Introduction to Linux

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조 진 성

Operating System

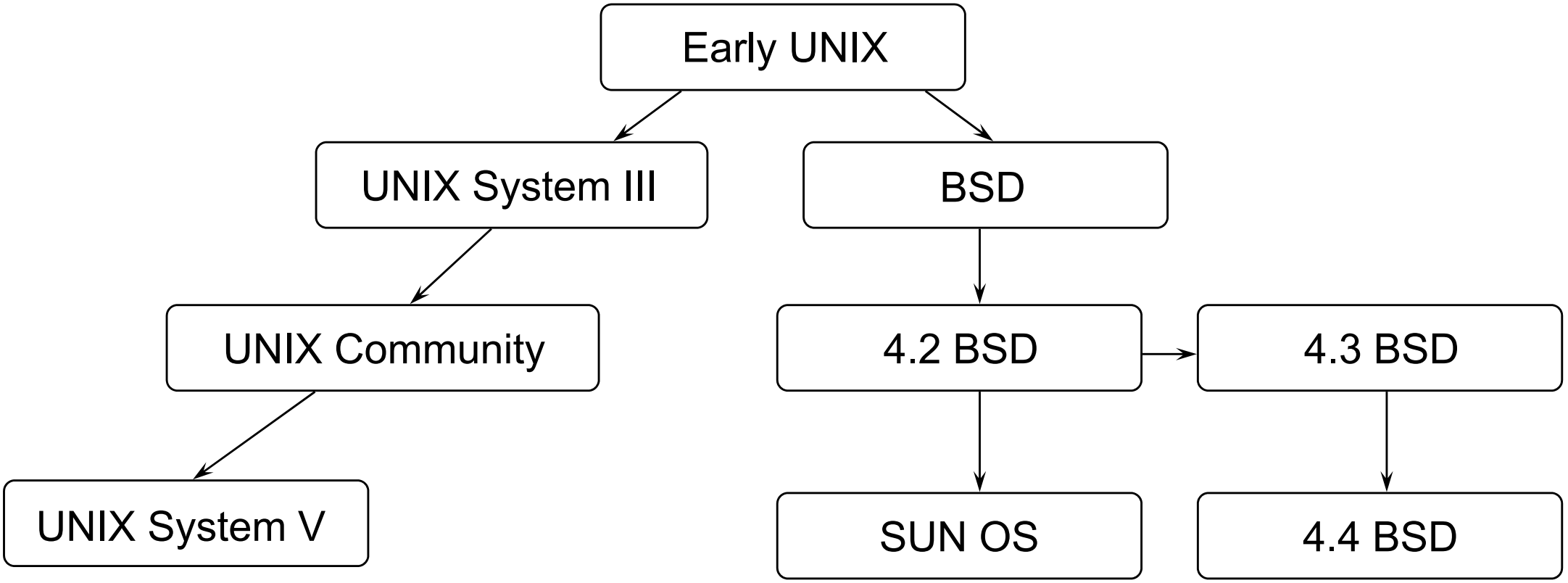
- A program that acts as an intermediary between a user of a computer and the computer hardware

- Operating system goals:
  - ✓ Make the computer system convenient to use
  - ✓ Use the computer hardware in an efficient manner

UNIX History

- To provide a development environment for programmers
  - ✓ Multics Project (1965~1969)
  - ✓ Porting to PDP-7 (1969)
    - Ken Thompson
    - named UNIX
  - ✓ Porting to PDP-11 (1971)
    - B language
  - ✓ Re-written in C language (1973)
    - Denis Ritchie
  - ✓ AT&T (1975)
    - Open to university
  - ✓ Porting to non-PDP machine (1977)
    - 500 sites including 125 universities

UNIX History (Cont'd)



BSD: Berkeley Software Distribution

Solaris, Linux: includes both features

UNIX History (Cont'd)

