Linux For Embedded Systems
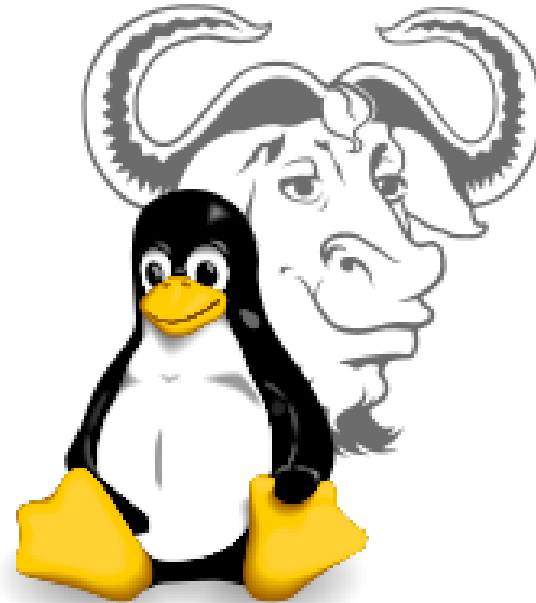
For Arabs

Course 101:
Introduction to Embedded Linux

Ahmed ElArabawy

Lecture 5:
Linux/GNU

HISTORICAL BACKGROUND

UNIX

- It started in Bell Labs with a terminated project for the Multics Multi-user operating system
- Dennis Ritchie and Ken Thomson started to work on Unix
- 1969: First Implementation of Unix, done on PDP-7 using assembly
- 1971: Ported Unix to PDP-11 using assembly
- 1972: Creation of "C" programming language to facilitate the porting
- 1973: Complete rewrite of UNIX into "C" (which led to high portability)
- First Public version, Unix System V6
- 1977: Unix System III

- 1982 Unix System V (by AT&T)

UC Berkeley

- BSD (Berkeley Software Distribution)
- 1979: 3BSD
- The Series 4BSD (4.0, 4.1, 4.2, 4.3 BSD)
- 1993: 4.4 BSD
- Dragonfly BSD, Free BSD, Net BSD, Open BSD

Commercial Unix

- Other companies built their variants
    - Digital → Tru64
    - HP → HP-UX
    - IBM → AIX
    - Sequent → DYNIX/ptx
    - SGI →IRIX
    - Sun Microsystems → Solaris

The Unix Fever....

- Unix has widely spread in universities and industry because,

    - Written in C (portable to different architectures)

    - Simplicity and elegant design:

        - Less number of System calls (compared to other OSs)

        - Almost everything is treated as a file

        - Fast Process creation using fork-exec concepts

        - Strong Inter-Process Communication (IPC) support

    - Powerful, Robust, and Stable

GNU
GNU Not Unix

- Richard Stallman is a software freedom activist and a computer programmer
- Believing in free software, he formed the Free Software Foundation and started the GNU project in 1983
- The target with the GNU project was to create a Unix-like operating system along with all the eco-system based on free software
- He is still active in advocating for free software and campaigning against software patents and digital right management (DRM)

- Created the GPL license (GNU Public License)
- Stallman pioneered the concept of **copyleft**,
    - If you modify a free software (GPL) then your modifications will have to be also GPL
- He started by building the eco-system **but lacked the kernel**

Then Comes Linux

"Hello everybody out there using minix - I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on things people like/dislike in minix. it probably never will support anything other than AT-harddisks, as that's all I have :-(."
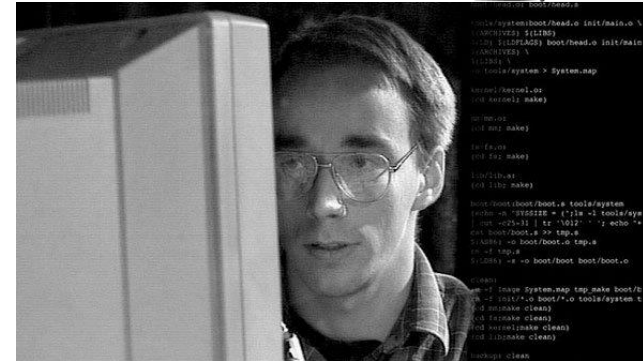
- Developed by Linus Torvalds (University of Helsinki) on an i-386 platform
- First public introduction in 1991
- Unix-like operating system kernel together with GNU Software and tools
- Open Source, received contribution by many
- Under the GNU GPL 2.0 License

