HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
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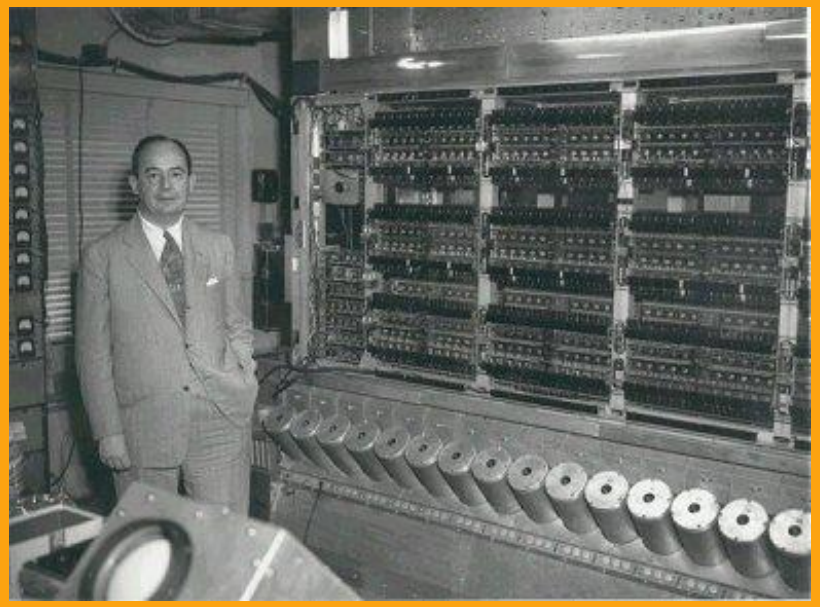
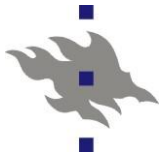
Computer systems- overview

Ch 1 - Ch 8 [Sta06]

