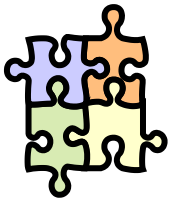
UNIX/Linux

Introduction

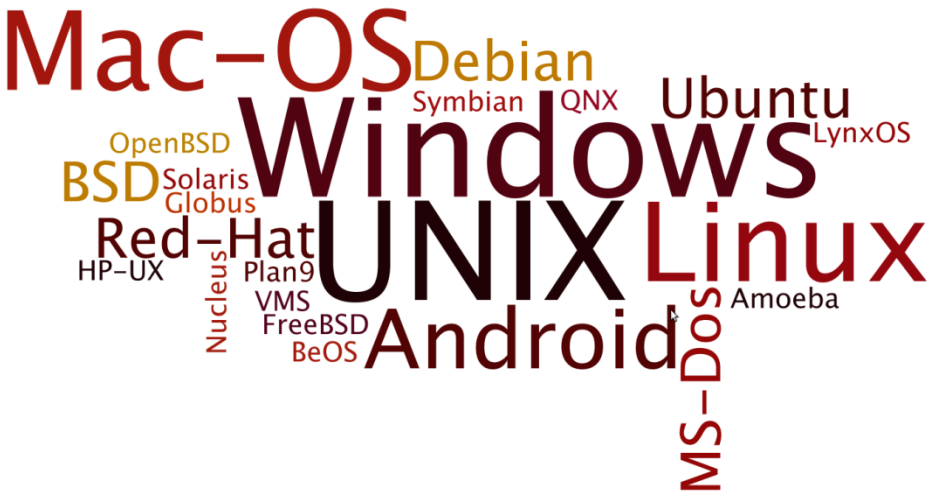
Summary

OS objectives

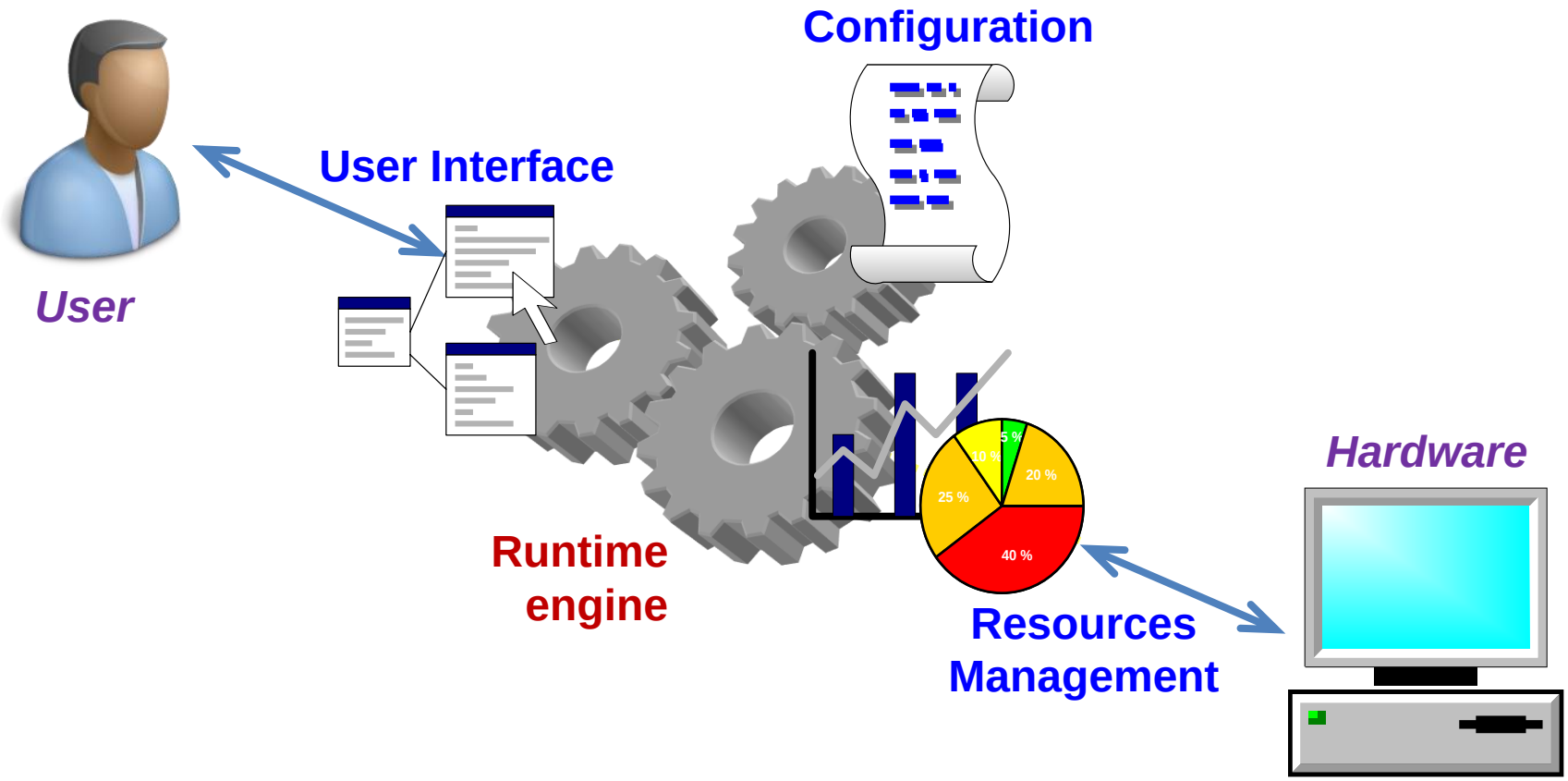


OS types

