



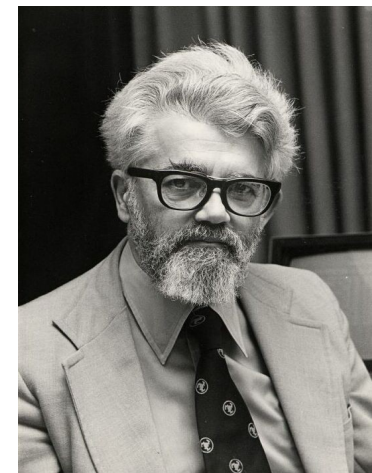
*Software Development*  
*UNIX: a short history*

*Davide Balzarotti*

Eurecom – Sophia Antipolis, France

# Early 60s - The Stone Age

- OSs were written for a particular machine and operated in **batch mode**:
  - Computers were completely dedicated to run a single program for a single user at the time
  - Programs had to be prepared offline on punch cards
- In the early 60s, scientists start working on the idea of supporting many users at the same time (**timesharing**)
  - While any single user was inefficient, a large group of users together were not
  - But running multiple programs at the same time, required completely re-designed OSs



\*John McCarthy



## Before Multics there was chaos.. and afterwards, too

- In 1965 a group of scientists from Bell Labs and GE joined an effort underway at MIT to develop a dependable timesharing operating system
  - The project was called **Multics**: Multiplexed Information and Computing Service
  - The joint effort was not successful and Bell Labs withdrew from the effort in 1969
- A few of Bell's employees (*Ken Thompson, Dennis Ritchie, Doug McIlroy, and J. F. Ossanna*) didn't give up and decided to try again
  - Frustrated by the size and complexity of Multics they decided to try with something simpler

# UNIX, the best Screwdriver ever built

- Thompson wrote the first version of the yet-unnamed operating system in assembly language for a DEC PDP-7 minicomputer
  - The name (written Unics at the beginning) was coined by Brian Kernighan as a pun on Multics

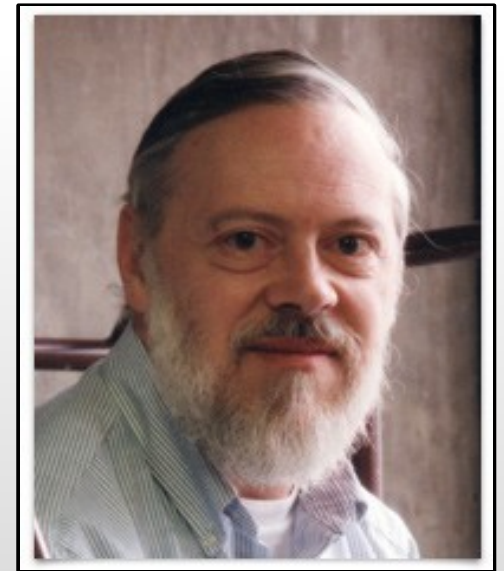


"I allocated a week each to the operating system, the shell, the editor, and the assembler to reproduce itself..."

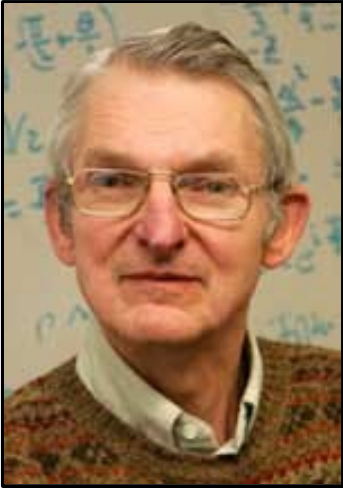
-- Ken Thompson

# A new language for a new system

- Thompson developed a compiler for a new high-level language he called B (stripped-down version of the BCPL language)
- In 1972 Dennis Ritchie created a new language called C
  - Inherited B's concise syntax
  - Add a powerful mix of high-level functionality and the low level features required to program an operating system
- In 1973 most of the UNIX kernel was rewritten in C
  - Easier to understand and modify
  - Easier to port to new platforms



# From a System to a Philosophy



"We should have some ways of coupling programs like garden hose -- screw in another segment when it becomes necessary to massage data in another way"

-- Doug McElroy

- The pipe fostered a distinctive approach to software design:
  - Solve a problem by interconnecting simpler tools, rather than by creating large monolithic application programs
  - Not just programs but **tools**: software programs that would be in a "tool box", available when the user needs them
- When Thompson implemented the pipes, he also put something else into UNIX -- a **philosophy**