Examples for Linux Platforms

- AMD x86-64
- ARM
- Compaq ALPHA
- CRIS
- DEC VAX
- H8/300
- Hitachi SuperH

- HP PA-RISC
- IBM 3/390
- Intel IA-64
- MIPS
- Motorola 68000
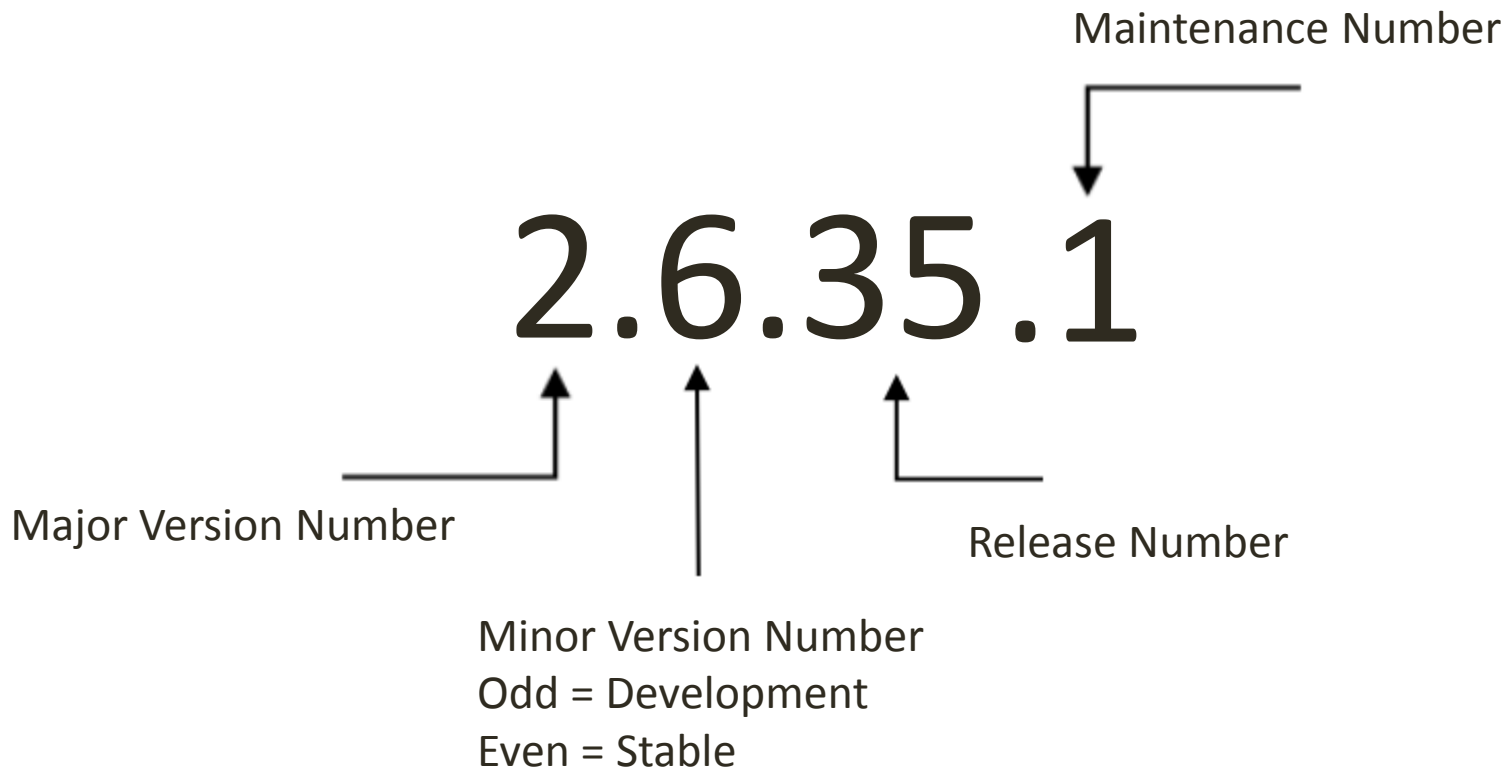- FreeScale PowerPC
- Sparc, Ultra-Sparc
- V850

