System Administration

LECTURE 1

INTRODUCTION

Slides are adopted from the previous year

Lecture 001: “System Administration: Introduction” by Amnir Hadachi
Outline

• Course Syllabus
• Booting Linux
  – Terminology
  – Major steps in the Boot Process
  – BIOS
  – Boot Loader (GRUB)
    • MBR based
    • EFI based
  – Kernel
  – Init
• Live Demo
• Questions
• Introducing Next Lecture topic
SYLLABUS

• Rules and Regulations:
  – Attendance to the Lectures and Labs are not mandatory. Lectures’ slides and video records will be available at the end of the lectures scheduled time on the study information system.

• course website:

• In order to be allowed to take the exam:
  – 100% of the labs should be done and completed one week before the exam date.

• The grading of this course is divided as follows:
  – 50% Labs
  – 50% Exam
SYLLABUS

- Topics covered:
  - Overview of the Linux system
  - Linux Boot process
  - Linux kernel
  - Linux environment

- Cloud deployment, network configuration

- Services: DNS, Mail server, Web Server, File server ...
  - ... and couple of optional services in case we have extra time!

- 3. Security
- 4. Backup
- 5. Tracking and monitoring
Readings & Resources

• Textbook
    By Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley,
    Published Jul 14, 2010 by Prentice Hall.

• References:
  – The debian administrator's handbook by Raphaël Hertzog and
    Roland Mas (Book is freely available under GNU General
    Public License)
    • ISBN: 979-10-91414-04-3
  – The Linux Command Line Tutorial by William Shotts
    • http://www.linuxcommand.org/tlcl.php
SYLLABUS

- **Course instructors:**
- **Lectures:**  
  - Artjom Lind
- **Lab assistants:**  
  - Alo Peets
  - Anders Martoja
  - Andre Tättar
  - Artjom Lind

- **Labs:**
- Building the Virtual Private Server (VPS) from scratch!
  - Preparing Virtual Disk Image (VDI)
  - Bootstrapping the OS
  - Deploying the VDI
  - Accessing it using Management Interface
  - Setting up network and remote accessing the VPS ...
- Setting up the services:
  - DNS, Mail, Web, Files ...
- Securing VPS, setting up backup, monitoring ...
LAB Infrastructure

- LAB Private Cloud
  - Each student will host the VPS there and maintain it
  - VPS management interface:
    - Browser based VNC client showing the VGA output of the VPS
      - … useful when VPS is offline or down ;)

- LAB Network, or “Sandbox” Internet
  - All VPS are interconnected into one LAN with Internet gateway
    - … static IP configuration
  - Remote accessing the LAB network using LAB OpenVPN
    - VPN clients can see all LAB VPS
    - VPN clients can not see each other
  - LAB DNS server
    - Allows to have personal domains of any kind ;)
      - Will only work in the scope of LAB network
      - Will only work for VPN connected clients
  - All the services we configure we will test in the scope of the LAB network
LECTURE 1: INTRODUCTION
BOOTING LINUX

- Terminology
  - What is BIOS? (Basic Input Output System)
    - Set of build software routines (PC’s personality)
  - Role: (A layer between hardware and software)
    - Govern the inner complexity arising out of the odd mixing between hardware and software.
    - Link between the circuits and the transcendent realm of software instructions.
    - Stored in non volatile random access memory chip
LECTURE 1: INTRODUCTION
BOOTING LINUX

- Terminology
- Bios:

- Memory test
- Initiate support chips
- Posrt test
- Cache intialisation
- initiate the components

POWER-ON SELF TEST

BOOTSTRAP LOADER

BIOS

BIOS SETUP UTILITY PROGRAM

SYSTEM SERVICE ROUTINES

Search for OS

Boot the OS

Access software interprets

Handle interprets vector table

Store settings of memory and disk type
LECTURE 1: INTRODUCTION
BOOTING LINUX

• Terminology

• what is Master Boot Record (MBR)?

• The MBR is the first sector of any hard disk where an operating system is located for booting purposes.
Lecture 1: Introduction

Booting Linux

- Terminology
  - What is Boot Loader or Boot Manager?
    - A small program in charge of loading the OS into the memory.
    - Boot Loader resides in the Master Boot Record (MBR) sector.
BOOTING LINUX

● Terminology
  − what is a kernel?
  − A core that provides basic services for all other parts of the OS such as:
    ● Controls and mediates access to hardware
    ● Implements and supports fundamental abstractions:
      − processes, devices, etc.
    ● Responds to user requests for service or commands. (through the shell, e.g. bash)
      − Allocates system resources:
    − Memory, disk, CPU, etc.
BOOTING LINUX