Some material from Comp. Org I



John von Neumann and EDVAC, 1949



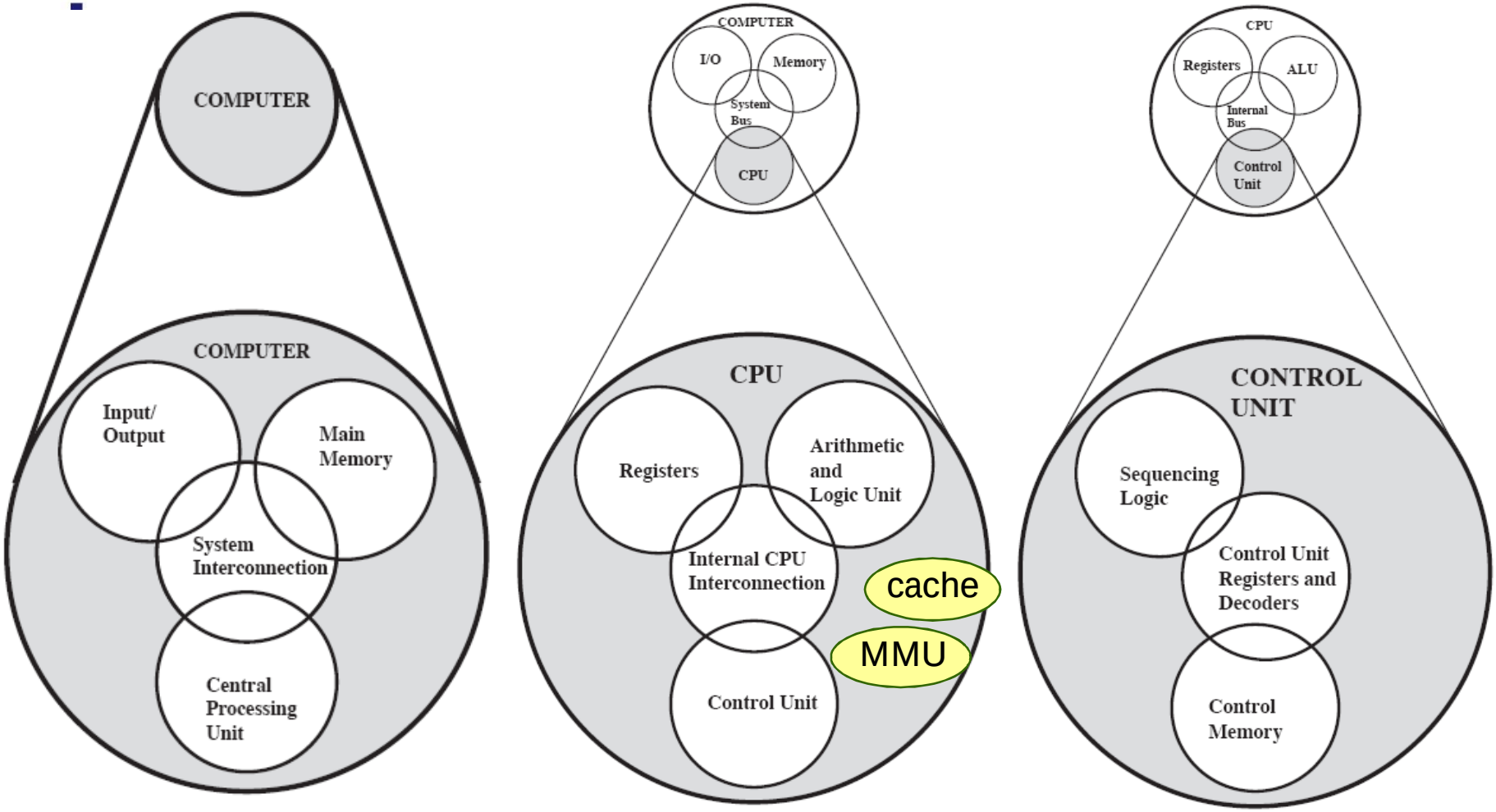
Content

- Structure
- OS view point
- Buses
- I/O-controller and memory-mapped I/O
- Memory hierarchy
- I/O layers
- Privileged mode
- Instruction cycle
- Interrupt handling

- Goal:
  - Remind what has already been covered on Comp. Org I

Structure of a computer (3)

Hardware vs Software



Control, Processing, Storage, Data movement

(Sta06 Fig 1.4, 1.5, 1.6)

Operating System's view point

User

Applications | Shell | System programs

System calls

Process management | Resource management

protection

OS

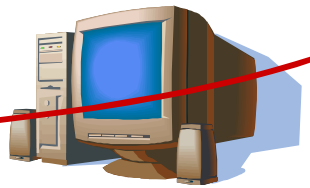
File system | Memory management

blocks

I/O management

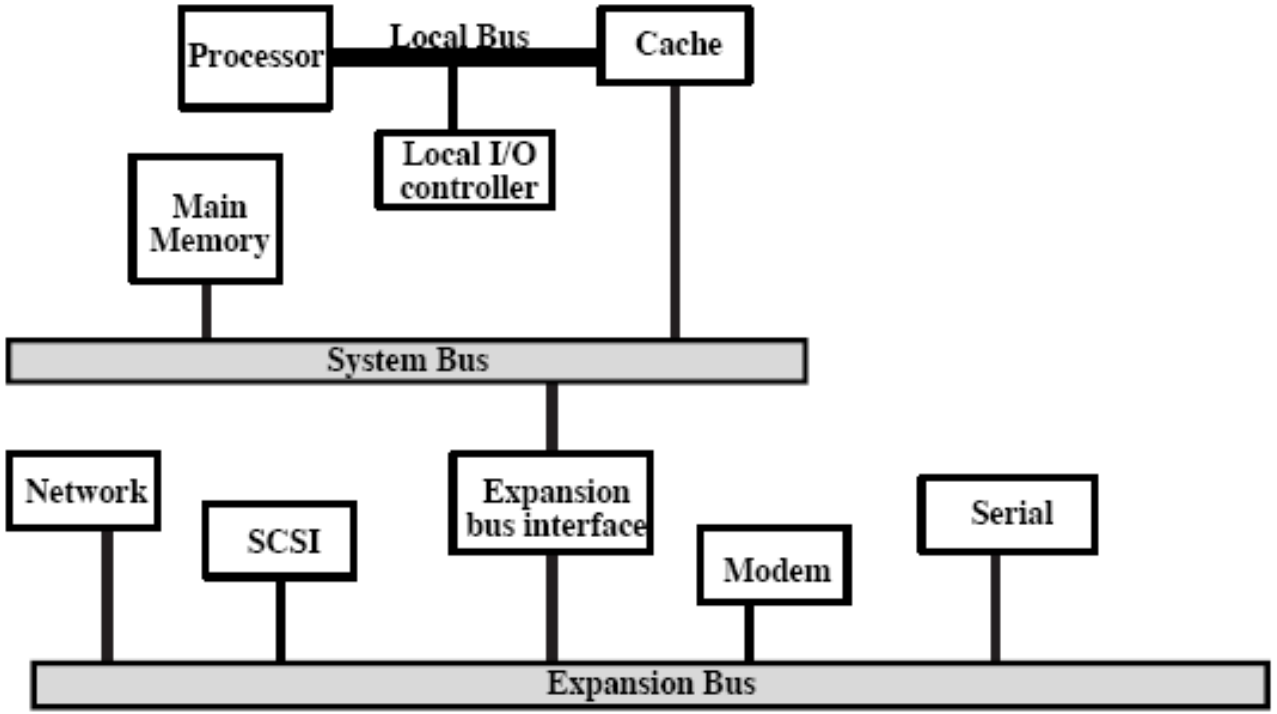
I/O module (Device controller) | Interrupt handling

Devices and device drivers



Buses

- Local (*Sisäinen*), System, I/O expansion
- Device controllers (*Laiteohjaimet*), NOTE: Sta06: I/O module