And the list keeps growing

System Requirement

- Linux was initially built on x86 architecture, but now it and tools and libraries associated with it support a large range of architectures
- The mainstream Linux requires at least 32 bit processors with support of MMU (Memory Management Unit), some special configurations can support MMU-less architectures
- Linux is highly configurable, developer can adjust its configuration based on the need and available hardware
- Required RAM depends on the configuration, but 8MB is a typical minimum requirement, and 32MB is a typical average requirement
- Required Storage also relies on configurations, but 4MB is a typical minimum for small systems.
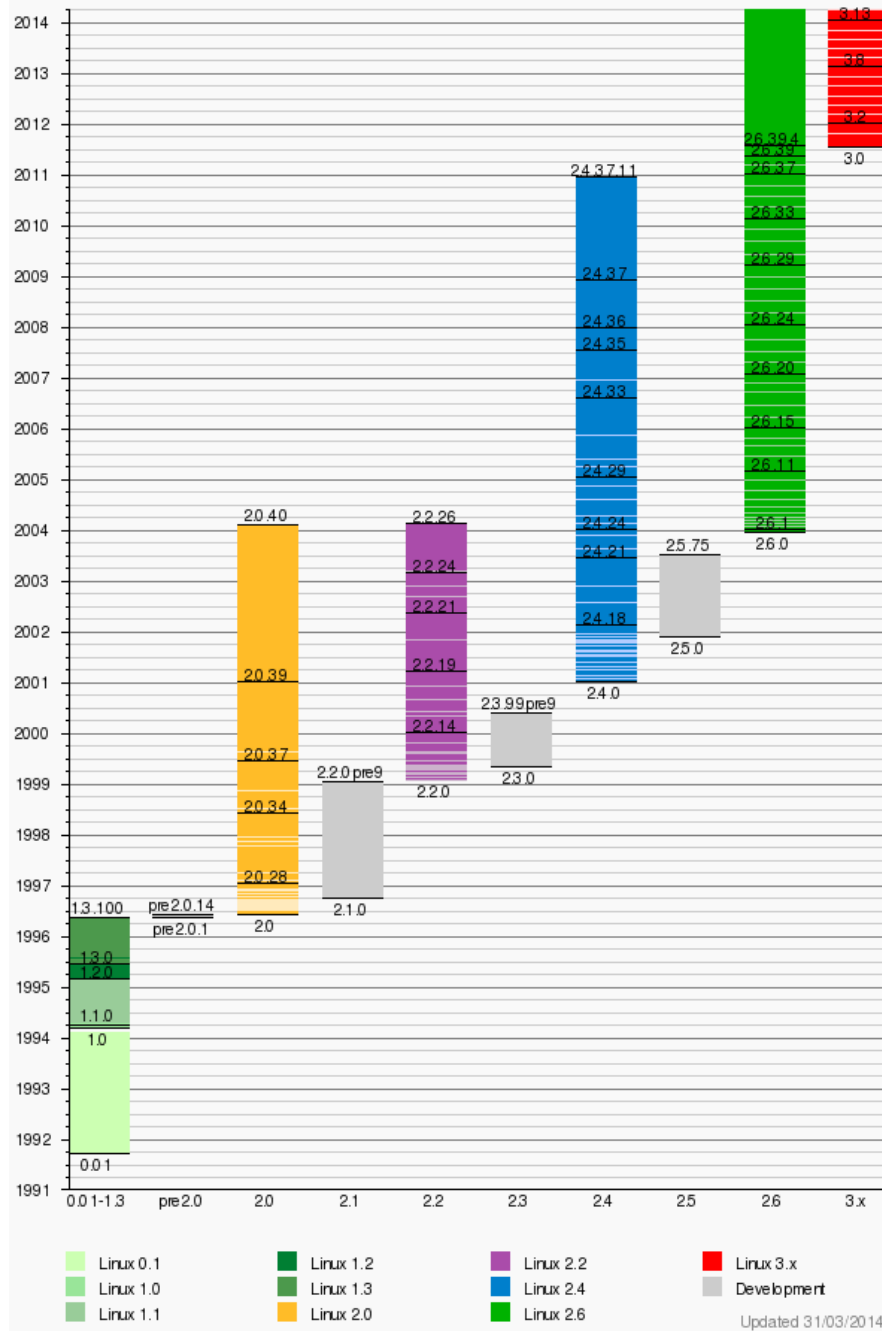
Kernel Version

