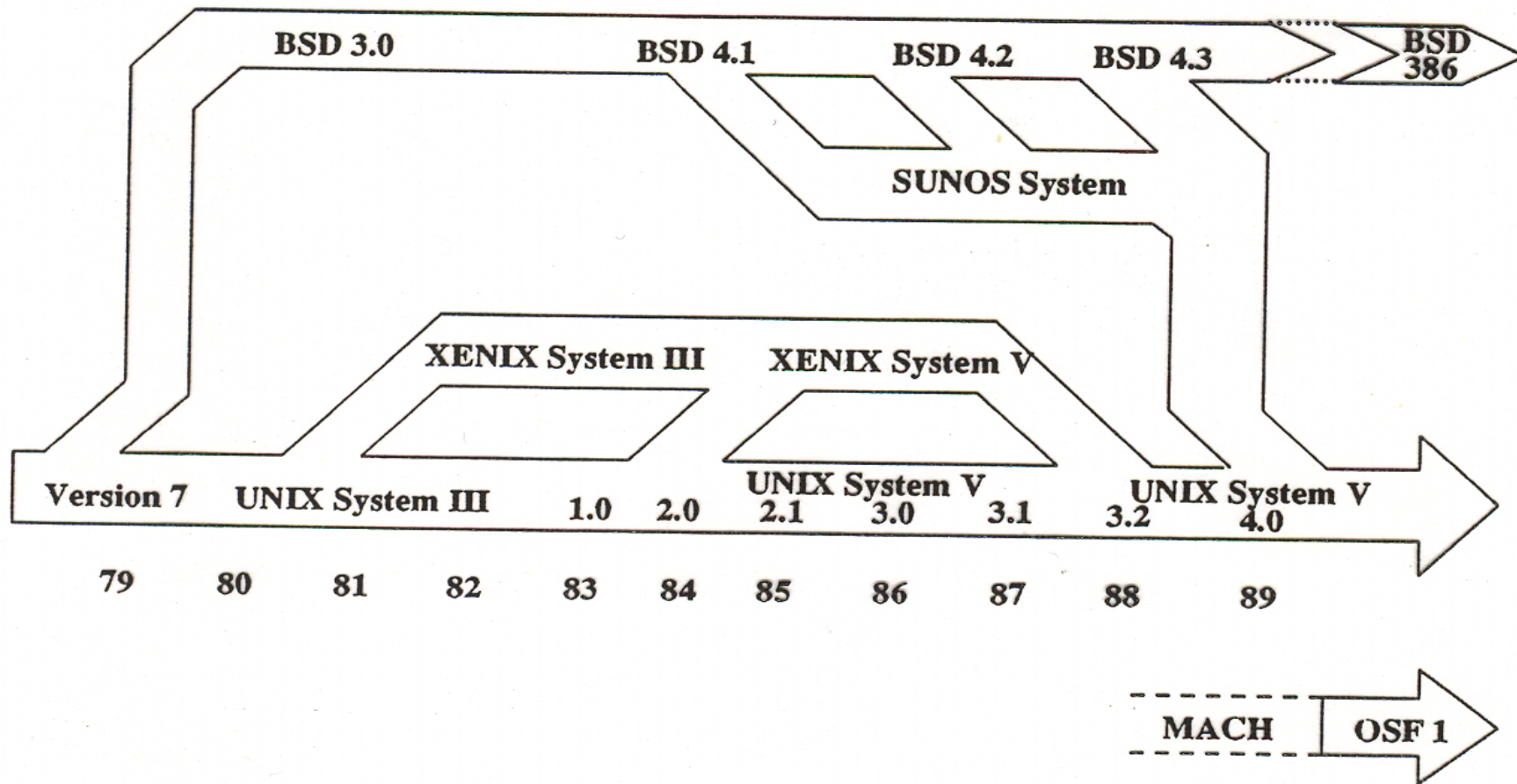
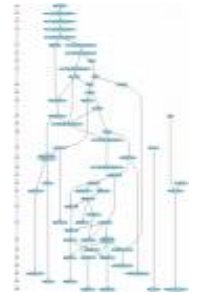
- Source Code Available
 - Computing “Aware” Communities
 - Universities, Vendors, ...
 - Many improvements
 - Berkeley: sockets, improved shell, history, background processes
 - AT&T: IPCs
 - Variety of UNIX'es
 - BSD, Ultrix, SunOS, Digital Unix, Solaris, HP-UX, AIX, OSF, MacOSX, Linux, Next, Darwin, iOS, Android, ...