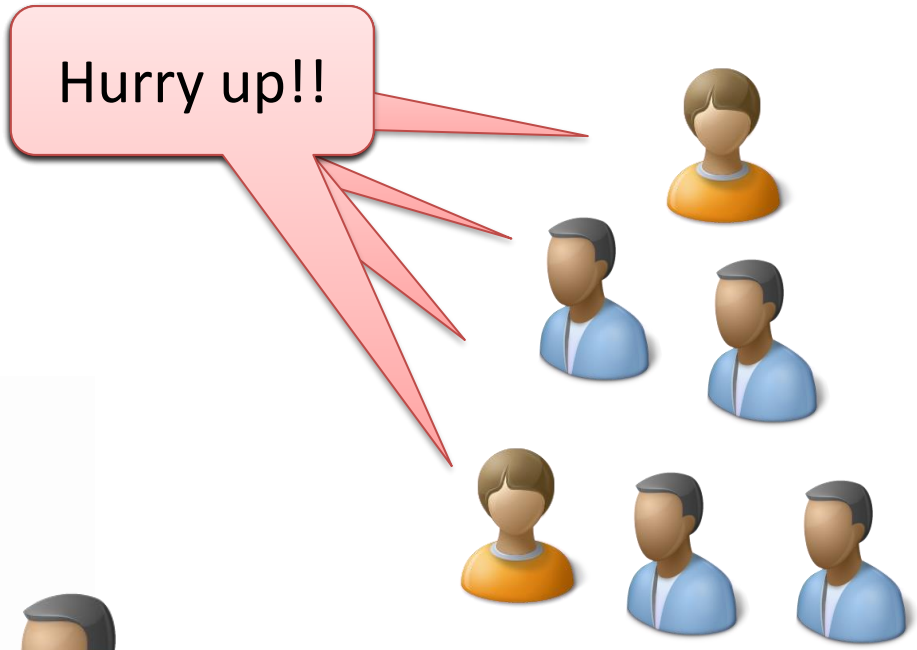
LINUX genesis



OS ?

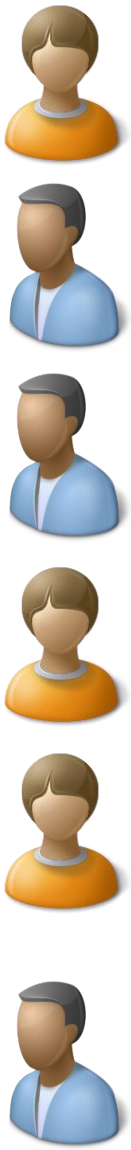

Configuration
User Interface
User
Runtime
engine
Resources
Management
Hardware
5 %
10 %
20 %
25 %
40 %