# AT&T at the time

- In 1951 the United States Department of Justice announced that it was pursuing an antitrust action against AT&T, which controlled most of the nation's telephone network
- In 1956 AT&T and the Government reached a consensus, including two important requirements:
  - Bell Systems patents should have been licensed to competitors on request
  - AT&T would stay out of *"any business other than the furnishing of common carrier communications services."*

# UNIX Early Days

- In October 1973 Thompson presented Unix to the 4<sup>th</sup> Association for Computing Machinery Symposium on Operating Systems Principles
- Suddenly, a large number of universities and research departments started asking AT&T for a copy of Unix
  - To avoid a fight with the government, AT&T declared that they had no intention in pursuing software as a business...
  - ..and start selling licenses of Unix “as is”:
    - No support
    - No Bug fixes
- The lack of technical support forced the users (in particular the universities) to share programs and information and to evolve the OS

# Phase 2: UNIX in the Universities

- In 1976-77, Thompson took a six-month sabbatical from Bell Labs to teach as a visiting professor at the University of California-Berkeley
- When Thompson returned to Bell Labs, students and professors at Berkeley continued to enhance UNIX
  - In 1977 Bill Joy puts together the first UNIX Berkeley Software Distribution (**BSD**)
- Joy also added a Pascal compiler, the C Shell, and a new text editor called **VI**
  - vi became the de facto standard Unix editor
  - The UNIX Specification specifies vi, so every conforming system must have it

# The rise of the Network

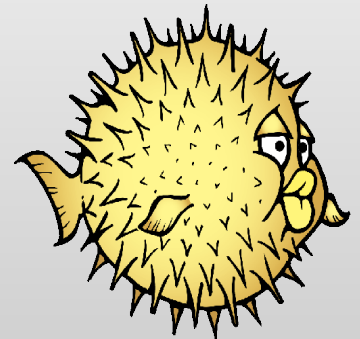
- DARPA gave Berkeley a major contract to enhance Unix so that it would be suitable for its network of research sites
  - Joy had been instructed to plug Bolt, Beranek and Newman (BBN) TCP/IP stack into Berkeley Unix
  - He refused because, in his opinion, BBN's stack wasn't good enough. So he wrote his own high-performance TCP/IP stack
- BSD worked so well that DARPA chose it to be the preferred operating system for its Arpanet research nodes

\* In 1982, Joy co-founded Sun Microsystems where he created NFS and helped designing the SPARC microprocessor and the JAVA language



# BSD Today

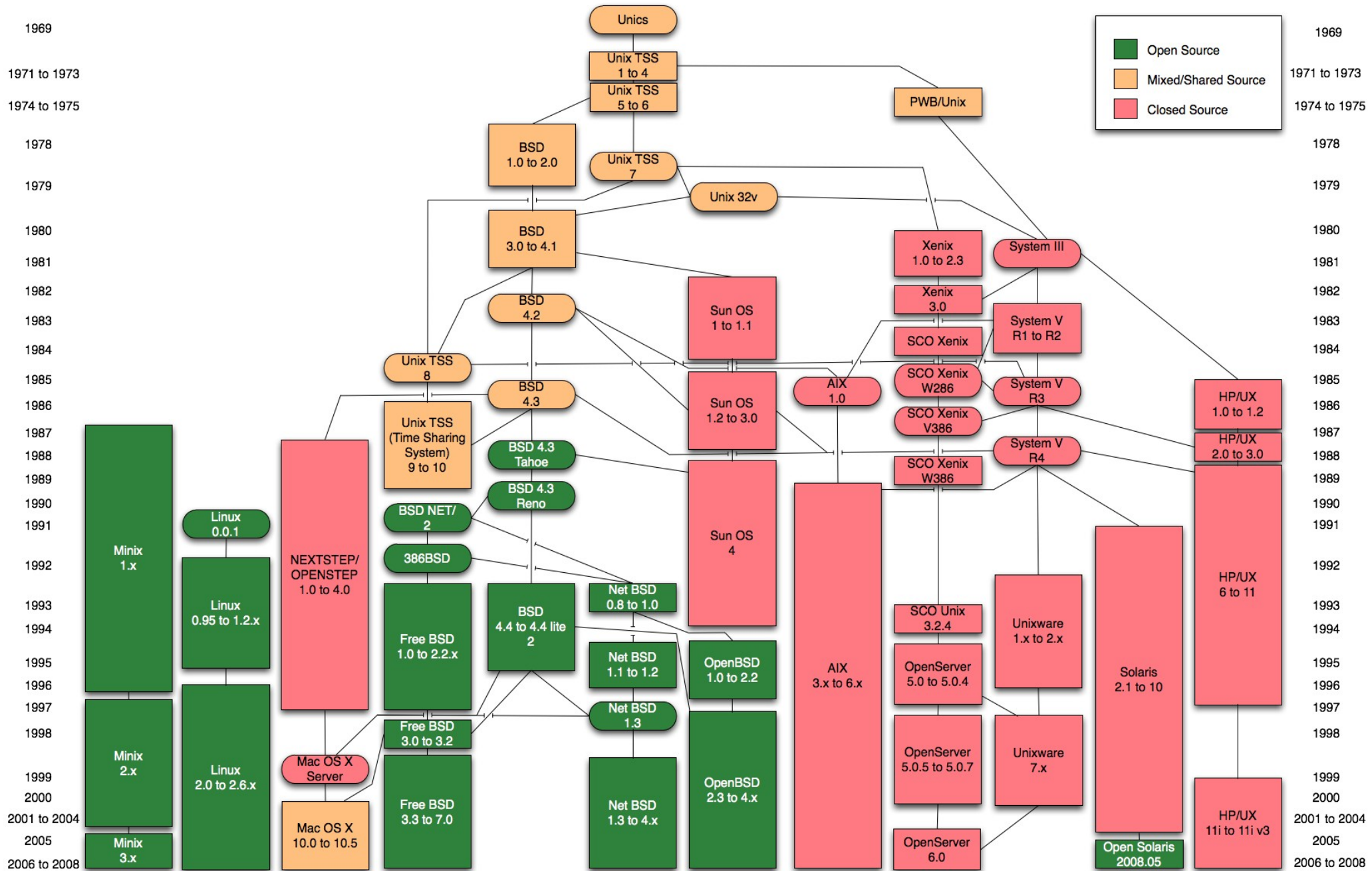
- Three BSD distributions were created (in '93 and '95) to maintain and enhance BSD
  - [FreeBSD](#), focused on personal computers  
Contains the more cutting edge feature, and has the larger user base
  - [NetBSD](#), focused on portability  
Supports as many platforms as possible
  - [OpenBSD](#), focused on improving the security of BSD
- All of them can be freely downloaded from the Internet
- BSD is also the base of some commercial OSs (such as Mac OS X)