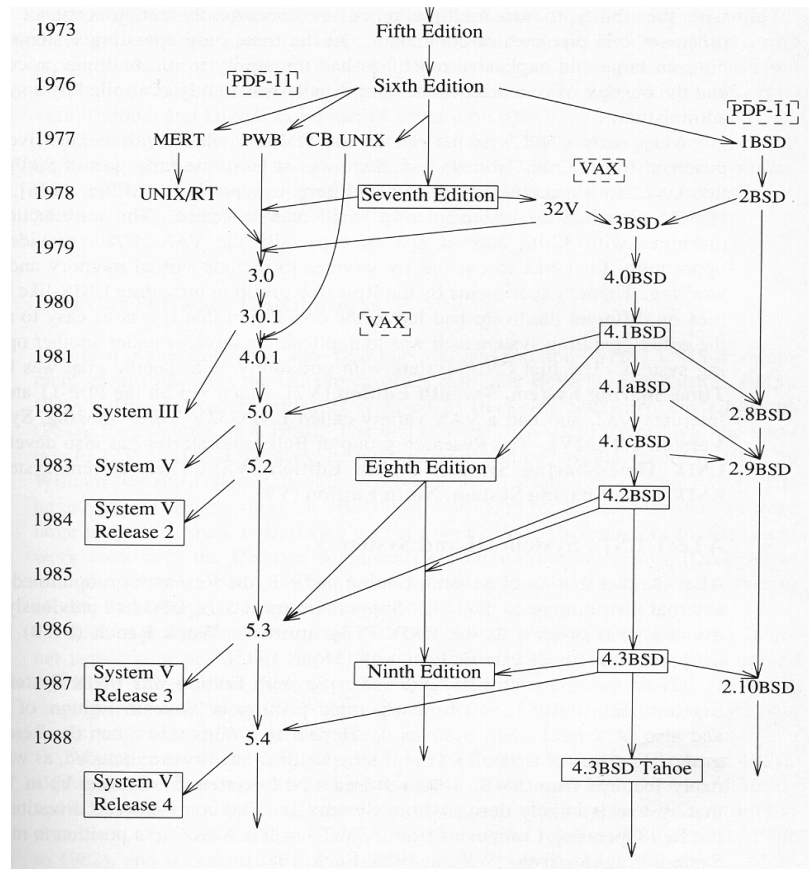
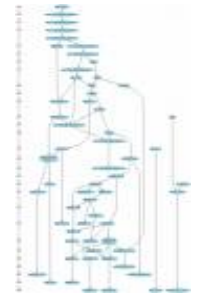
UNIX - History (I)

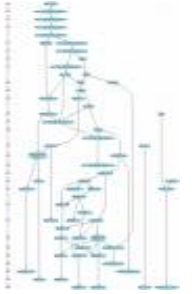


UNIX - History (II)



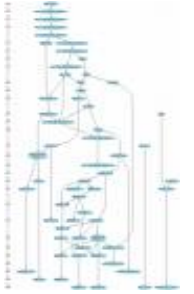
UNIX - History (III)





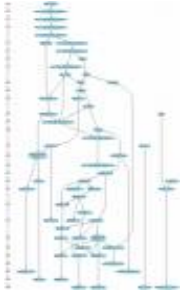
UNIX - annoyances

- BSD and System V flavors differs, e.g.
 - BSD: `ps aux`
 - Sys V: `ps -eaf`
- Can be solved by compatibility environments
 - e.g. Solaris has a BSD environment
 - `/usr/ucb/bin`
 - environment: `PATH=/usr/ucb/bin:$PATH`



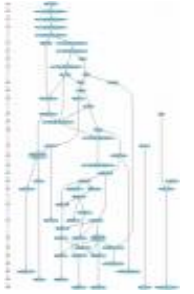
UNIX - History (IV - The Story)

- The whole story
 - <http://www.levenez.com/unix/>
 - unix_plotter.pdf
- Just to remember
 - Two main flavors of UNIX
 - System V
 - Berkeley (BSD)
 - So ... what about Linux ?