60’s - One machine = One user

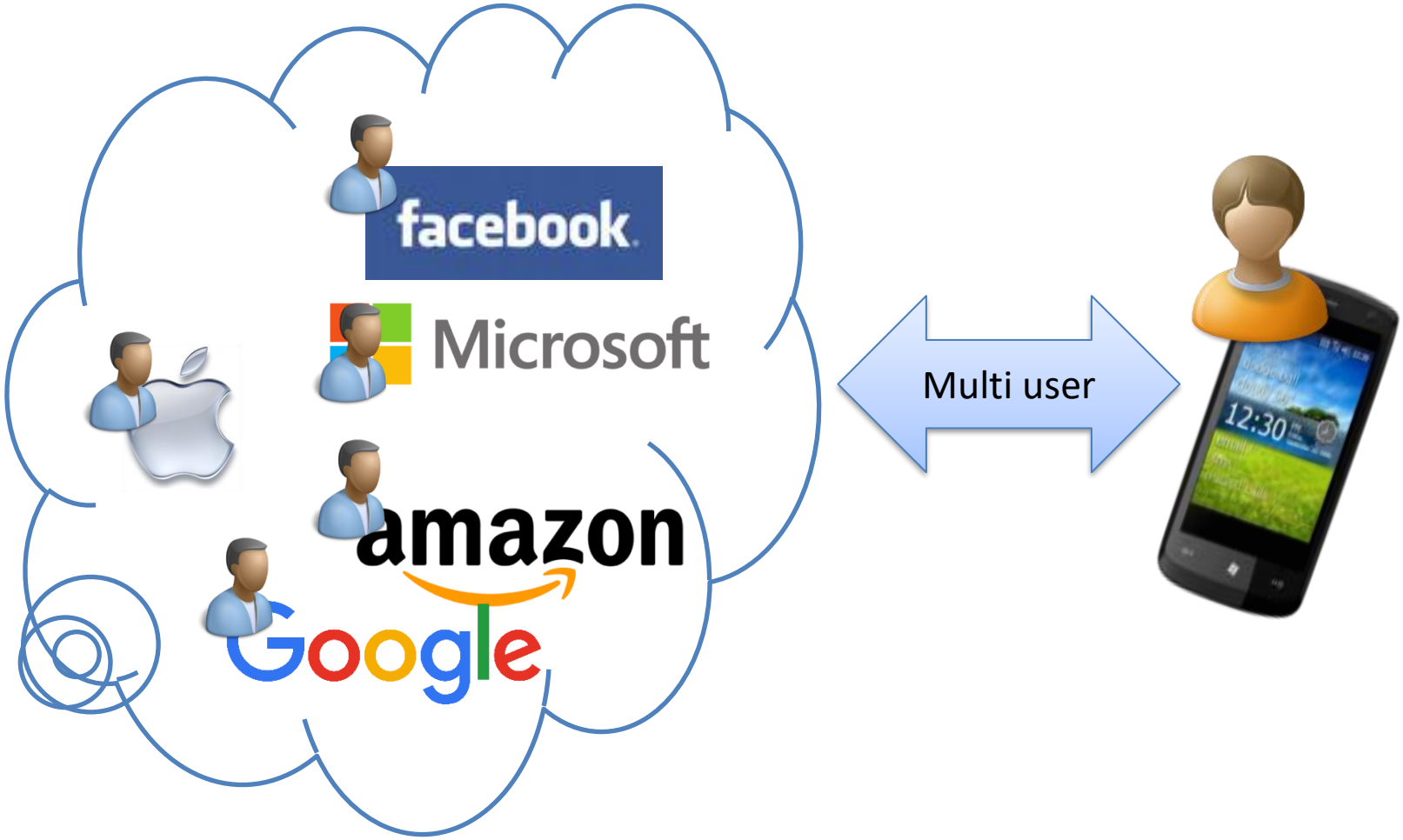


70’s – Time sharing

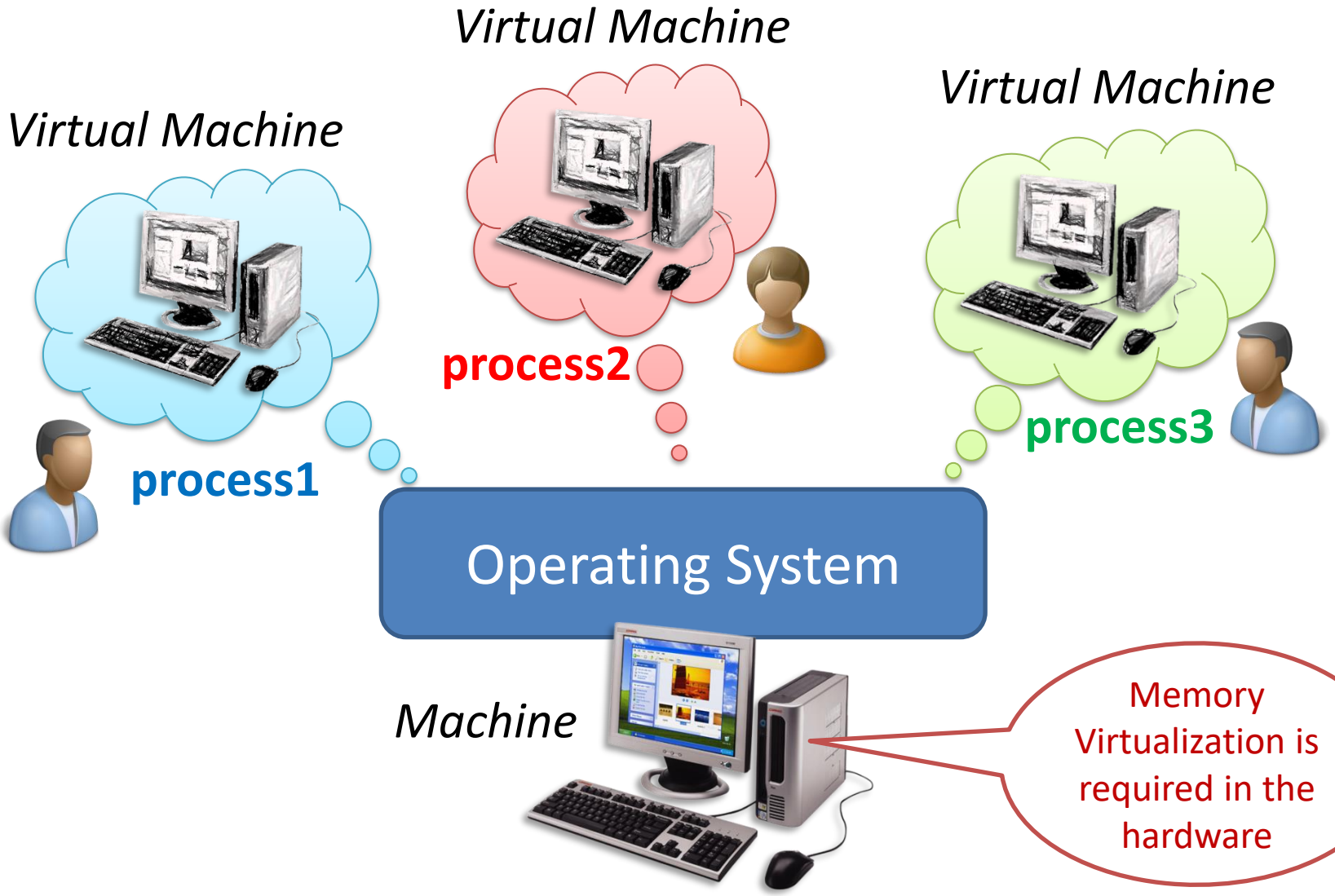
Multi user



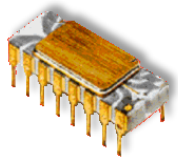
2010 - Mobile



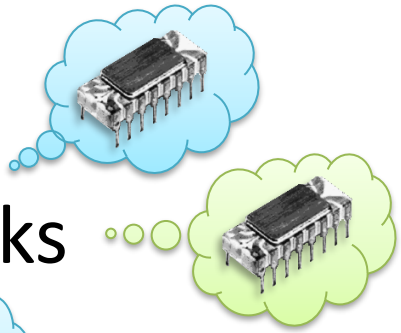
OS sharing mechanism



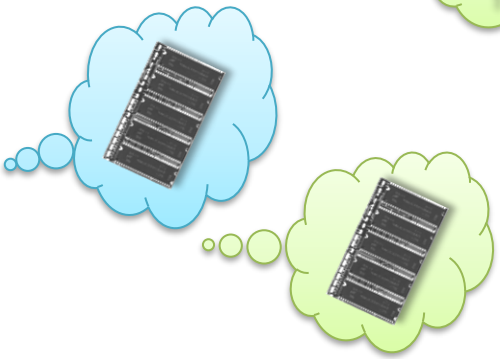
Role of an OS



Virtual CPU → Schedule tasks



Virtual RAM → MMU



Virtual I/O → Driver management

- File system
  - Byte streams
  - User interface

OS Layers

SOFT

HARD

User environment

- TTY shell
- GUI shell

Developer environment

- *System API (LIBC, POSIX, Win32 …)*
- *OOP framework (JAVA, .NET …)*

Services

Virtualized I/O

- Persistence → HDD, SSD, File System …
- IPC → pipes, sockets …
- Peripherials & Stacks → Serial, USB, Ethernet …