• Terminology
• Kernels’ categories:
  - Monolithic kernels
    • Ability to load modules at runtime
    • Linux, FreeBSD
  - Microkernels
    • provides strict minimum services
    • BeOS, Mac OS X
  - Hybrid kernels
    • run more swiftly than microkernels
    • e.g. Windows NT, XP
  - Exokernels
    • limited functionalities to protection and multiplexing
    • still experimental kernel
BOOTING LINUX

- Boot Process
- Three major steps
  - Bios
  - Boot loader
  - Kernel
- Nowadays the Bios part is actively substituted by EFI
  - Unified Extensible Firmware Interface
  - Adding another layer between Hardware and OS

LECTURE 1: INTRODUCTION
BOOTING LINUX

- Bios
  - First program to run
  - Runs from ROM
- OS independent
- Post (Power-on self test)
- Boot OS from storage device
  - go through the list till it finds the MBR
BOOTING LINUX

- BIOS based boot use HDD's special area to read the bootable code
  - MBR
  - first sector in the drive
- Boot loader usually reside in the MBR
- MBR runs the bootlader
  - Boot loader loads the OS
  - can be automatic
  - e.g. GRUB, LILO (LInux LOader)
- May add special boot parameters:
  - Kernel boot parameters
  - initrd= “initial ramdisk”
    - RAM-based file system
BOOTING LINUX

• Boot loader loads the kernel
  – location of the kernel: /boot/vmlinuz
  – Remark: The kernel (compressed file)
• Boot loader loads the initramfs (optionally)
• Kernel gets the hardware running
  – Kernel optionally loads firmware and drivers from initramfs
• initrd ramdisk is dismounted
• Kernel finds ROOT-fs (where the “/” directory is)
  – OS is now started to boot (init scripts)
  – OS boots all the services (specified to start at boot time)
what is happening during the running the "init":β

- Kernel is loaded
- Init starts
- initialization (file)
  - Sets the path
  - Starts swapping
  - Checks file systems
  - etc. ...
  - Continue to read the file
  - Setting up the "run levels"
  - Location
  - sbin
  - etc/initdb

Configuration of processes
BOOTING LINUX

• run levels:
• Unix-like systems can be run in different process configuration.
  - run level 0: Halt the system
  - run level 1: single user mode
  - run level 2: local multiuser with networking but without network services (example NFS)
  - run level 3: full multiuser with networking
  - run level 4: Not used
  - run level 5: full multiuser with networking and Gui
  - run level 6: Reboot
Lecture 1: Introduction

Boot Linux

- After the run level
BOOTING LINUX

- rc<x>.d file
  - SYMBOLIC LINKS POINTING TO SCRIPTS LOCATIONS IN “/etc/init.d”
- rc file characteristics:
  - Contains symbolic links
  - The links are numbered and ordered
- After init has progressed and ran the selected level, the “inittab” script forks a “getty” process for each virtual console for login prompt in text mode.
- In case the run level is 5:
  - The “inittab” script runs “/etc/X11/prefdm” for displaying the GUI interface:
    - prefdm" script runs preferred D display manager by referring to the configuration in “/etc/sysconfig/desktop” directory. (this typically gem if you run GNOME or kdm)
LECTURE 1: INTRODUCTION
BOOTING LINUX

- General Summary of the Booting sequence:

  1. Machine on
  2. CPU jump to address of BIOS (0xFFFFF0)
  3. BIOS runs POST (Power-On Self Test)
  4. Find bootable devices
  5. Loads and execute boot sector from MBR
  6. Load OS
Questions to me?

Questions you:

What shall we do next?

- Show more intro slides form previous years?
  - Live demo of Linux boot
    - Boot loader options?
    - EFI based booting?
- Live Demo of this weeks lab tasks?
System Administration

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BOOTING LINUX

- Terminology
- Bios:
  - Memory test
  - Power-on self test
  - Cache initialization
  - Initiate the components
  - Search for OS
  - Boot the OS
  - BIOS setup utility program
  - System service routines
  - Store settings of memory and disk type
  - Hardware interprets vector table
LEcTURE1: INTRODUCTION
BOOTING LINUX

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  - Boot OS from storage device
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- MBR
- Power on
- Setup
- Execute POST
- Configure interrupt services
  - Yes
  - No
  - Memory

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Artjom Lind (artjom.lind@ut.ee)
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After the run level

Kernel is loaded

Init

Initialization (file)

- run level selected

Necessary Processes

- kill scripts
- start scripts
- etc...

lsmod

/etc/inittab

/etc/crash-<x>.d

/etc/inittab

/etc/crash-<x>.d
BOOTING LINUX

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