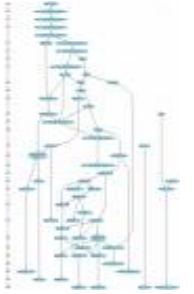
UNIX - ... versus Linux ...

- Linux is a free, open source version of the UNIX OS.
 - Source code written from scratch (?) with the same interface as the original UNIX
- Many versions (“distro”) of Linux (Red Hat, Suse, Debian, ...)
 - But “one” linux kernel
 - “Mimic” the UNIX kernel interface
 - system calls
 - Distro’s differs from
 - the application/management layer
 - base GUI (KDE, GNOME, AfterStep, ...)
 - software packages (Apache, MySQL, OpenOffice, ...)
 - distribution media
 - help-desk, support, language (walloon in Red Hat :-)) ...



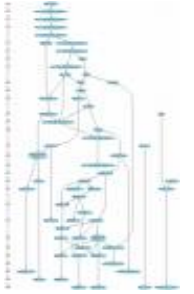
Linux - Choice of a “distro”

- Main usage of the system
 - Home usage
 - Server
 - Mid-range
 - High-end
 - Mission critical
- Support
- Software life cycle
- Maintenance
- Hardware compatibility/certification



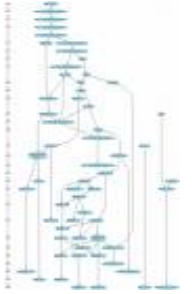
Linux - Red Hat

- Red Hat was a very popular distribution
- Red Hat is now focusing on the commercial market
 - Last free release is Red Hat 9
 - Project moved to the Fedora Core Project (FC)
 - New product: Red Hat Enterprise Linux (RHEL)
- FC - no support - life cycle 1.5 * **6 monthes**
 - Longer with the Fedora Legacy Project
- RHEL - support - life cycle 5 x **18 monthes**



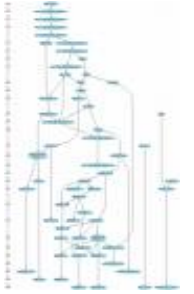
Linux - Red Hat

- FC - Distribution through network - free
- RHEL - Distribution through commercial channels (network, CDs, ...) - paid
- However - Linux is open software
 - RHEL source code available on the network
 - Fell free to recompile it
 - E.g. CERN Scientific Linux Distribution
 - E.g. Centos
- Massive deployment via kickstart



UNIX - The Computing Market

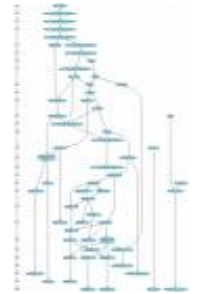
- At the beginning UNIX was used within universities, research centers, ...
- Mid 80's starts to address “mini” computer and some supercomputer (Cray)
- Linux is a major step toward home users
 - script kiddies, hackers,
 - a perfect computing laboratory
- Linux is becoming more and more present ...

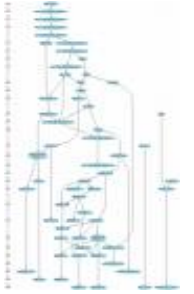


UNIX - vs Windows (I)

- Desktop
 - A long debate between Win - MacOSX - Linux
 - French Police Dept., City of Munich, ...
- Server
 - UNIX is taking over spec. with multi-cpus (16x)
 - US Postal, yahoo, ebay, www.windows95.com, skynet, ...
 - Apple .mac accounts managed by SUN Mail servers
- Embedded systems
 - Small and specialized distribution (knoppix, ...)
 - E.g. Lotto terminal, firewall appliance, kiosk, ...