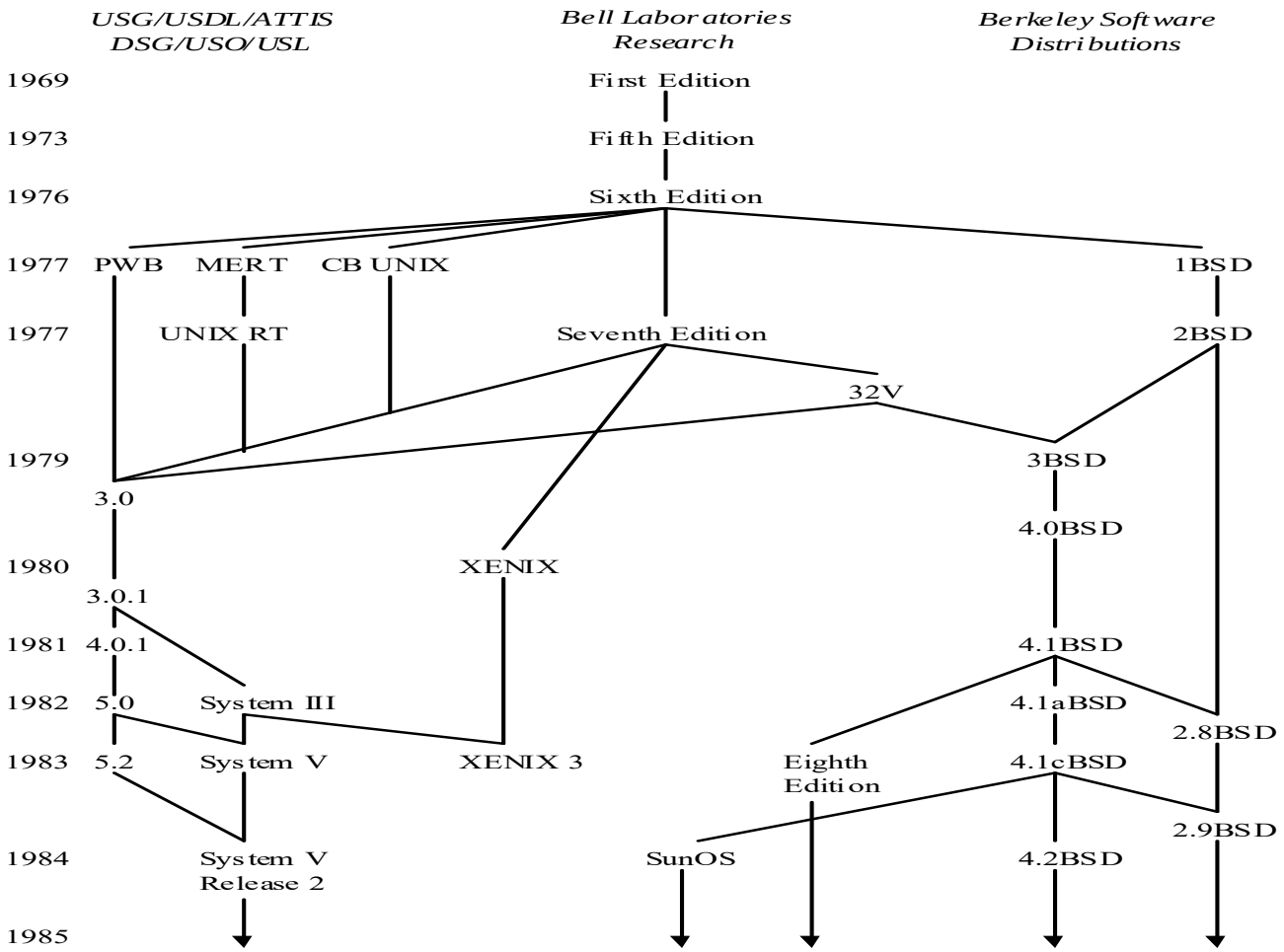


Figure 1.1 The UNIX system family tree, 1969-1985

UNIX History (Cont'd)

