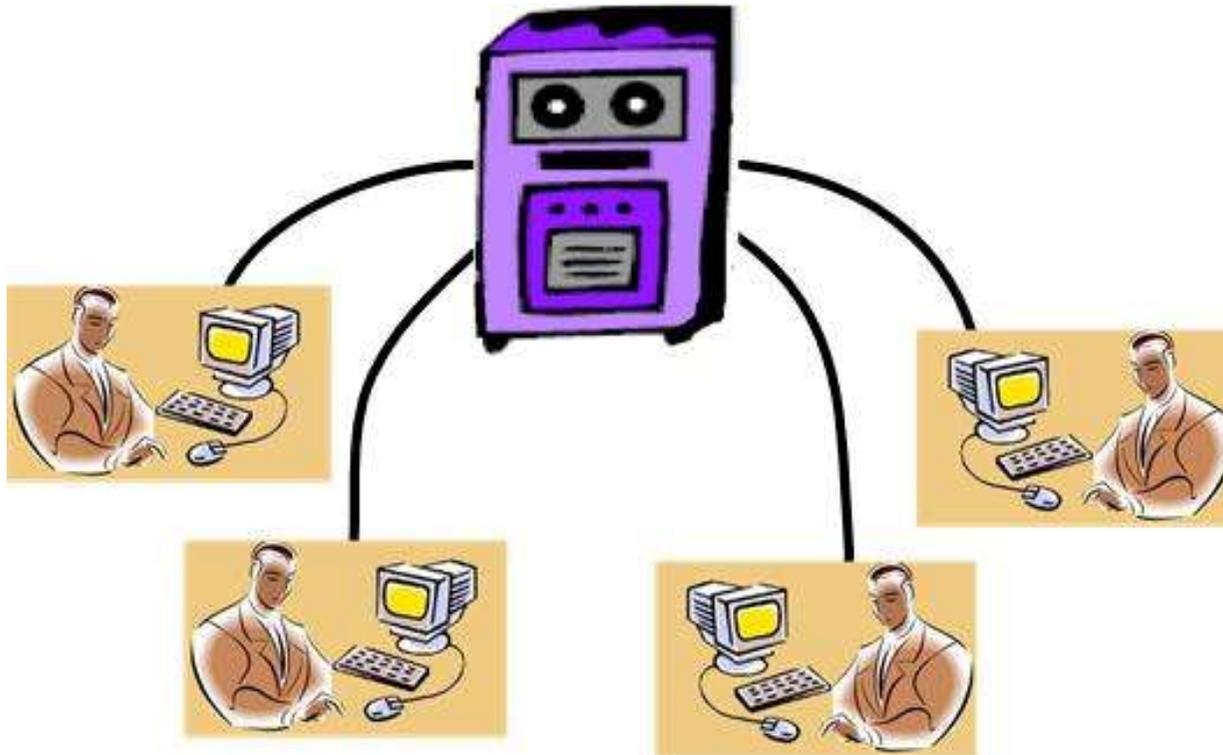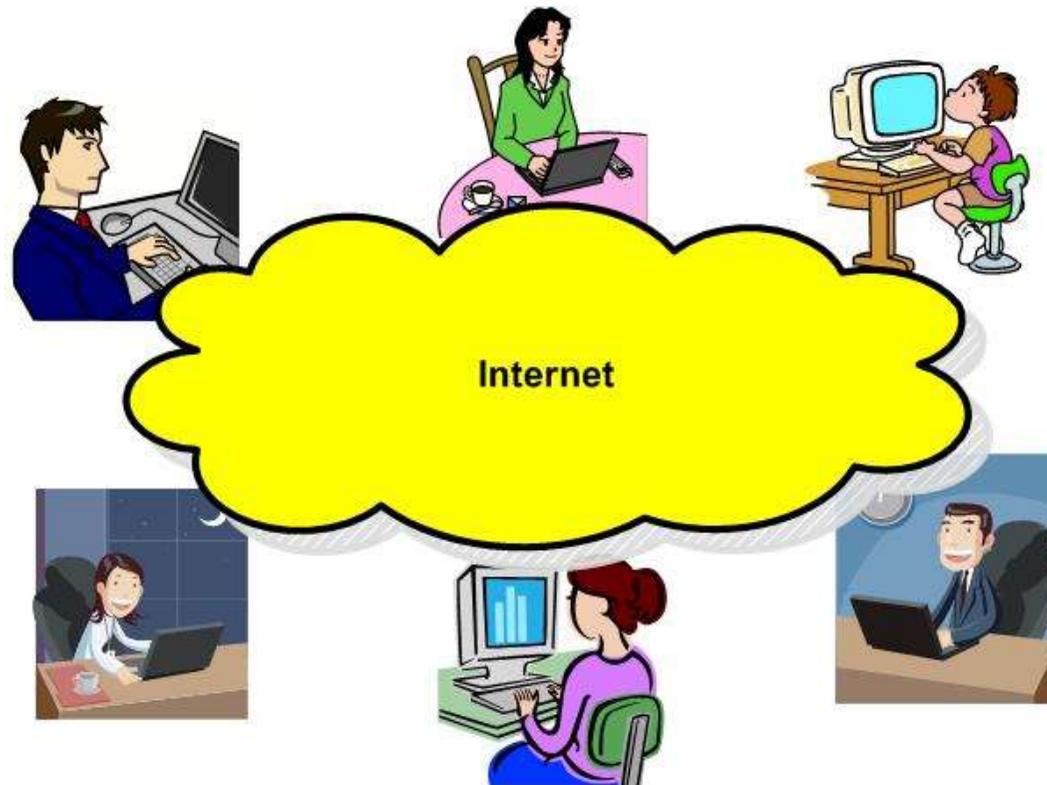# Embedded System