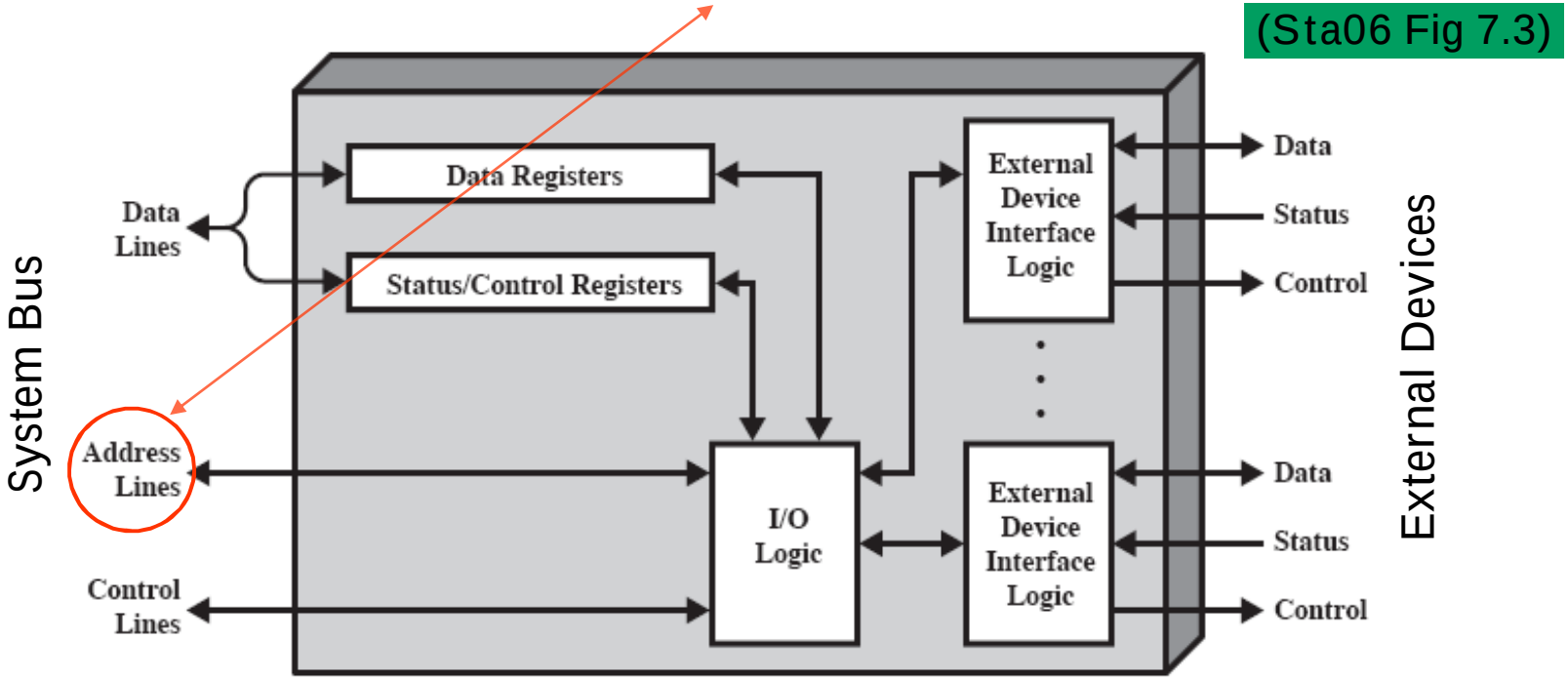


(a) Traditional Bus Architecture

(Sta06 Fig 3.18 a)

I/O controller and memory-mapped I/O

(Sta06 Fig 7.3)



- Device driver (*ajuri*) controls the device via controller's registers
- Driver refers to these registers as regular memory locations
  - Common memory references, like in load/store -instructions
  - Controller (*ohjain*) detects its own memory addresses on the bus
  - Device controller ~ 'intelligent' memory location