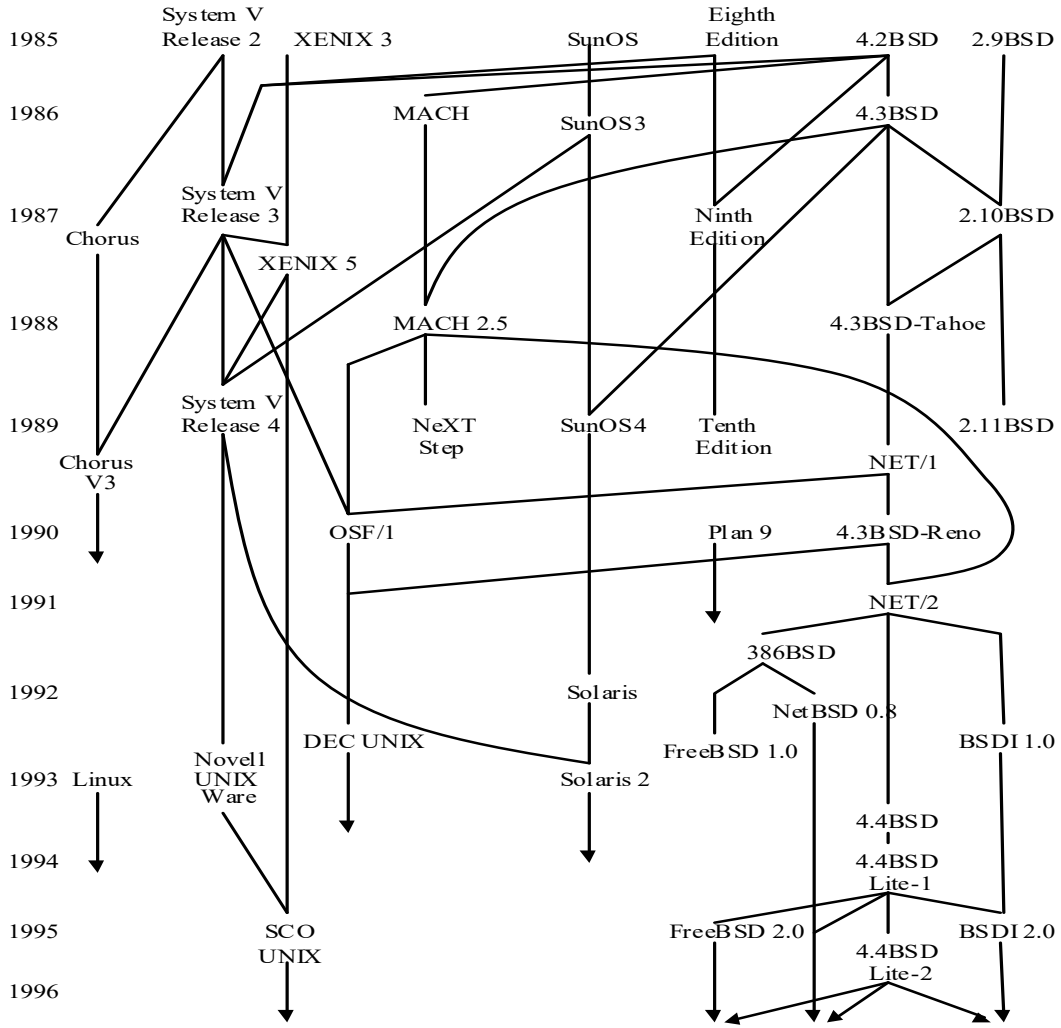


Figure 1.2 The UNIX system family tree, 1986-1996

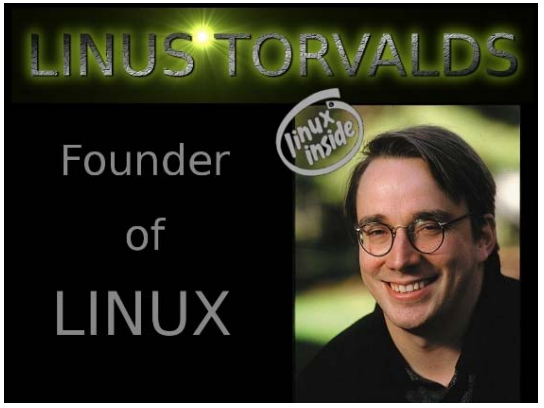
UNIX History (Cont'd)

- Sun Solaris
- HP HP-UX
- IBM AIX
- Caldera (SCO) Unixware
- Digital ULTRIX
- Compaq Tru64
- SGI Irix
- Linux, FreeBSD, NetBSD
- Apple Mac OS X, etc.

