# CSGE602055 Operating Systems CSF2600505 Sistem Operasi Week 09: Storage, BIOS, Loader, & Systemd

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https://os.vlsm.org/
Always check for the latest revision!

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## Operating Systems 2019-1

A (Rm 3114) [Tu/Th 10-12] — B (Rm 3114) [Tu/Th 13-15] — C (Rm 3114) [Tu/Th 16-18] — D (Rm 2401) [Tu/Th 10-12] — E (Rm 2306) [Tu/Th 13-15]

Week	Schedule	Topic	OSC10
Week 00	07 Feb - 13 Feb 2019	Overview 1, Virtualization & Scripting	Ch. 1, 2, 18.
Week 01	14 Feb - 20 Feb 2019	Overview 2, Virtualization & Scripting	Ch. 1, 2, 18.
Week 02	21 Feb - 27 Feb 2019	Security, Protection, Privacy,	Ch. 16, 17
		& C-language	
Week 03	28 Feb - 06 Mar 2019	File System & FUSE	Ch. 13, 14, 15
Week 04	12 Mar - 18 Mar 2019	Addressing, Shared Lib, & Pointer	Ch. 9
Week 05	19 Mar - 25 Mar 2019	Virtual Memory	Ch. 10
Mid-Term	23-30 Mar 2019 (tba)	MidTerm (UTS)	
Week 06	02 Apr - 08 Apr 2019	Concurency: Processes & Threads	Ch. 3, 4
Week 07	09 Apr - 15 Apr 2019	Synchronization & Deadlock	Ch. 6, 7, 8
Week 08	16 Apr - 22 Apr 2019	Scheduling	Ch. 5
Week 09	23 Apr - 29 Apr 2019	Storage, BIOS, Loader, & Systemd	Ch. 11
Week 10	30 Apr - 06 May 2019	I/O & Programming	Ch. 12
Reserved	07 May - 17 May 2019		
Final	18-25 May 2019 (tba)	Final (UAS)	This schedule is
Extra	27 Jun 2019	Extra assignment confirmation	subject to change.

## The Weekly Check List

•	☐ <b>Resources</b> : https://os.vlsm.org/
	☐ (THIS) Slides — https://github.com/UI-FASILKOM-OS/
	SistemOperasi/tree/master/pdf/
	☐ <b>Demos</b> — https://github.com/UI-FASILKOM-OS/
	SistemOperasi/tree/master/demos/
	☐ Extra — BADAK.cs.ui.ac.id:///extra/
	□ <b>Problems</b> — rms46.vlsm.org/2/195.pdf, 196.pdf,, 205.pdf
	☐ <b>Text Book</b> : any recent/decent OS book. Eg. <b>(OSC10)</b> Silberschatz
	et. al.: <b>Operating System Concepts</b> , 10 <sup>th</sup> Edition, 2018.
	☐ Encode your <b>QRC</b> with size upto 7cm x 7cm (ca. 400x400 pixels):
	"OS182 CLASS ID SSO-ACCOUNT Your-Full-Name"
	$\square$ For <b>Week 00</b> , send your <b>embedded</b> QRC <b>before the</b> $2^{nd}$ <b>lecture</b>
	mailto:operatingsystems@vlsm.org
	With Subject: OS182 CLASS ID SSO-ACCOUNT Your-Full-Name
	☐ Write your Memo (with QRC) every week.
	☐ Login to badak.cs.ui.ac.id via kawung.cs.ui.ac.id for at least
	10 minutes every week. Copy the weekly demo files to your own home
	directory.
	Eg. (Week00): cp -r /extra/Week00/W00-demos/ W00-demos/

## Agenda

- Start
- Schedule
- Agenda
- 4 Week 09
- 5 Week 09: Storage, BIOS, Loader, & Systemd
- 6 Storage Management
- RAID
- 8 Legacy BIOS
- UEFI
- Operating System (Boot) Loader
- GRUB Map
- init (SYSV legacy)
- UpStart Ubuntu
- The All New "systemd"
- systemctl
- 16 The End

## Week 09 Storage, BIOS, Loader, & Systemd: Topics<sup>1</sup>

- Storage
- Storage Arrays
- BIOS
- Loader
- Systemd

<sup>&</sup>lt;sup>1</sup>Source: ACM IEEE CS Curricula 2013

# Week 09 Storage, BIOS, Loader, & Systemd: Learning Outcomes<sup>1</sup>

- Storage [Usage]
- Storage Arrays [Usage]
- BIOS [Usage]
- Loader [Usage]
- Systemd [Usage]

## Week 09: Storage, BIOS, Loader, & Systemd

- Reference: (OSC10-ch11)
- Mass-Storage Structure
  - Obsolete: Magnetic Tape, Disket
  - Until When?: Magnetic Disk, DVD
  - Until When?: Mechanical Disk Arm Scheduling
  - Solid-State Disks (SSD)
  - (What is a) Flash Disk
- Attached-Storage
  - Host-Attached Storage: via I/O
  - Network-Attached Storage (NAS): via distributed FS
  - Storage Area Network (SAN): dedicated Network

## Storage Management

- Formating
  - Low Level (Physical)
  - High Level (FS)
- Boot Block
- Disk Partition
  - "MBR"-scheme
    - upto 4 primary partition
    - upto 2 TB disk
  - "GPT"-scheme
    - "unlimited" partition
    - "unlimited" disk
    - redundancy
- Swap Space Management: On Partition or FS?