Drivers

Memory

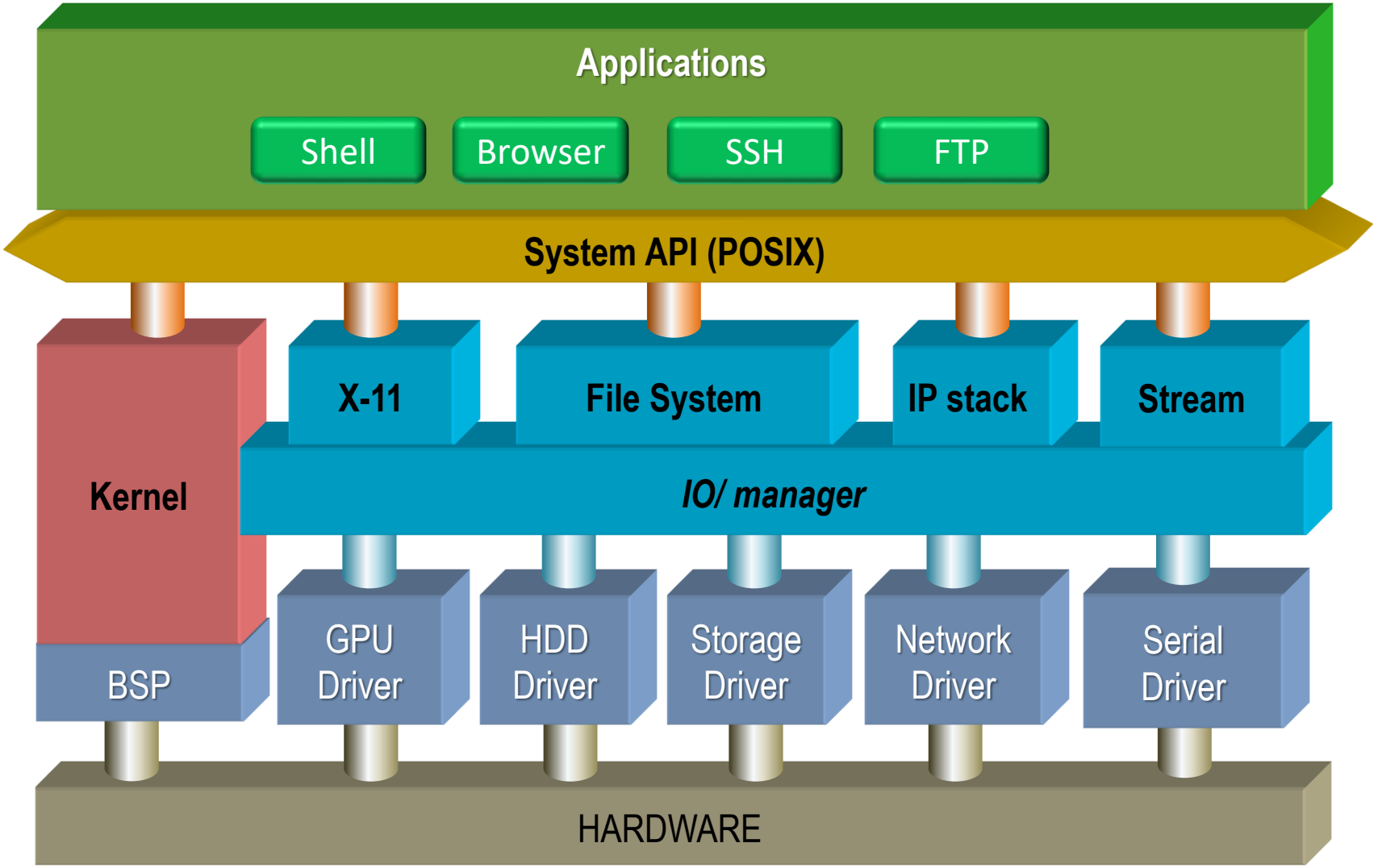
- MMU → processus → protection

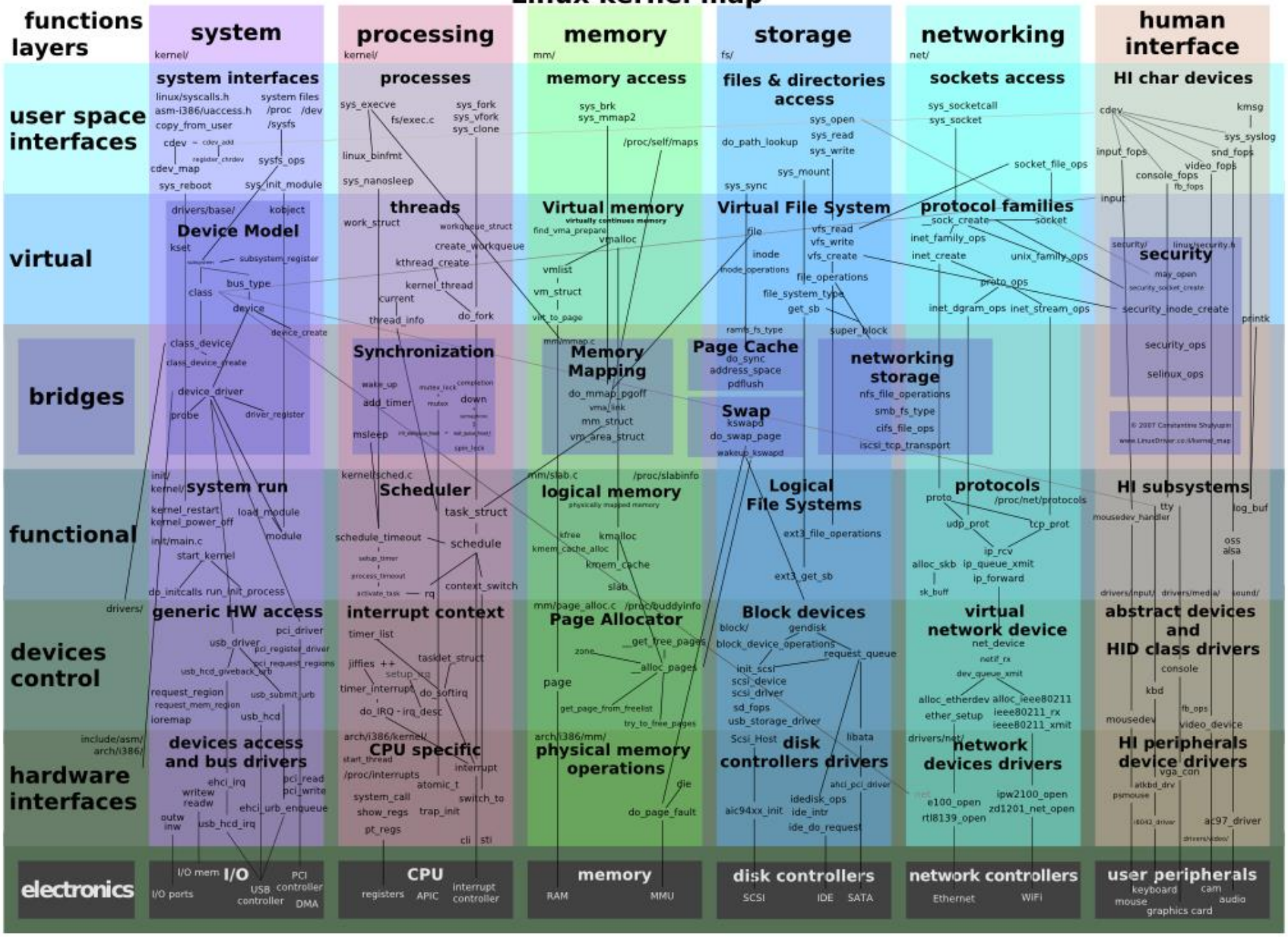
Execution

- Scheduler→ thread → synchronization

Kernel

OS logical organization




Linux kernel map
functions layers
system
kernel/
processing
kernel/
memory
mm/
storage
fs/
networking
net/
human interface
user space interfaces
system interfaces
linux/syscalls.h
asm-i386/uaccess.h
copy_from_user
system files
/proc
/dev
/sysfs
cdev
cdev_add
register_chrdev
cdev_map
sysfs_ops
sys_reboot
sys_init_module
processes
sys_execve
fs/exec.c
sys_fork
sys_vfork
sys_clone
linux_binfmt
sys_nanosleep
memory access
sys_brk
sys_mmap2
/proc/self/maps
files & directories access
sys_open
sys_read
sys_write
do_path_lookup
sys_mount
sys_sync
sockets access
sys_socketcall
sys_socket
socket_file_ops
HI char devices
cdev
kmsg
sys_syslog
input_fops
snd_fops
video_fops
console_fops
fb_fops
input
virtual
drivers/base/
kobject
Device Model
kset
subsystem
subsystem_register
bus_type
class
device
device_create
threads
work_struct
workqueue_struct
create_workqueue
kthread_create
kernel_thread
current
thread_info
do_fork
Virtual memory
virtually continuous memory
find_vma_prepare
vmalloc
vmlist
vm_struct
virt_to_page
Virtual File System
file
inode
inode_operations
vfs_read
vfs_write
vfs_create
file_operations
file_system_type
get_sb
ramfs_fs_type
super_block
protocol families
_sock_create
socket
inet_family_ops
inet_create
unix_family_ops