Memory hierarchy

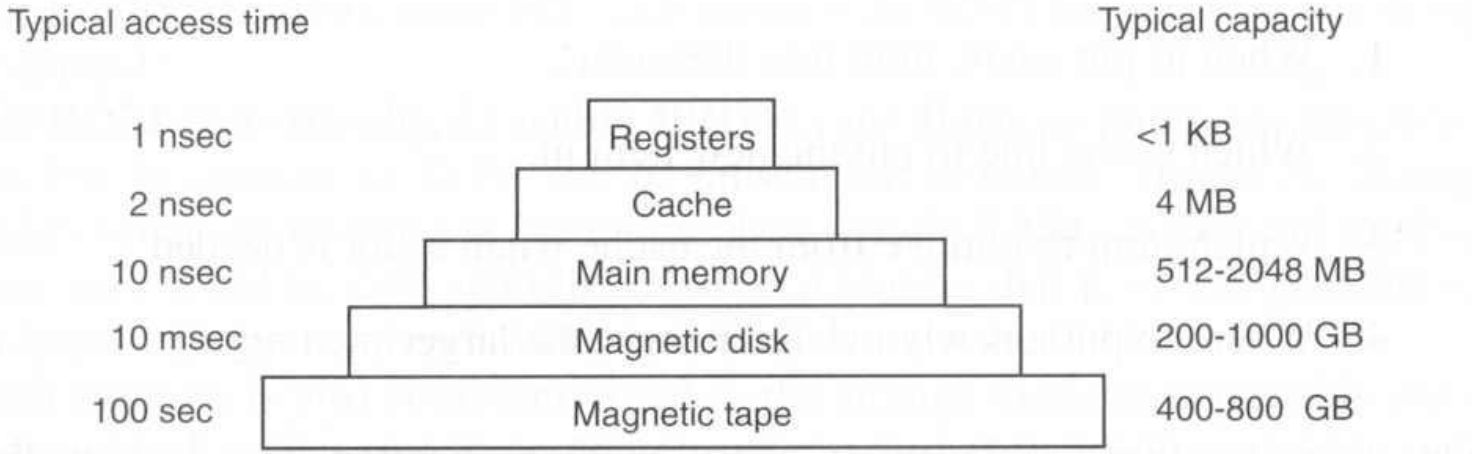
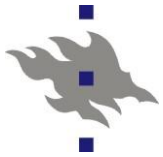


Figure 1-9. A typical memory hierarchy. The numbers are very rough approximations.

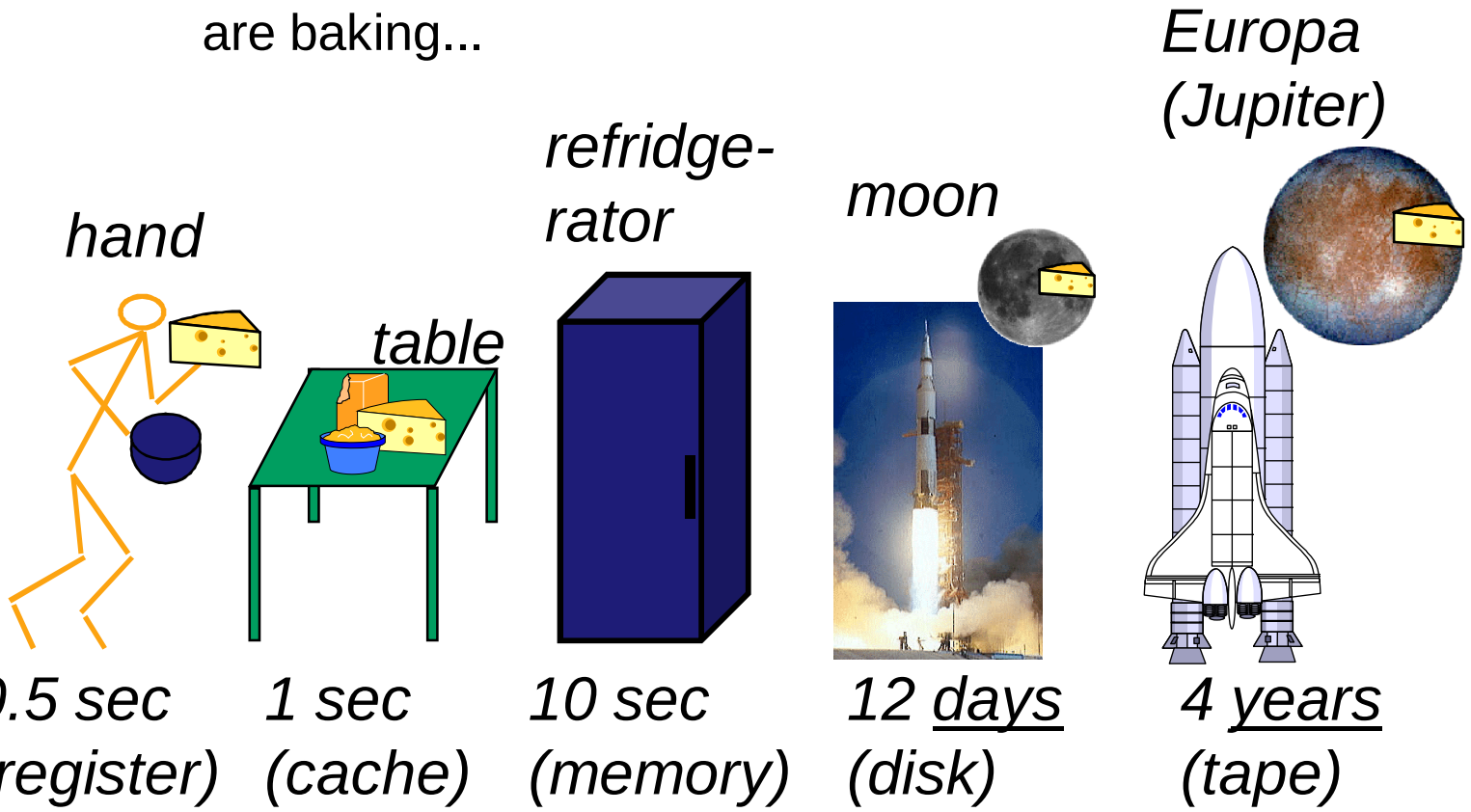
- Access time (*saantiaika*) (un?)dependent of the location
  - Registers, cache, main memory
  - Block buffering (*lohkopuskurointi)* (OS functionality!)
  - Magnetic and optical storage devices
- File servers (*tiedostopalvelimet*)
  - Network Attached Storage (NAS)
  - Storage Area Network (SAN)