- POSIX-compliant (Portable Operating System Interface)
  - ✓ IEEE1003.1 (1986)

Birth of Free Software

- 1983
  - ✓ Richard Stallman, GNU project and free software concept
  - ✓ gcc, gdb, glibc, and other tools
- 1991
  - ✓ Linus Tovalds, Linux kernel project
  - ✓ Completely free operating system: Linux/GNU
- 1995
  - ✓ Linux is more and more popular on server systems
- 2000
  - ✓ Linux is more and more popular on embedded systems
- 2008
  - ✓ Linux is more and more popular on mobile devices
- 2010
  - ✓ Linux is more and more popular on phones



Linux Today

Americas

Berkeley County, South Carolina
Council Bluffs, Iowa
Douglas County, Georgia
Quilicura, Chile
Mayes County, Oklahoma
Lenoir, North Carolina
The Dalles, Oregon

Asia

Hong Kong
Singapore
Taiwan

Europe

Hamina, Finland
St Ghislain, Belgium
Dublin, Ireland

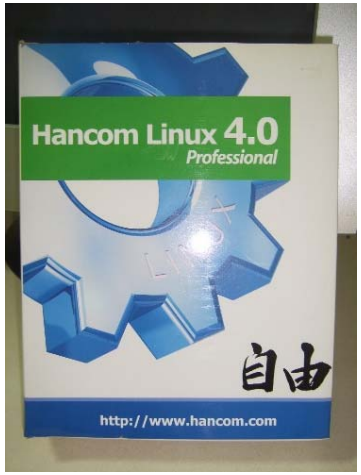
Linux

- Includes both features of System V and BSD
- Linux is a kernel
  - ✓ Others from BSD, GNU, etc.
  - ✓ GNU/Linux System
- Open source
  - ✓ GPL (GNU General Public License)
  - ✓ http://www.opensource.org/licenses/gpl-license.html
- Distributions