Change of Computing Paradigm

- Mainframe computing
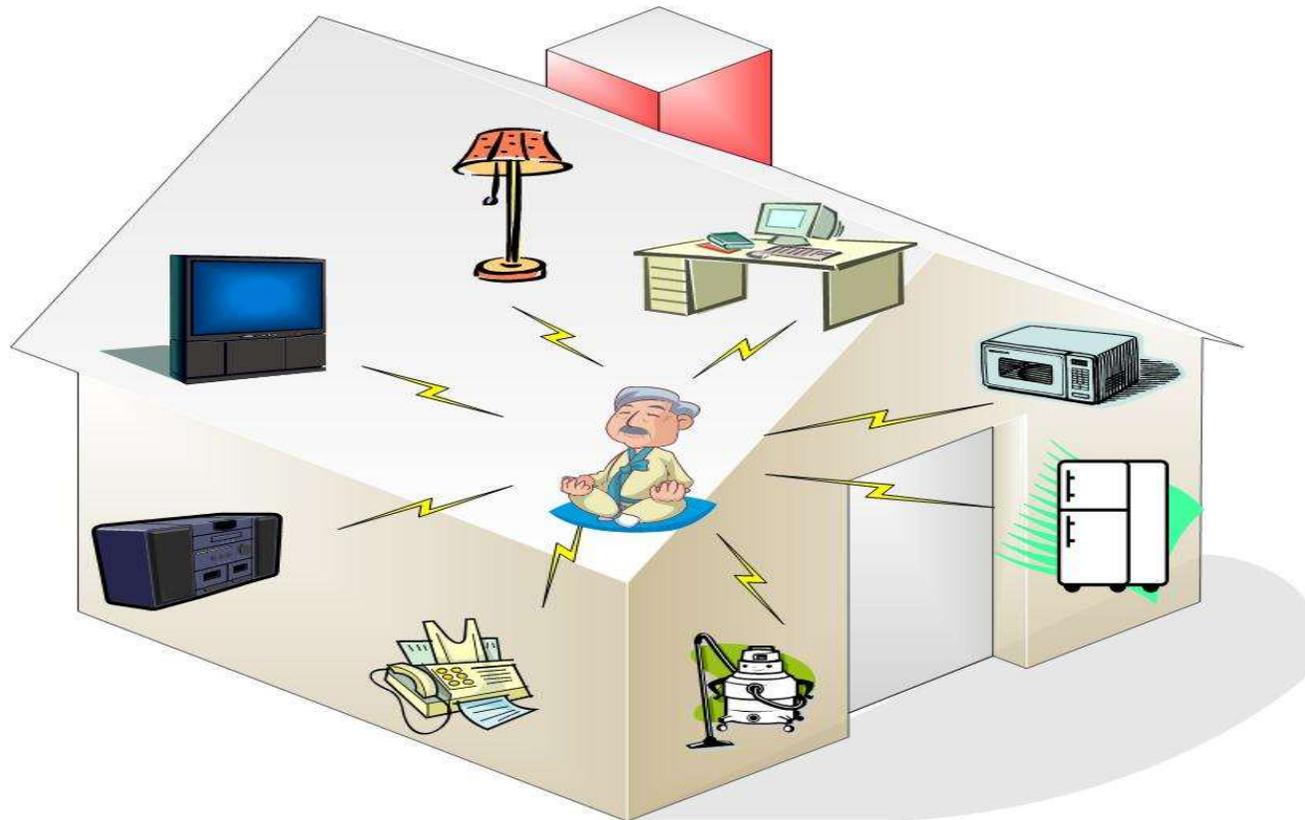 - ✓ One computer, many people (1:N)