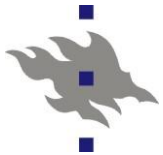
Tan08 Fig 1.9



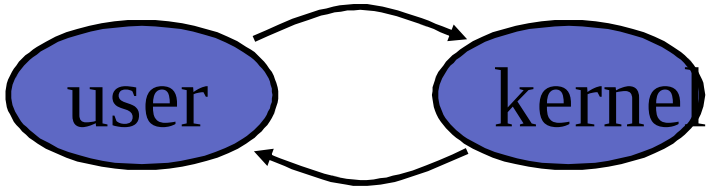
Teemu's cheese cake

- Register, on-chip cache, memory, disk, and tape speeds relative to times locating cheese for the cheese cake you are baking...





CPU execution modes



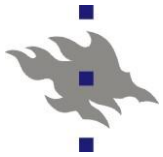
- Instruction privileges
  - Privileged (*etuoikeutetut*) and normal
- Memory protection
  - Memory area marked for a user and controlled access
- User mode *(käyttäjätila*)
  - May use only normal instructions
  - Can refer only to its own memory area
- Kernel mode (*etuoikeutettu tila*)
  - Can use all instructions, including the privileges ones
  - May refer to all memory locations, including the kernel data structures of the operating system

privileged, kernel

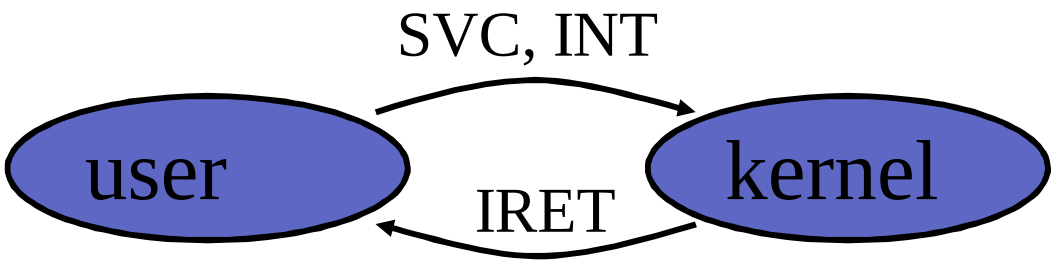
user, normal

user mode, normal mode

kernel mode, privileged mode

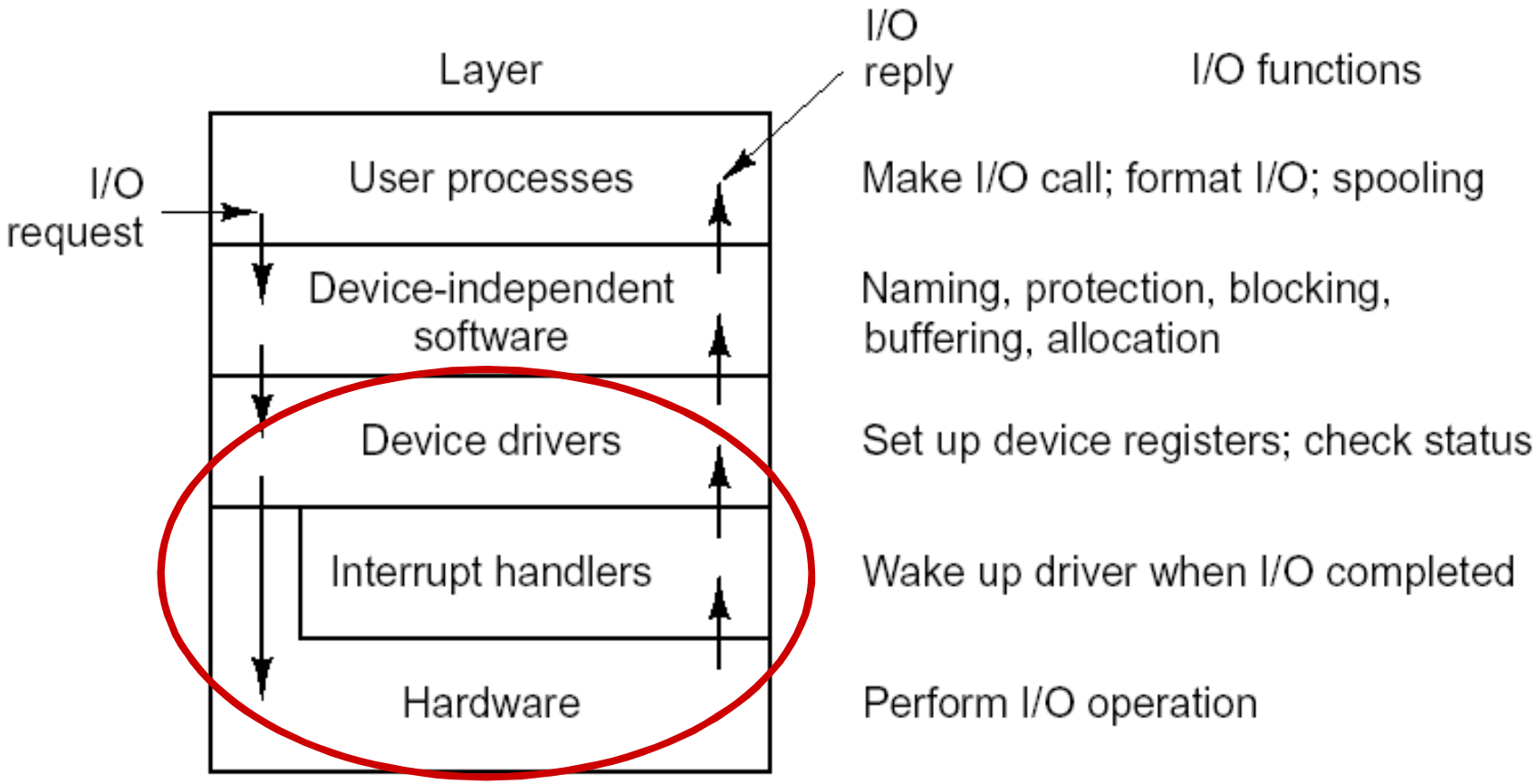


Mode change

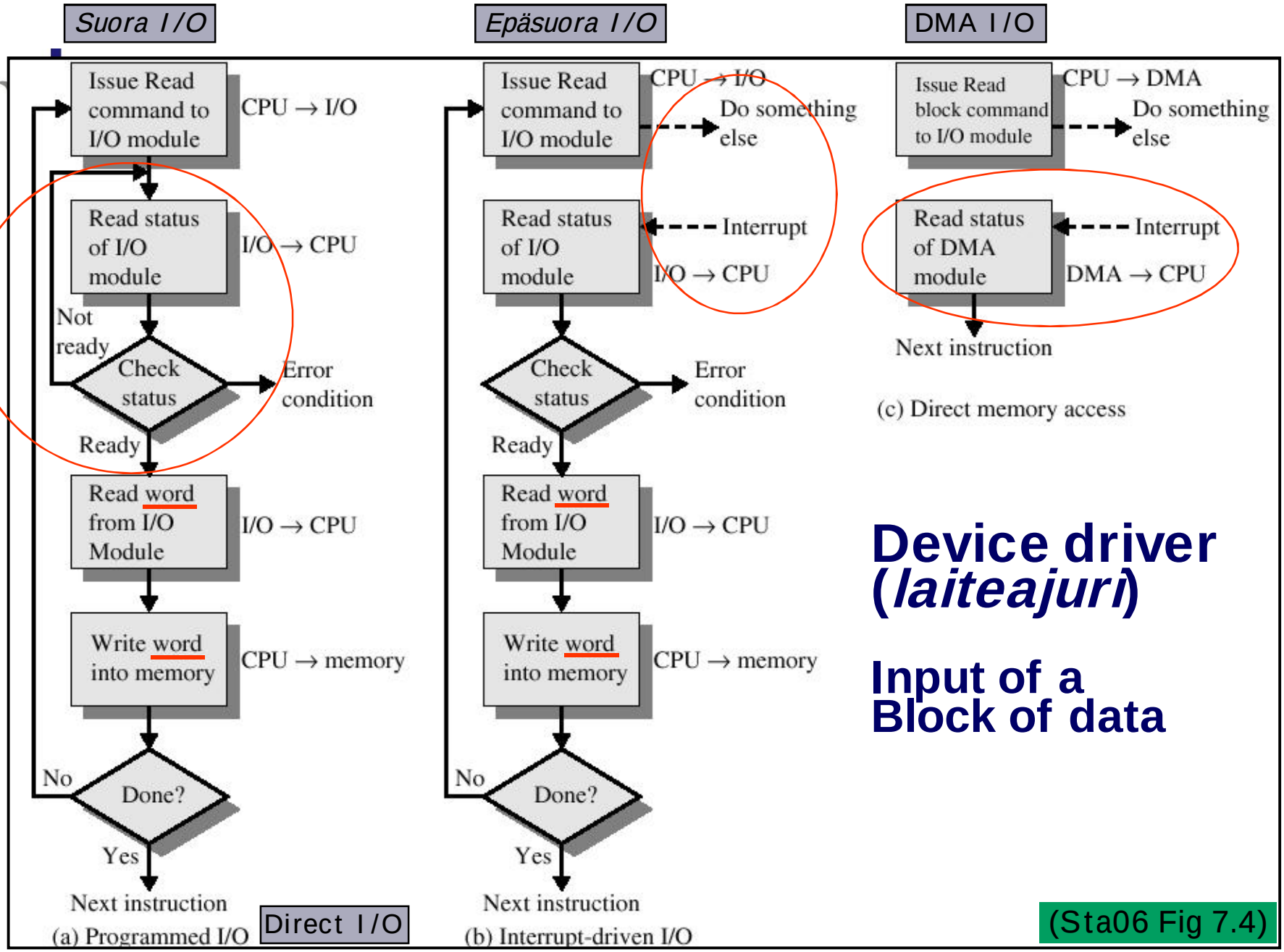