debian

SuSE

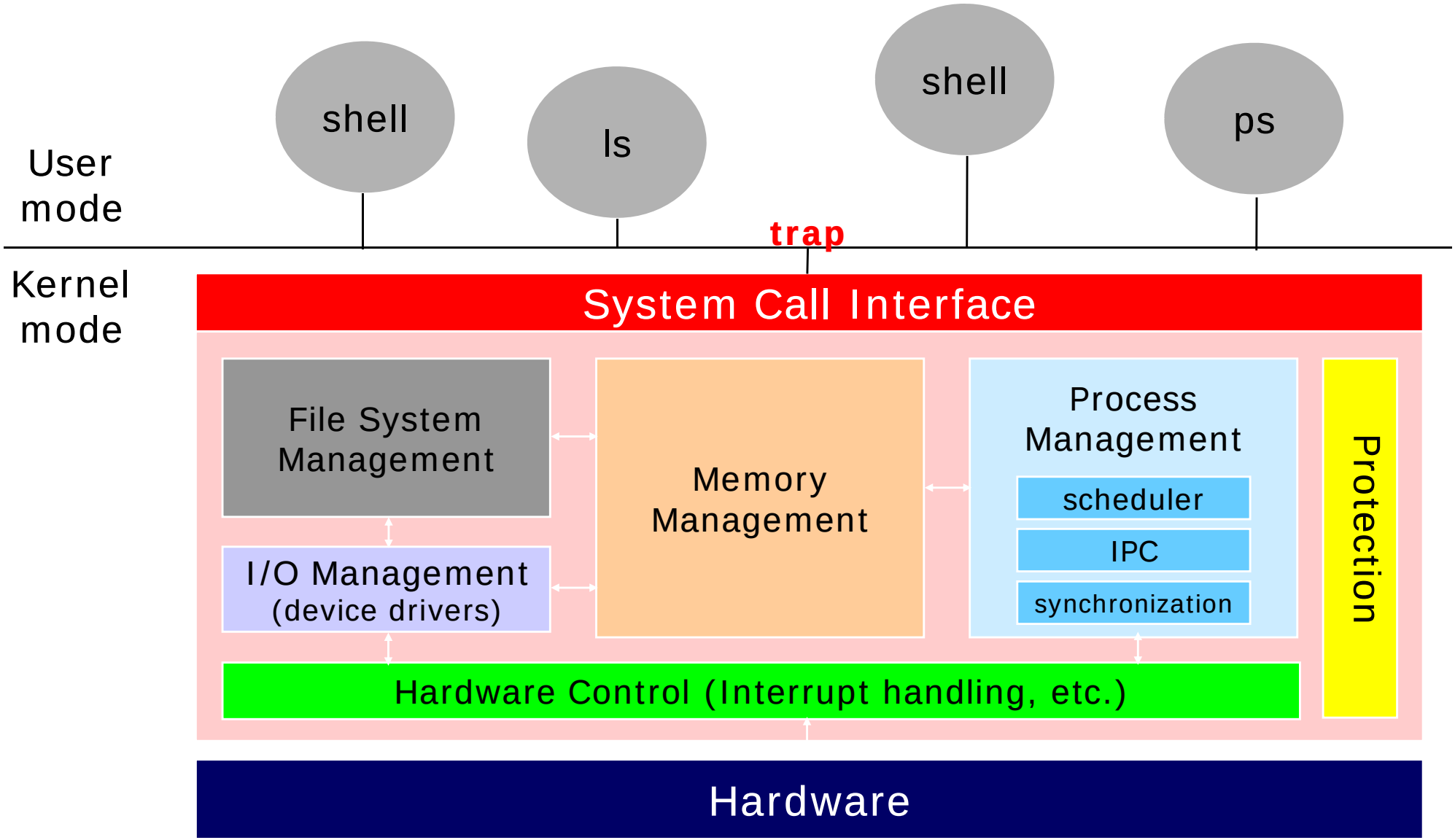
Linux Mandrake



Programming on Various Platforms

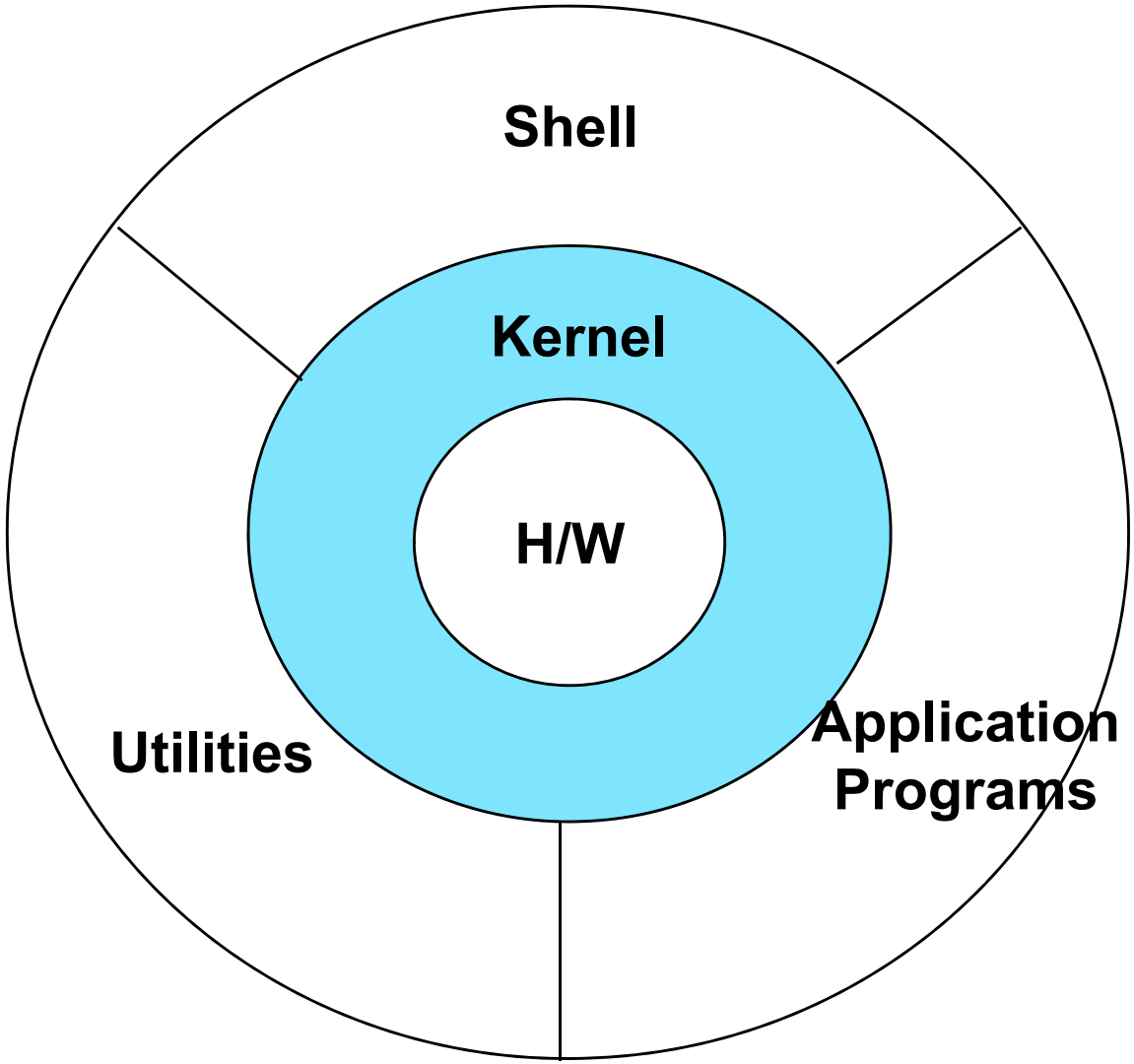
App.	App.	App.	App.	App.
GTK/QT	MFC/.NET	Cocoa	Cocoa Touch	Android
Linux/Unix	MS-Windows	Mac OS X	Mac OS X	Embedded Linux
Hardware	Hardware	Hardware	Hardware	Hardware