## RAID: Redundant Array of In\* Disks

- RAID 0, 1, 5, 6, 10, 100
- Note (http://www.commodore.ca/windows/raid5/raid5.htm):
  - RAID was created to enhance data performance, reliability and availability.
  - Striping, parity checking and mirroring are three primary functions of RAID systems.
  - RAID performs its functions transparent to the operating system.
  - Systems are typically defined by ranks consisting of five disks each connected to one or two Disk Array Controllers.
  - Different RAID levels provide varying degrees of speed and data protection.
- Problems with RAID
- Stable-Storage Implementation

## BIOS, Boot, & Systemd

- Firmware
  - BIOS: Basic Input Output System.
  - UEFI: Unified Extensible Firmware Interface.
  - ACPI: Advanced Configuration and Power Interface.
- Operating System (Boot) Loader
  - BOOTMGT: Windows Bootmanager / Bootloader.
  - LILO: Linux Loader.
  - GRUB: GRand Unified Bootloader.
- Operating System Initialization
  - Init (legacy)
  - UpStart
  - Systemd

## Legacy BIOS

- Check Settings.
- Initialize CPU & RAM.
- POST: Power-On Self-Test.
- Initialize ports, LANS, etc.
- Load a Boot Loader.
- Handover to the Boot Loader.
- Provides "Native" (obsolete) Drivers only (not loadable).
- Provides "INT" services .
- Limitation.
  - Technology of 1970s.
  - 16 bits software.
  - 20 bits address space (1 MB).
  - 31 bits disk space (2 TB).

#### **BIOS**



Figure: BIOS

### **UEFI**

- A Firmware Specification, not an Implementation!
- No (INT) service after boot.
- HII: Human Interface Infrastructure.
- Protected Mode.
- Flexible.
  - Technology of 2000s.
  - writen in C.
  - (third party) loadable drivers and tools.
  - Emulate Legacy BIOS transition (MBR block, INT service).
  - UEFI Shell: environment shell for diagnostic (no need for DOS).
- Problems
  - Who controls the Hardware?
  - Is "Secure Boot" a good thing?
  - How about a NASTY/LOCKING/TROJAN UEFI implementation?
  - Different DRIVERS.

#### **UEFI**



Figure: UEFI

#### **UEFI** Boot

## Platform Initialization (PI) Boot Phases

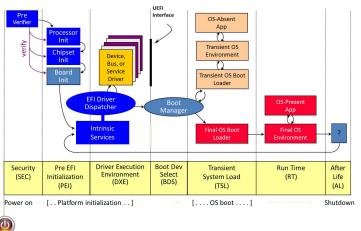


Figure: UEFI Boot Process<sup>1</sup>.

## Operating System (Boot) Loader

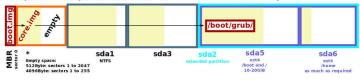
- General
  - How/Where to start the operating system?
  - What to do?
  - How many ways to boot?
  - How many types of OS?
- Disk Partition
  - MBR: Master Boot Record (1983).
  - GPT: GUID (Globally Unique Identifiers) Partition Table (2010s).
- GRUB: GRand Unified Boot system
  - Stage 1: a small boot.img inside the MBR.
  - Stage 1.5 (core.img): FS drivers after MBR.
  - Stage 2: Kernel Selection: Windows, Linux, BSD, etc.
- GRUB2
  - More flexible than GRUB legacy.
  - More automated than GRUB legacy.
  - Accept MBR and GPT.
  - Stage 1.5 (core.img): generated from diskboot.img.
  - No 1024 cylinder restriction.

## **GRUB Map**

#### **GNU GRUB 2**

Locations of boot.img, core.img and the /boot/grub directory

Example 1: an MBR-partitioned harddisc with sector size of 512 or 4096Bytes



Example 2: a GPT-partitioned harddisc with sector size of 512 or 4096Bytes



Figure: GRUB<sup>1</sup>.

<sup>&</sup>lt;sup>1</sup>Source Shmuel Csaba Otto Traian 2013

## init (SYSV legacy)

- File: /etc/inittab.
- Folders: /etc/rcX.d X = runlevel.
  - Seven (7) different runlevels:
    - 0 (shutdown).
    - 1 (single-user/admin).
    - 2 (multi-user non net).
    - 3 (standard).
    - 4 (N/A).
    - 5 (3+GUI).
    - 6 (reboot).
  - SXX-YYY: Start
  - KXX-YYY: Kill.
- One script at a time in order.
- dependency is set manually.

## UpStart - Ubuntu

- Developer: Ubuntu.
- Folder: /etc/init/.
- Control: initctl.
  - initctl list listing all processes managed by upstart.
- better support for hotplug devices.
- cleaner service management.
- faster service management.
- asynchronous.

## The All New "systemd"

- Replaces (SYSV) init and UpStart.
  - better concurency handling: Faster!
  - better dependencies handling: No more "S(tarts)" and "K(ills)".
  - better crash handling: automatic restart option.
  - better security: group protection from anyone including superusers.
  - simpler config files: reliable and clean scripts.
  - hotplug: dynamic start/stop.
  - supports legacy systems (init).
  - overhead reducing.
  - unified management way for all distros.
  - bloated: doing more with more resources.
  - linux specific: NOT portable.

## systemctl

```
for II in
   'systemctl list-unit-files | head -8; echo "(...)";
       systemctl list-unit-files| tail -8' \
   'systemd-analyze blame | wc -1; echo "===";
       systemd-analyze blame | head -15' \
   'systemctl --full | wc -1; echo "===";
       systemctl --full | head -10' \
   'systemctl list-units | wc -1; echo "===";
       systemctl list-units | head -10' \
   'systemctl list-units |grep .service|wc -l;echo "===";
       systemctl list-units|grep .service|head -10' \
   'systemctl list-units | grep ssh.service' \
   'systemctl status ssh.service' \
   'systemctl is-enabled ssh' \
   'journalctl' \
   'journalctl -b' \
dο
```

#### The End

- $\square$  This is the end of the presentation.
- extstyle ext
- This is the end of the presentation.