proto_ops
inet_dgram_ops
inet_stream_ops
security/
linux/security.h
security
may_open
security_socket_create
security_inode_create
security_ops
selinux_ops
printk
bridges
class_device
class_device_create
device_driver
probe
driver_register
Synchronization
wake_up
mutex_lock
completion
add_timer
mutex
down
msleep
spin_lock
Memory Mapping
mm/mmap.c
do_mmap_pgoff
vma_link
mm_struct
vm_area_struct
Page Cache
do_sync
address_space
pdflush
Swap
kswapd
do_swap_page
wakeup_kswapd
networking
storage
nfs_file_operations
smb_fs_type
cifs_file_ops
iscsi_tcp_transport
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www.LinuxDriver.co.il/kernel_map
functional
init/
kernel/
system run
kernel_restart
kernel_power_off
load_module
module
init/main.c
start_kernel
do_initcalls
run_init_process
kernel/sched.c
Scheduler
task_struct
schedule_timeout
schedule
setup_timer
process_timeout
activate_task
rq
context_switch
mm/slab.c
/proc/slabinfo
logical memory
physically mapped memory
kfree
kmalloc
kmem_cache_alloc
kmem_cache
slab
Logical File Systems
ext3_file_operations
ext3_get_sb
protocols
proto
/proc/net/protocols
udp_prot
tcp_prot
ip_rcv
alloc_skb
ip_queue_xmit
ip_forward
sk_buff
HI subsystems
tty
mousedev_handler
log_buf
oss
alsa
drivers/input/
drivers/media/
sound/
devices control
drivers/
generic HW access
pci_driver
usb_driver
pci_register_driver
pci_request_regions
usb_hcd_giveback_urb
request_region
request_mem_region
ioremap
usb_submit_urb
usb_hcd