Linux System Structure

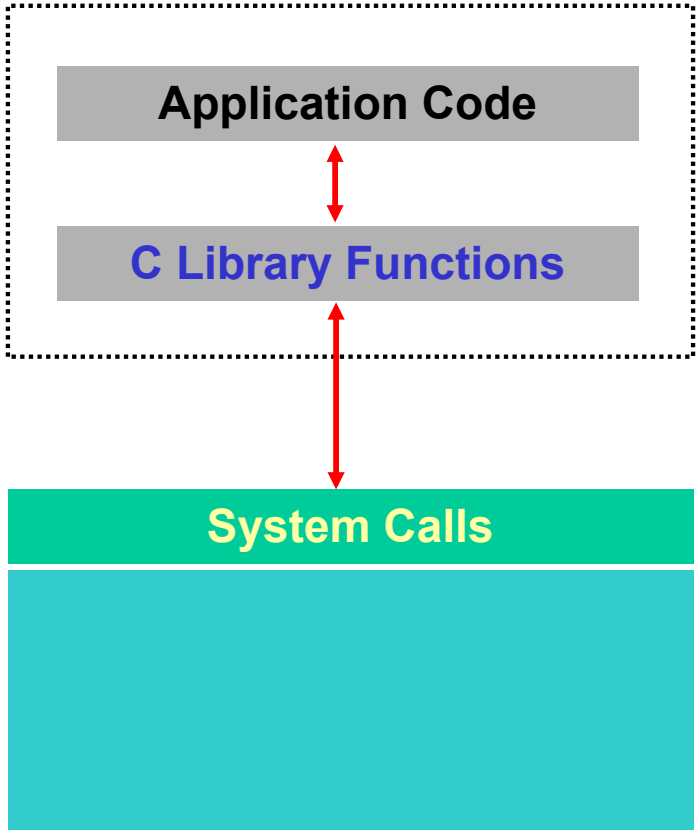


Linux System Structure (Cont'd)

- Kernel
- Shell
- File system
- System call
- Run-time library
- Utility & Application programs
  - ✓ System administration
  - ✓ Program development