# Commercial Success

- Each company proposed its own Unix flavor:
  - AIX (IBM)
  - Solaris, SunOS (SUN)
  - Ultrix (DEC)
  - Hp-UX (HP)
  - IRIX (Silicon Graphics)
  - XENIX (Microsoft → SCO)
  - MacOSX (Apple)
  - Tru64 (Compaq)
- Portable Operating System Interface for Unix (POSIX)
  - Set of IEEE standards to define the application programming interface (API), shell and utilities interfaces for software compatible with variants of the Unix operating system

# The Family Picture



# A Guy with a Dream

- In September 1983, [Richard Stallman](#) launched a project to create a free Unix-like operating system called [GNU](#) (recursive acronym for “GNU's Not Unix”)
  - The Free Software Foundation (FSF) was founded in '85 to raise funds to help the GNU Project
  - In '89, the FSF published a new license called The GNU General Public License (GPL)
- Stallman also contributed with many tools
  - The [Emacs](#) text editor
  - The GNU Compiler Collection ([GCC](#))
  - The GNU Debugger ([GDB](#))



# Free as In Freedom

- The program's users must have four essential **freedoms**:
  1. The freedom to **run the program**, for any purpose
  2. The freedom to **study** how the program works, and **change** it to make it do what you wish  
(access to the source code is a precondition for this)
  3. The freedom to **redistribute** copies so you can help your neighbor
  4. The freedom to **improve** the program, and **release** your improvements (and modified versions in general) to the public, so that the whole community benefits  
(access to the source code is a precondition for this)
- A program is Free Software if users have all of these freedoms
  - The FSF website lists all the licenses that are free software compatible

# A System looking for a Kernel

- By 1990, the GNU system had almost all the pieces except the OS kernel
  - BSD was in the middle of a lawsuit against AT&T over intellectual property related to UNIX
  - In 1987, a professor named Andrew Tanenbaum wrote from scratch a UNIX-like operating system for the IBM PC. He called it **MINIX**
    - The source code was available but its modification and redistribution were restricted (no free software)
  - In '91, a Finnish student by name Linus Torvalds released a freely modifiable UNIX-like kernel
- The combination GNU/Linux is what is now simply called **Linux**

# The Age of the Penguin

- In 1993 Patrick Volkerding puts together the first Linux distribution (Slackware).
- In 1994 the Linux kernel ver. 1.0 is released
- In 2009 Windows is still used in most of the desktops. However, Linux is used in 89% of the top500 supercomputers
- Today there are over 300 Linux distributions in active development
  - Each distribution consists of a large collection of applications
  - Some are maintained by companies (Fedora, Ubuntu, Mandriva..)
  - Some are maintained by a distributed community (Debian, Gentoo..)