2.6.35.1

Maintenance Number

Major Version Number

Minor Version Number
Odd = Development
Even = Stable

Release Number

Stable Patch Release

3.4.1

Version Number

Release Number

LINUX DISTRIBUTION

Linux Distributions

- You can build your own distribution (not an easy job, but sometimes it is worth it)

- If interested check the Linux From Scratch Project (http://www.linuxfromscratch.org/)

- A dedicated course will target building a customized Linux Distribution

Linux Distributions

- Otherwise, you can use readily available distributions
- There are a lot of distributions available, most popular now is the Ubuntu
- We will use Ubuntu in our course and other courses in this track (unless we are building our own)

KDE & GNOME

- The Unix/Linux environment and graphical desktop went through these phases,
  - Initially it was developed by a consortium of companies (Sun Microsystems, HP, IBM, Unix Systems Labs). This resulted in CDE (Common Desktop Environment)
  - CDE was out in 1993, but it looked very lame compared to Windows
  - 1996, the KDE project started to improve the Linux Desktop. It started as open source, but deviated from this by using some non-GPL tools and apps
  - 1997, the GNOME project was started to stick to GPL only software
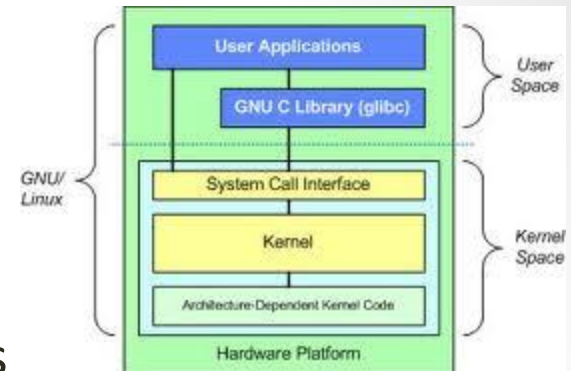 - Today we have both KDE and GNOME desktops