interrupt context
timer_list
jiffies ++
tasklet_struct
setup_irq
timer_interrupt
do_softirq
do_IRQ
irq_desc
mm/page_alloc.c
/proc/buddyinfo
Page Allocator
__get_free_pages
zone
_alloc_pages
page
get_page_from_freelist
try_to_free_pages
Block devices
block/
gendisk
block_device_operations
request_queue
init_scsi
scsi_device
scsi_driver
sd_fops
usb_storage_driver
Scsi_Host
libata
disk controllers drivers
ahci_pci_driver
idedisk_ops
ide_intr
ide_do_request
aic94xx_init
virtual network device
net_device
netif_rx
dev_queue_xmit
alloc_etherdev
alloc_ieee80211
ether_setup
ieee80211_rx
ieee80211_xmit
drivers/net/
network devices drivers
e100_open
ipw2100_open
zd1201_net_open
rtl8139_open
abstract devices and HID class drivers
console
kbd
fb_ops
mousedev
video_device
hardware interfaces
include/asm/
arch/i386/
devices access and bus drivers
ehci_irq
writew
readw
pci_read
pci_write
ehci_urb_enqueue
outw
inw
usb_hcd_irq
arch/i386/kernel/
CPU specific
start_thread
/proc/interrupts
interrupt
atomic_t
system_call
switch_to
show_regs
trap_init
pt_regs
cli
sti
arch/i386/mm/
physical memory operations
die
do_page_fault
HI peripherals device drivers
vga_con
atkbd_drv
psmouse
i8042_driver
ac97_driver
drivers/video/
electronics
I/O mem
I/O
PCI controller
I/O ports
USB controller
DMA
CPU
registers
APIC
interrupt controller
memory
RAM
MMU
disk controllers
SCSI
IDE
SATA
network controllers
Ethernet
WiFi
user peripherals
keyboard
cam
mouse
audio
graphics card