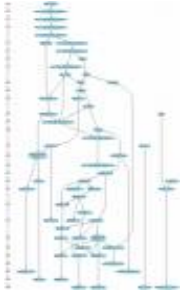
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UNIX - Summary

- A very powerful OS for programmers
 - Provides a consistent access to ressources
 - Provides a well-defined interface to the kernel
 - Provides high level libraries
- A very powerful OS for system admin.
 - Easy to manage
 - Clear text configuration files
 - Command line interface
 - Remote access



UNIX - Documentation

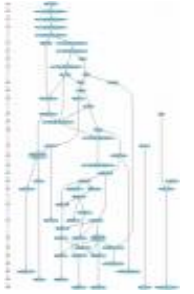
- man

1 - user commands	5 - file formats
2 - system calls	6 - games
3 - fc libraries	7 - misc
4 - devices/network interfaces	8 - admin commands

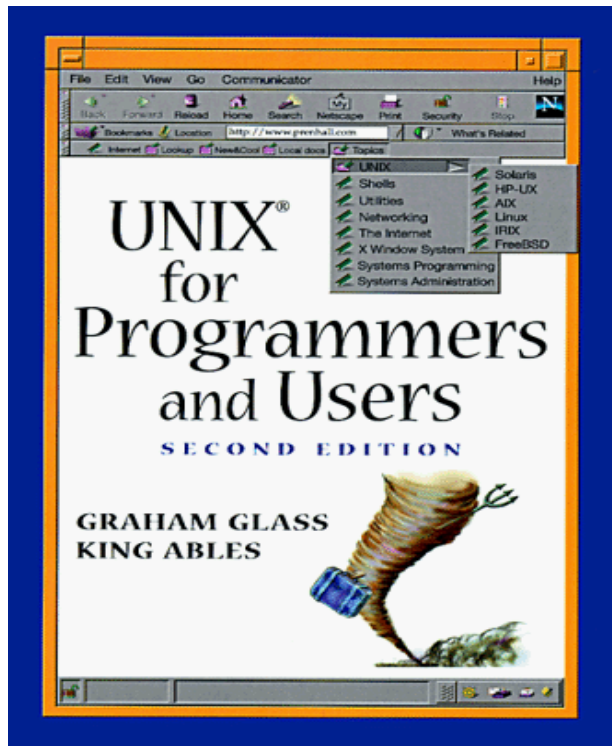
- network

- forums

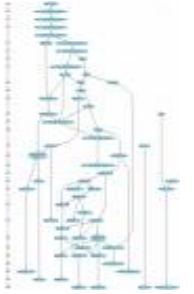
- books (O'Reilly)



UNIX - A First Reference



- “UNIX for Programmers and Users”
- Graham Glass, King Ables
- Prentice Hall - ISBN 0-13681-685-1

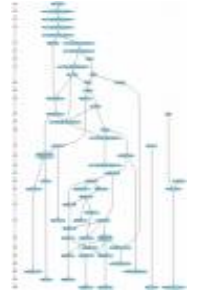


UNIX - Cmd Interpreters (I)

- The UNIX command interpreter ...
 - A Shell
 - Used for interactive use (cli) or command scripts.
- A shell is an ordinary program
 - Lies between the user and the UNIX OS (UI)
 - Executes commands on behalf of the user
 - Allows one to combine commands into powerful control structures

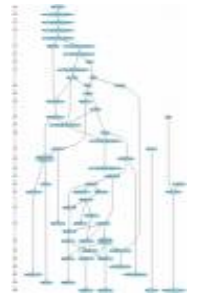
[illegible]

- Bourne shell (/bin/sh)
- C shell (/bin/csh)
- Korn shell (/bin/ksh)
- Turbo C shell (/bin/tcsh)
- Z shell (/bin/zsh)
- Bash (/bin/bash)
-



UNIX - Cmd Interpreters (III)

Name	Interactive	Scripts
Bourne	BAD	OK
C Shell	OK	BAD
Korn Shell	OK	OK
Bash	OK	OK



UNIX - Real Life Examples

1. `grep NET_DROP kernel | \`
`awk '{print $11}' | sort -n | uniq -c`
2. `tail -100000 AppleMailServer.POP.log | \`
`grep "with APOP" | awk '{print $7}' | sort | uniq`
3. `cd /afs`
`ls --color=none | awk -F. '{print $NF}' | sort | uniq -c | sort -n`