Linux Model
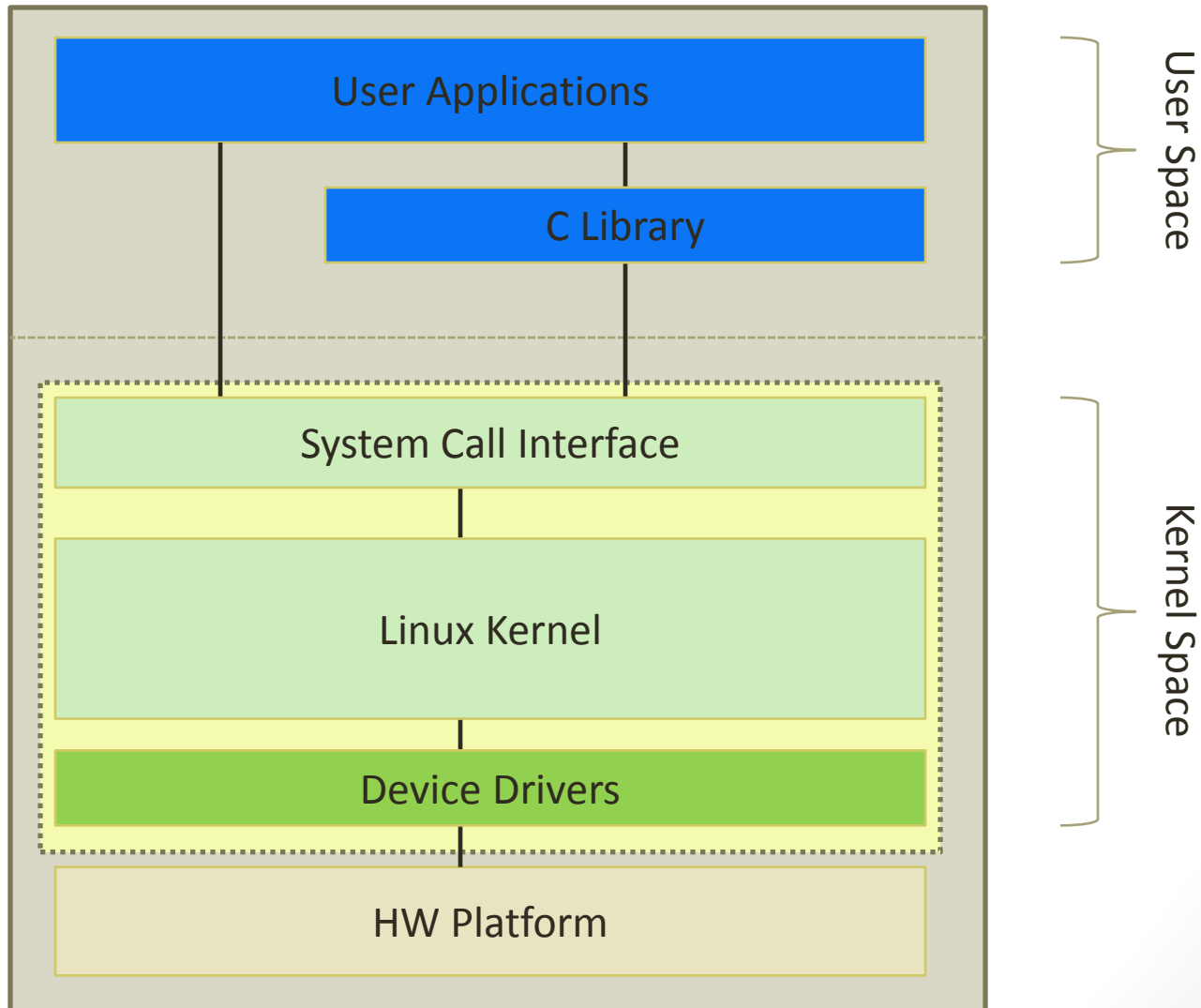
User Space Apps

- These are the typical applications
- Uses the "C" library in a lot of functionality
- Linux uses the MMU capability to protect apps from corrupting each other memory
- User apps can not access the hardware (screen, I/O, files, …) directly
- Must use "System Calls" into the kernel which perform the task on behalf of the user application
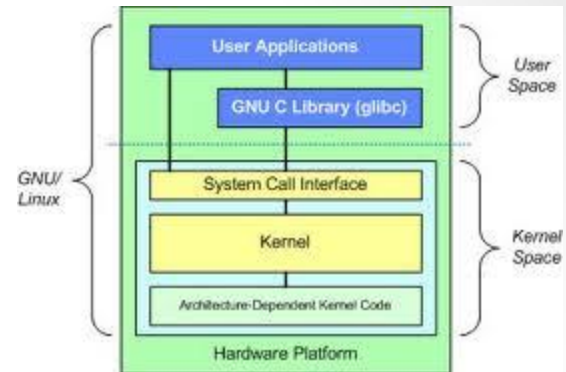
Kernel Space

- Have direct access on all system resources
- Perform tasks on behalf of the user app in System Calls
- Dangerous … can easily crash the system
- No access to "C" library
- Handles Interrupts and mission critical jobs
- Connects with hardware via device drivers

Linux 4 Embedded Systems

http://Linux4EmbeddedSystems.com