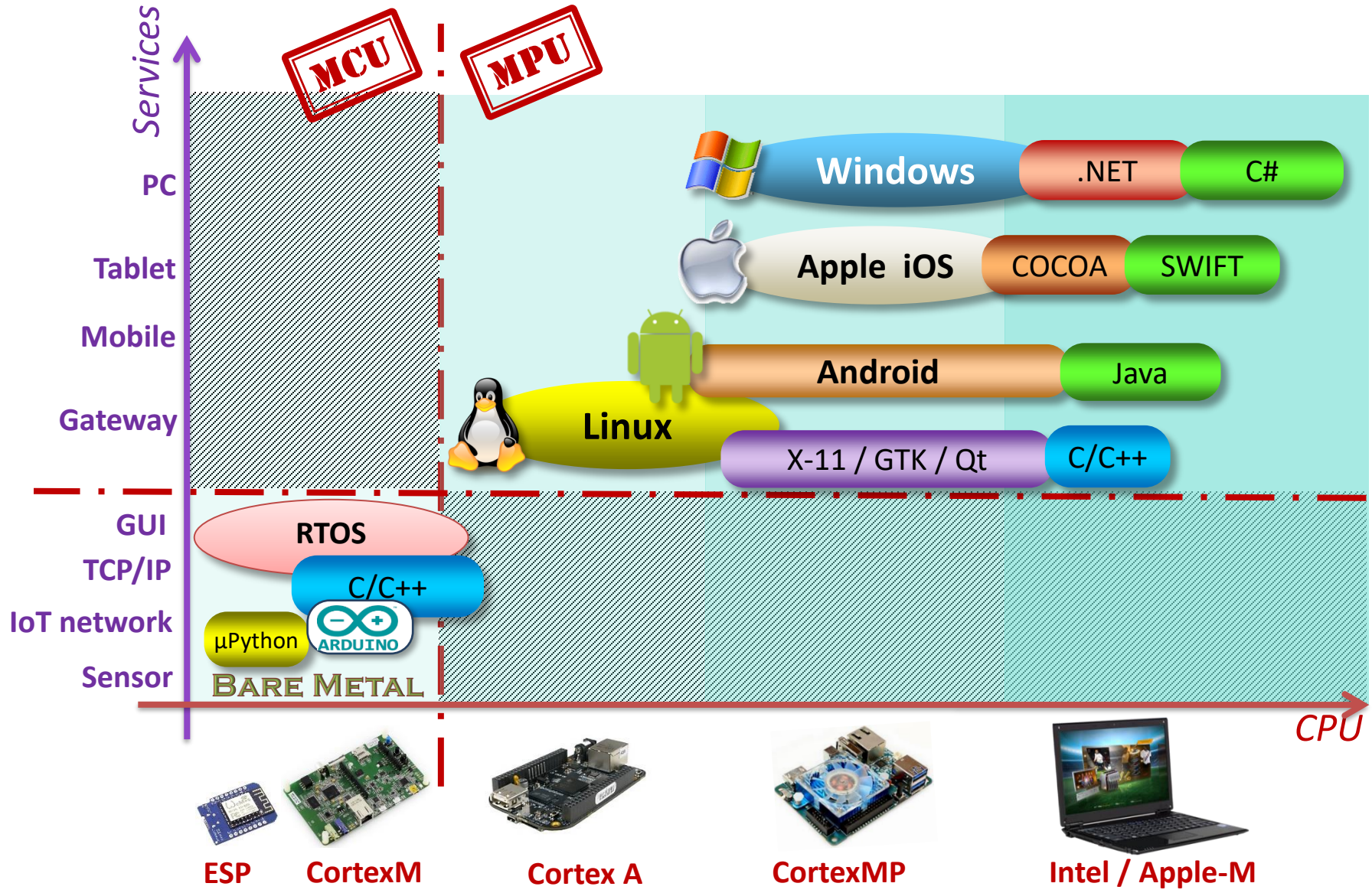
OS landscape

- Universal → *Kernel + Drivers + Services*
  - Unix / Linux
  - Windows

- Embedded → *Kernel + (Drivers + Services)*
  - Yocto
  - QNX

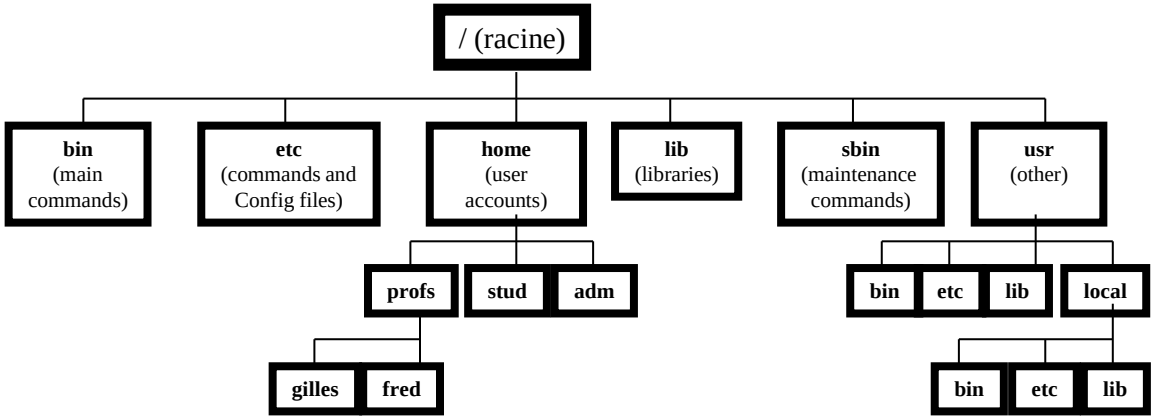
- RTOS → *Kernel (+ Drivers)*
  - FreeRTOS
  - ThreadX
  - Nucleus

General HARD/SOFT landscape



Linux from a user perspective

- File system



- Command shell & Packages
  - BASH, APT
- Graphical interface
  - X11, GTK, Qt, etc.
  - Browser,

OS from a developer perspective

Specific
Optimized

Openness (SDK)
Portability

Firmware/RTOS

OS

Dedicated software

Portable software

Unix from a developer perspective

- **Developer toolchain**
  - GCC, G++, GDB, make, cmake, etc.
  - objdump, pmap, ldd, git etc.

- **System API**
  - C library (`printf, fork, etc`.)
    - Prototypes definitions (includes)
  - POSIX extentions (`pthread_t, mmap, etc`.)
    - includes and libraries (pthread, etc.)