Change of Computing Paradigm

- Desktop computing
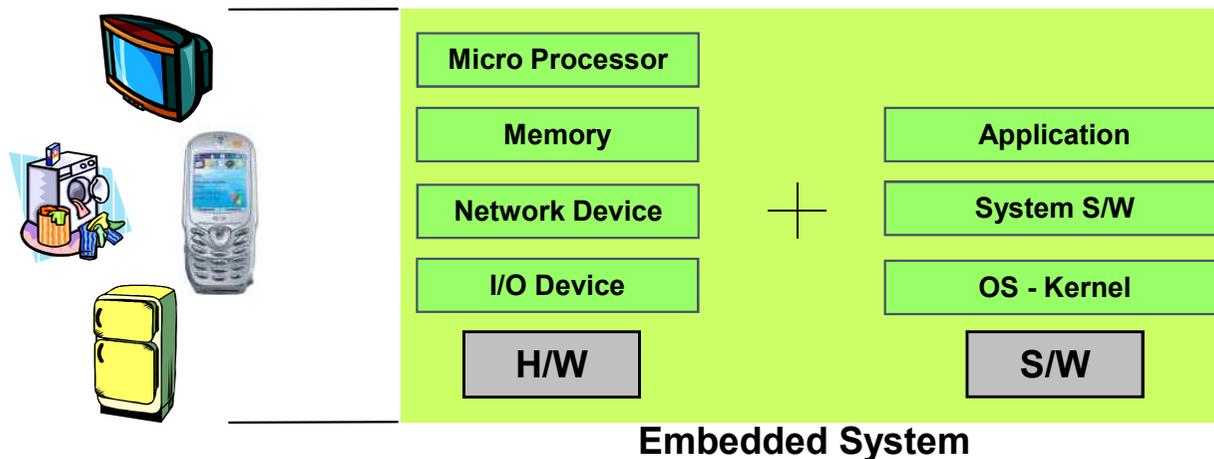 - ✓ One computer, one person (1:1)

Change of Computing Paradigm

- Internet of Things (IoT)
  - ✓ Many computers, one person (N:1)

IoT Computing Environment

- Every thing has computing and communication capability
- Embedded Systems Everywhere

Embedded Systems ?

- Embedded systems
    - ✓ Computer inside a product (or a system)
    - ✓ Device that includes a programmable computer but is not itself a general-purpose computer
    - ✓ A system that performs a specific purpose by combining computer hardware and software

Micro Processor	
Memory	Application
Network Device	System S/W
I/O Device	OS - Kernel
H/W	**S/W**

Embedded System

Embedded System Hardware

- Embedded System Hardware
  - ✓ Processor : processes program instructions
  - ✓ Memory : stores data
  - ✓ I/O device : connects external devices
  - ✓ Network : provides network

H/W 항목	PC	임베디드 시스템
프로세서	고성능 탑재	최소한의 성능 탑재
메모리	대용량 메모리	최소한의 메모리 사용
보조기억장치	다양함:HDD,ODD,DVD	거의 사용 안 함 또는 플래시 메모리
주변장치	다양함:KBD,MOUSE,SPKR	필요한 장치만 사용

Embedded System Software

- Embedded System Software
  - ✓ OS : RTOS, Embedded Linux
  - ✓ System SW : OS API, Device Driver, Network API, …
  - ✓ Application SW

S/W 항목	PC	임베디드 시스템
OS	Windows	Real-Time OS, Linux
시스템 S/W	Windows API	Real-Time OS & Linux API
응용 S/W	HDD에서부터 수행	메모리에서부터 수행
개발환경	Visual Studio .NET	교차개발환경