System Calls and Library Functions



User Process

Kernel

Ex-1) strcpy

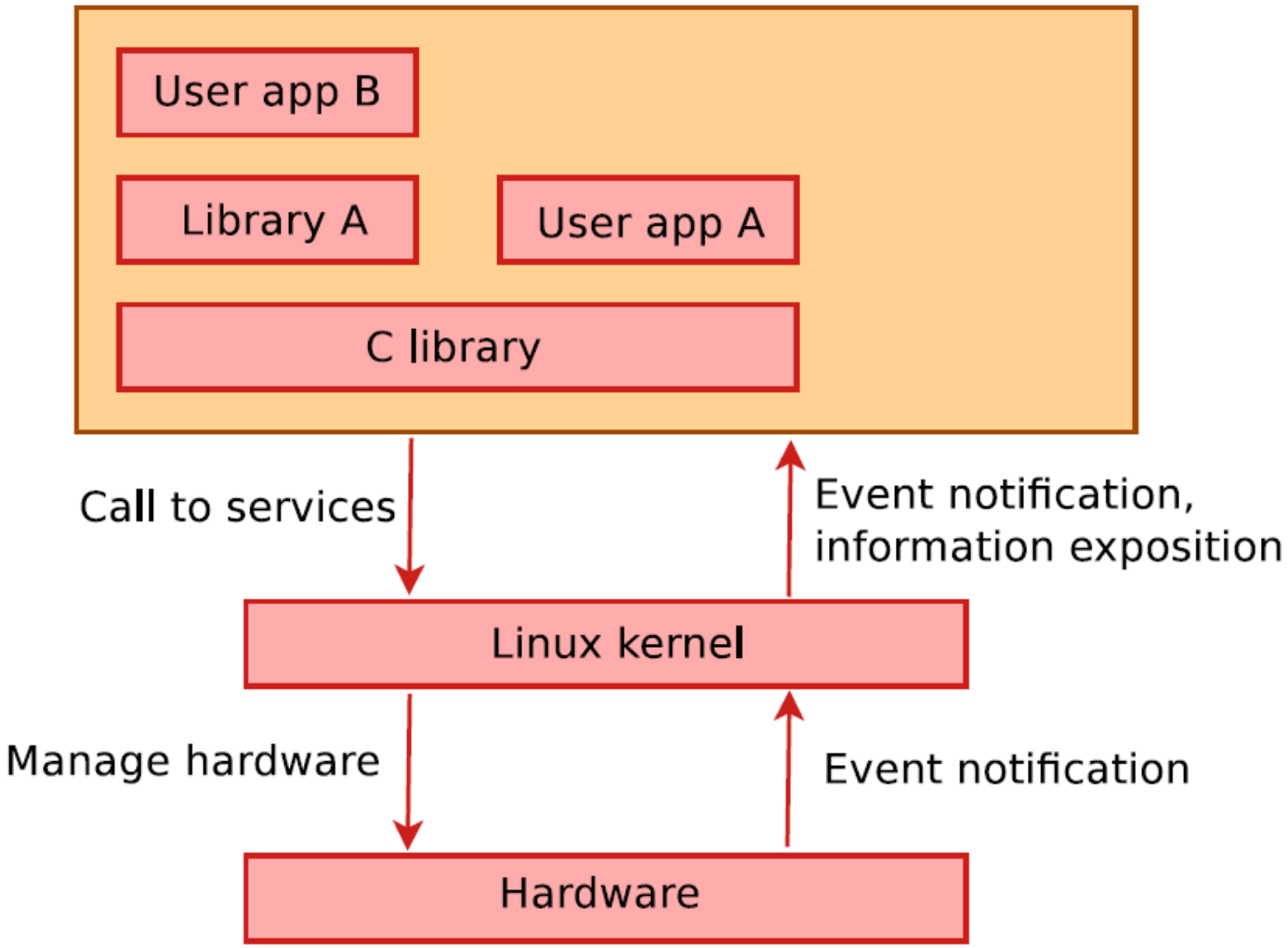
Ex-2) fork

Ex-3) printf

In this class, we will study how to program in Linux using system calls and library functions !!!

Linux Kernel

- Linux kernel in the system



Linux Kernel

- Location of kernel sources
  - ✓ The official version of the Linux kernel, as released by Linus Torvalds is available at http://www.kernel.org
    - This version follows the well-defined development model of the kernel
  - ✓ Many kernel sub-communities maintain their own kernel, with usually newer but less stable features
    - Architecture communities (ARM, MIPS, PowerPC, etc.)
    - Device drivers communities (I2C, SPI, USB, PCI, network, etc.)
    - Other communities (real-time, etc.)

Linux Kernel

- Linux kernel size
  - ✓ Linux 3.1 sources:
    - Raw size: 434 MB (39,400 files, approx. 14,800,000 lines)
    - gzip compressed tar archive: 93 MB
    - bzip2 compressed tar archive: 74 MB (better)
    - xz compressed tar archive: 62 MB (best)
  - ✓ Minimum Linux 2.6.29 compiled kernel size with CONFIG_EMBEDDED, for a kernel that boots a QEMU PC (IDE hard drive, ext2 filesystem, ELF executable support):
    - 532 KB (compressed), 1325 KB (raw)
  - ✓ Why are these sources so big?
    - Because they include thousands of device drivers, many network protocols, support many architectures and file systems...
    - The Linux core (scheduler, memory management...) is pretty small!