- User mode, normal mode → kernel mode, privileged mode
  - Interrupt or special SVC instructions (service request)
  - Interrupt handler checks the right for mode change
- Kernel mode → User mode
  - Privileged instuction, for example IRET (return from interrupt)
  - Returns the cotnrol and mode as they were before the mode change
    - Very similar with return from a subroutine

Layers of the I/O system



(Tan08, Modern Oper. Syst, Fig 5-17)

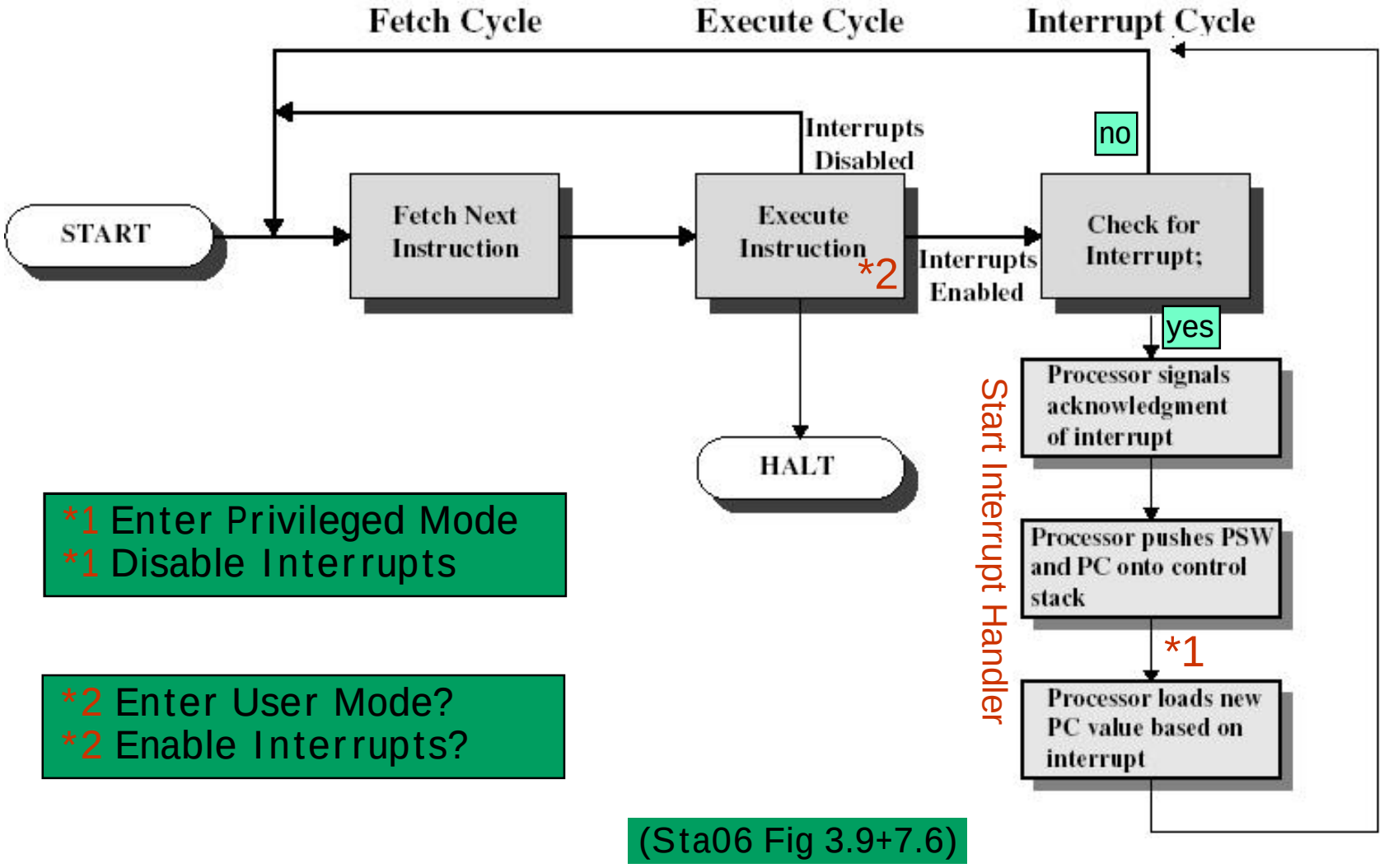


Device driver (*laiteajuri*)