Embedded Systems

Hardware
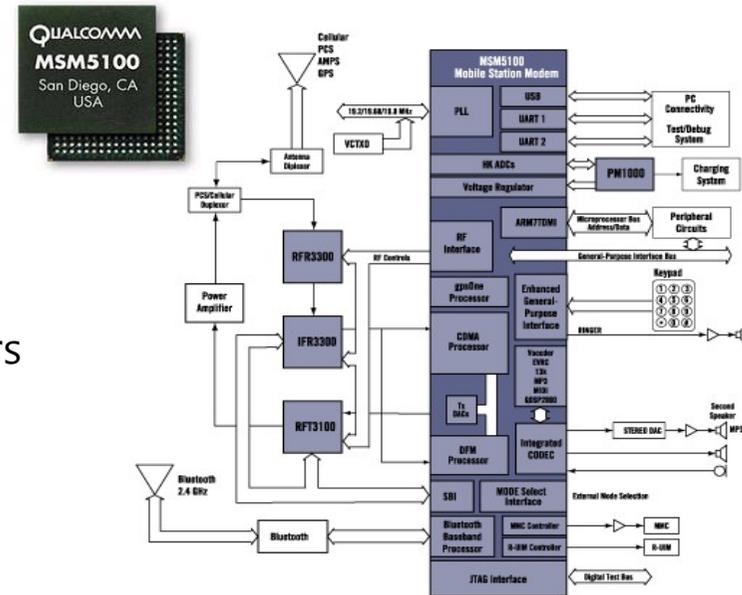 Higher integration-level
  Higher performance
  Lower power consumption
  Higher flexibility in control
  Emergence of various new devices

Software
  Closer to complete operating systems
  Higher needs for various middleware
  More diverse standards
  Plug & Play application software

Hardware Trend: Processor Part

UART

LCD control

DRAM control

ARM

Other IOs

Flash control

USB

Intel XScale

TI OMAP

Hardware Trend: Comm. Part

- Communication modules
  - ✓ RF communication modem
    - ➢ Protocol processing SoC + RF components
    - ➢ MSM series from Qualcomm
  - ✓ RF communication module package
    - ➢ All in one package
    - ➢ Direct interface to general purpose processors

Additional APIs (system programming APIs)
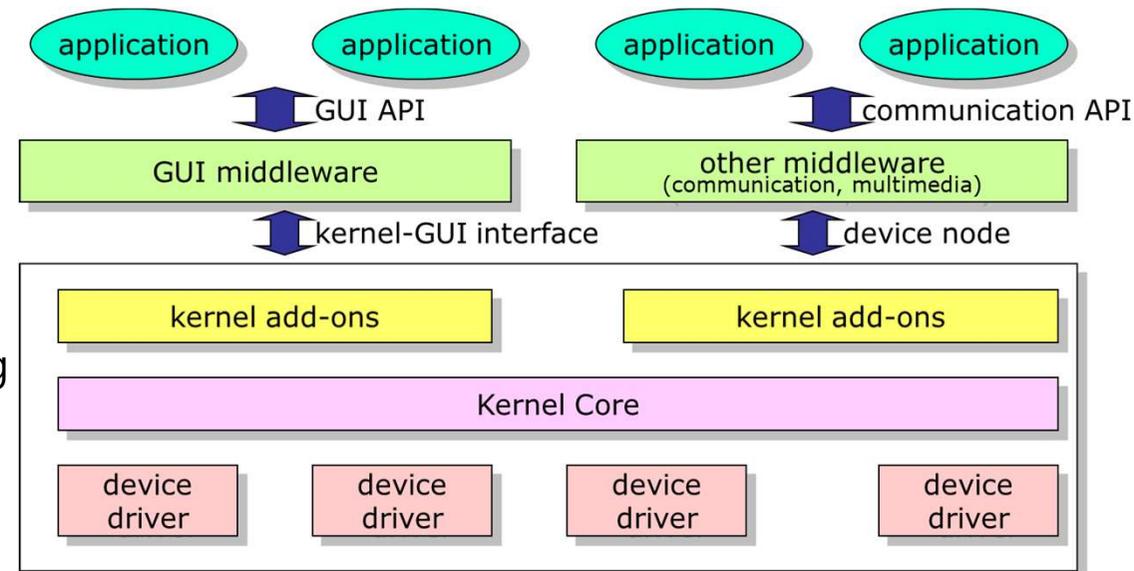
Kernel

Power Management (DVS, DPM)