Linux Kernel

- Linux kernel size (Cont'd)
  - ✓ As of kernel version 3.2

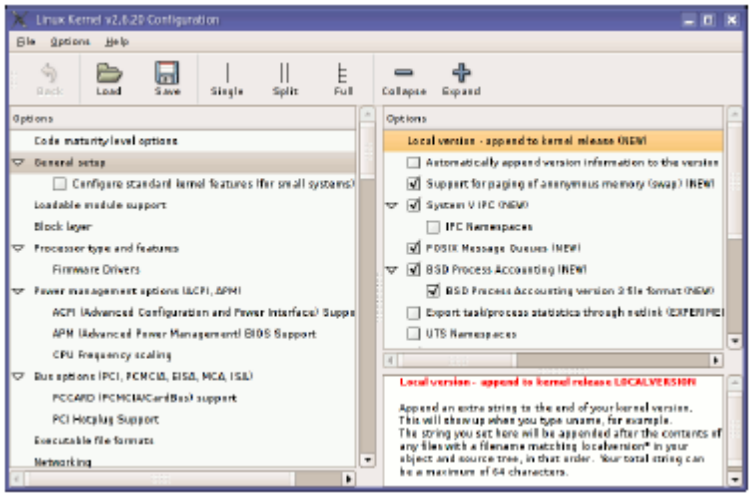
drivers/	: 53.65%	scripts/	: 0.44%
arch/	: 20.78%	security/	: 0.40%
fs/	: 6.88%	crypto/	: 0.38%
sound/	: 5.04%	lib/	: 0.30%
net/	: 4.33%	block/	: 0.13%
include/	: 3.80%	ipc/	: 0.04%
firmware/	: 1.46%	virt/	: 0.03%
kernel/	: 1.10%	init/	: 0.03%
tools/	: 0.56%	samples/	: 0.02%
mm/	: 0.53%	usr/	: 0%

Linux Kernel

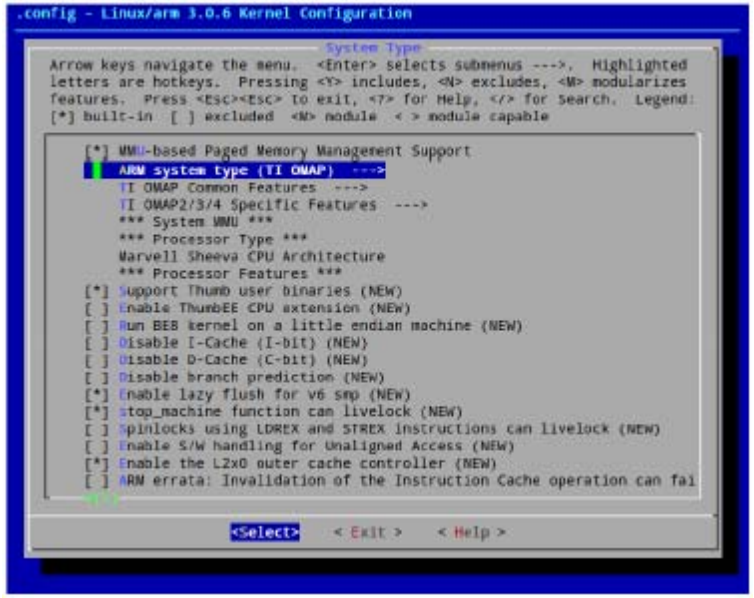
- Kernel vs. module
  - ✓ The **kernel image** is a single file, resulting from the linking of all object files that correspond to features enabled in the configuration
    - This is the file that gets loaded in memory by the bootloader
    - All included features are therefore available as soon as the kernel starts, at a time where no file system exists
  - ✓ Some features (device drivers, file systems, etc.) can however be compiled as **modules**
    - Those are plugins that can be loaded/unloaded dynamically to add/remove features to the kernel
    - Each module is stored as a separate file in the file system, and therefore access to a file system is mandatory to use modules
    - This is not possible in the early boot procedure of the kernel, because no file system is available

Linux Kernel

- Kernel configuration
  - ✓ GUI interface
    - make xconfig
    - make gconfig (→)



  - ✓ Text interface
    - make menuconfig (→)
    - make nconfig
    - make oldconfig
    - make allnoconfig



Summary

- Introduction to Linux
  - ✓ Features
    - Usually used for large-scale servers
  - ✓ History
    - BSD vs. System V
  - ✓ Platform
    - From super computer to PC
    - Even smart phone !
  - ✓ Standards
    - IEEE POSIX

- In this class, we will study how to program in Linux
  - ✓ Linux commands
  - ✓ Development environment (editor, compiler, debugger, make, etc.)
  - ✓ Programming using Linux system calls and libraries