Input of a Block of data

(Sta06 Fig 7.4)

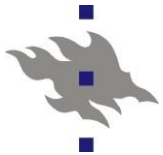
CPU Instruction cycle (*käskysykli)*



*1 Enter Privileged Mode
*1 Disable Interrupts

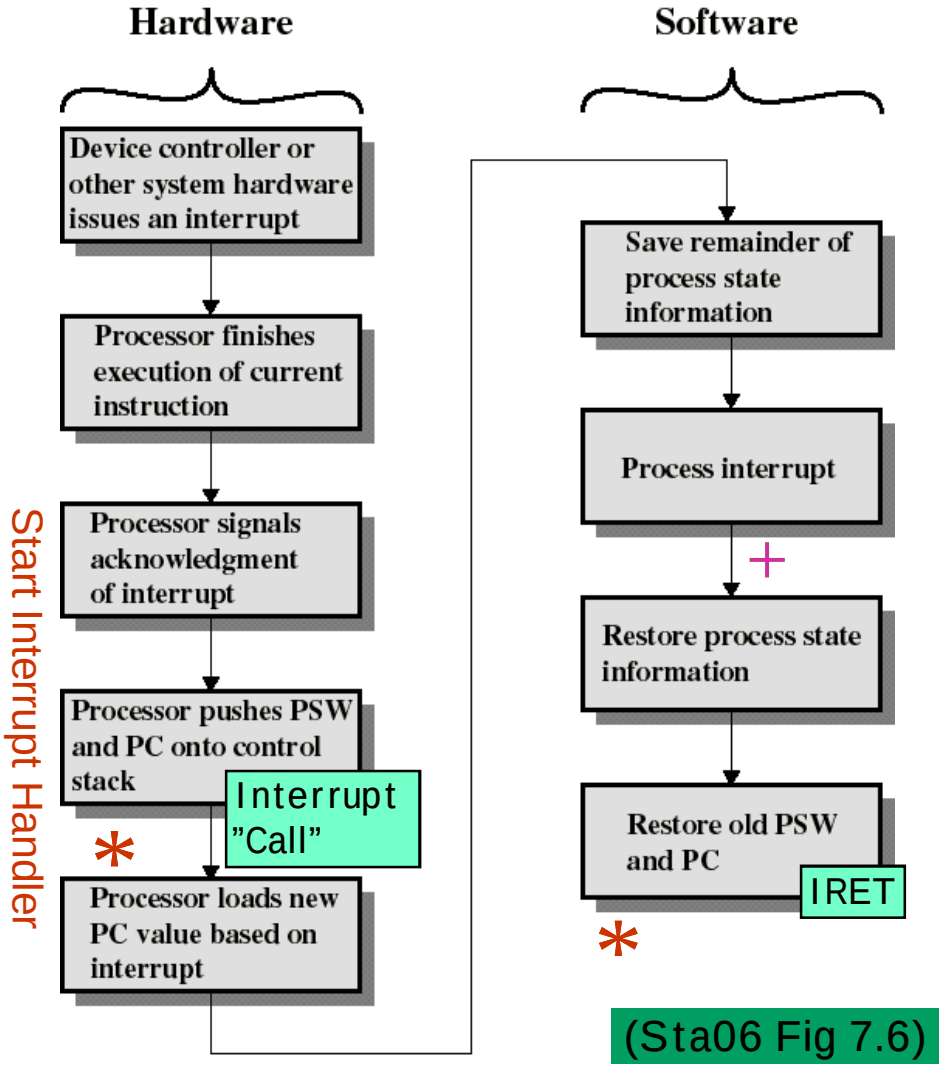
*2 Enter User Mode?
*2 Enable Interrupts?

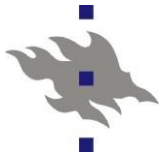
(Sta06 Fig 3.9+7.6)



Interrupt handler (*keskeytyskäsittelijä*)

* Privileged mode vs. User mode
* Interrupt disabling vs. enabling
+ Scheduling *(vuorotus)*





Review Questions

- Course book: at the end of each chapter
  - Answers in the chapter text
- From earlier courses: (see web)
  - Mainly in Finnish, created in project in earlier courses
- Create yourself:
  - List the most difficult and/or important issues
- Think at least about these:
  - Main parts of a computing system?
  - DMA: principles and functionalites?
  - Obligatory hardware and its features?
  - How to make CPU to execute normal user program? Operating system?