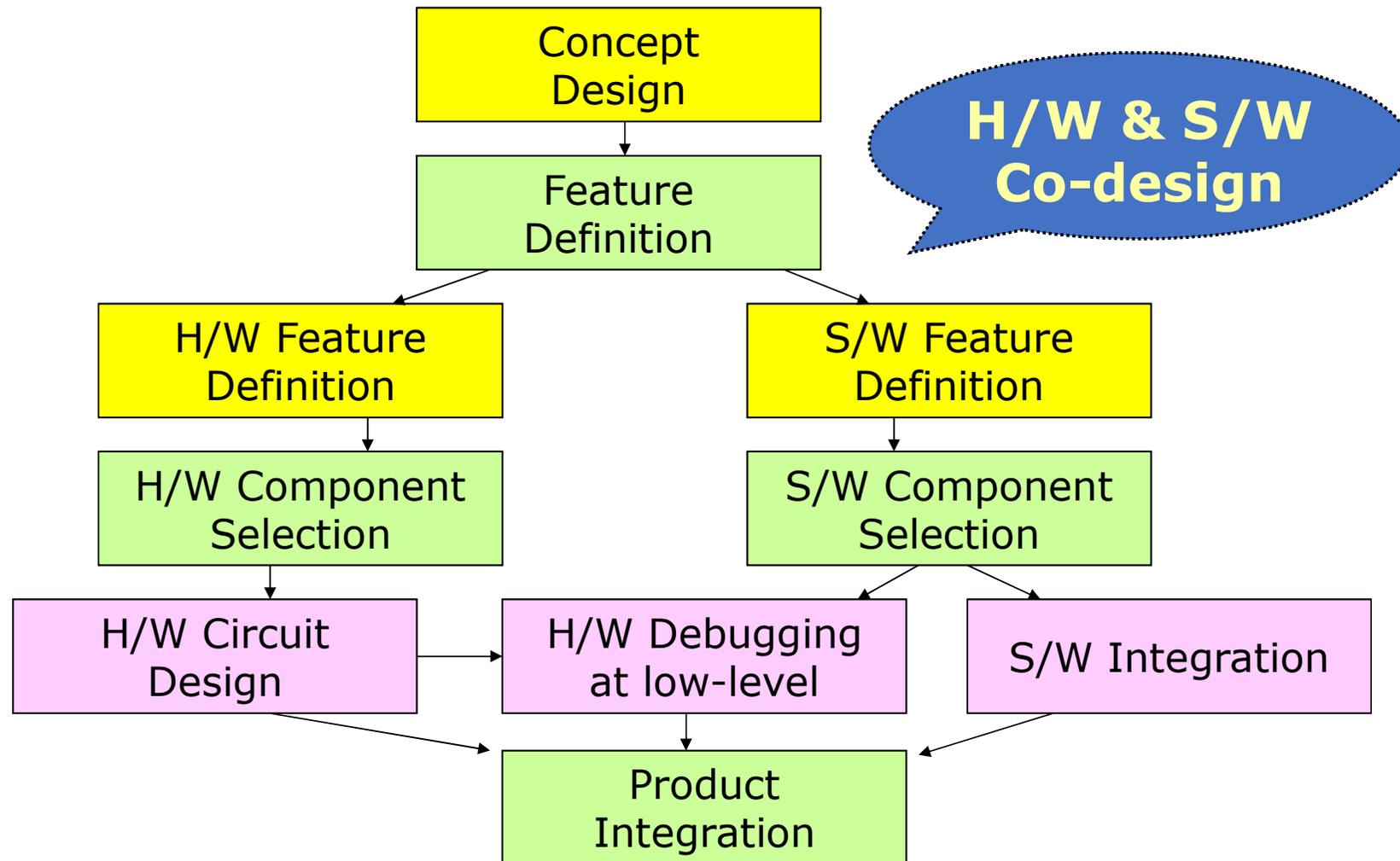Flash Memory Support (JFFS2, XIP)

Various Device Support

Kernel core components (generalized)
(Process management, memory management, networking)

Software Trend: Middleware

- Generic middleware
  - ✓ JAVA for small footprint devices
    - ➤ J2ME virtual machine implementations
    - ➤ J2ME application development
  - ✓ Integrated system for communication devices
  - ✓ Light-weight GUI

- Multimedia support
  - ✓ High-performance audio/video processing
    - ➤ Small footprint, but fast multi-media codecs
    - ➤ Utilizing separate DSPs

- Communication support
  - ✓ Handling interrupts from communication modules seamlessly
    - ➤ Phone call, messaging

Embedded System Development

END