

Embedded Systems - Introduction

System Definition

- A way of working, organizing or performing one or many tasks according to a fixed set of rules, program or plan.

System Definition

- Also an arrangement in which all units assemble and work together according to a program or plan.

Examples of Systems

- Time display system – A watch
- Automatic cloth washing system – A washing machine

Embedded System Definitions:

1. “An embedded system is a system that has software embedded into computer-hardware, which makes a system dedicated for an application (s) or specific part of an application or product or part of a larger system.” –

Present Book

Embedded System Definitions:

2. “An embedded system is one that has a dedicated purpose software embedded in a computer hardware.” – *Present Book*

3. “It is a dedicated computer based system for an application(s) or product. It may be an independent system or a part of large system. Its software usually embeds into a ROM (Read Only Memory) or flash.” – *Present Book*

“It is any device that includes a programmable computer but is not itself intended to be a general purpose computer.” –
Wayne Wolf, Ref: 61

“Embedded Systems are the electronic systems that contain a microprocessor or a microcontroller, but we do not think of them as computers- the computer is hidden or embedded in the system.” – ***Todd D. Morton,***

Ref: 38

Let's consider a Computer

A computer is a system that has the following or more components.

- A microprocessor
- A large memory comprising the following two kinds:
 - (a) Primary memory (*semiconductor* memories - RAM, ROM and fast accessible caches)

Computer

(b) Secondary memory [*magnetic* memory located in hard disks, diskettes and cartridge tapes, *optical* memory in CD-ROM or memory stick (in mobile computer)] using which different user programs can load into the primary memory and can be run.

- I/O units such as touch screen, modem, fax cum modem etc.

Computer

- Input units such as keyboard, mouse, digitizer, scanner, etc.
- Output units like LCD screen, video monitor, printer, etc.
- Networking units like Ethernet card, front-end processor-based server, bus drivers, etc.
- Operating system (OS).
- General purpose user interfaces and application-software, mostly in secondary memory

Now consider **Embedded system**

–**Three main embedded components**

1. Embeds hardware to give computer like functionalities
2. Embeds main application software generally into flash or ROM and the application software performs concurrently the number of tasks.

Embedded system components

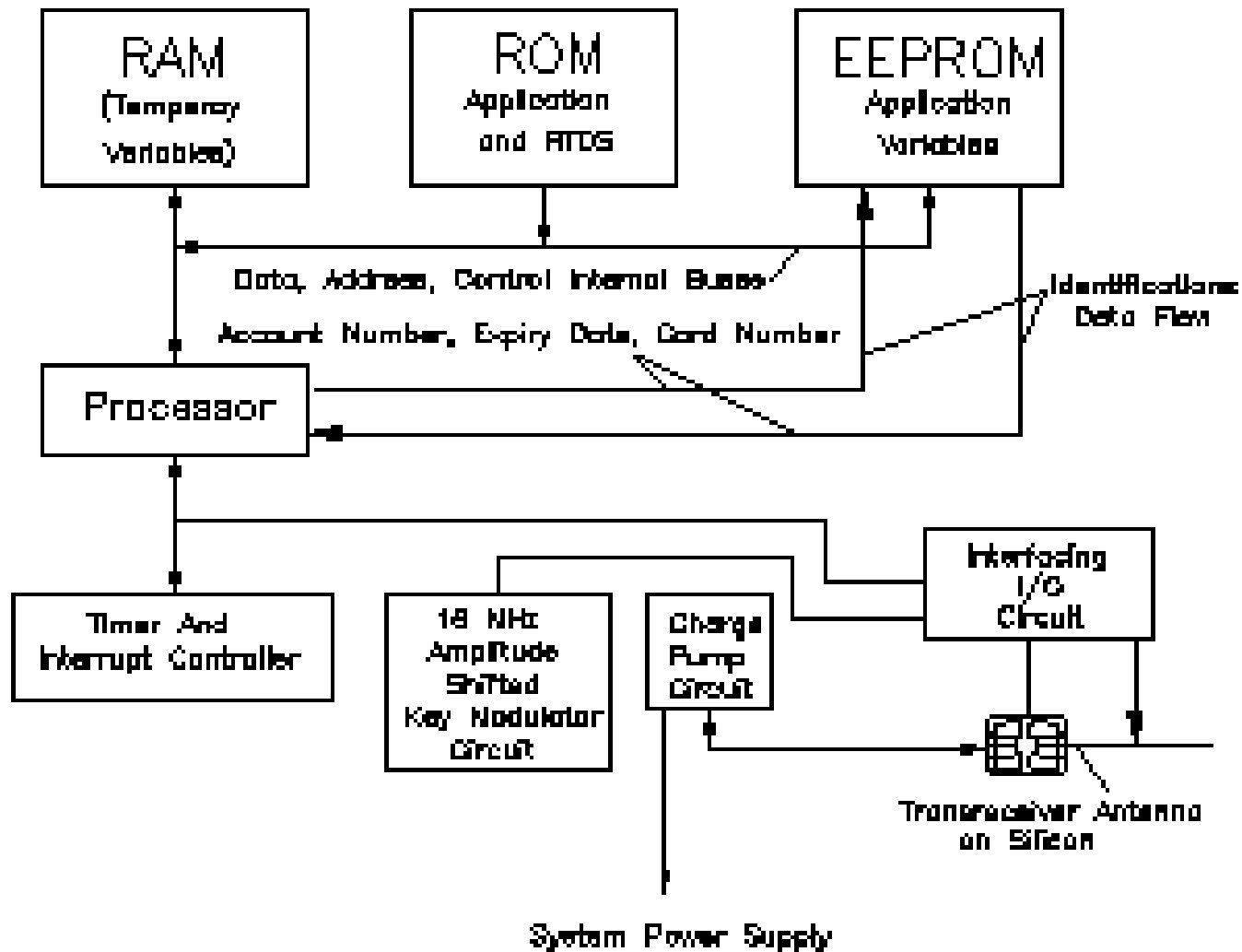
3. Embeds a real time operating system (RTOS), which supervises the application software tasks running on the hardware and organizes the accesses to system resources according to priorities and timing constraints of tasks in the system.

Embedded system RTOS

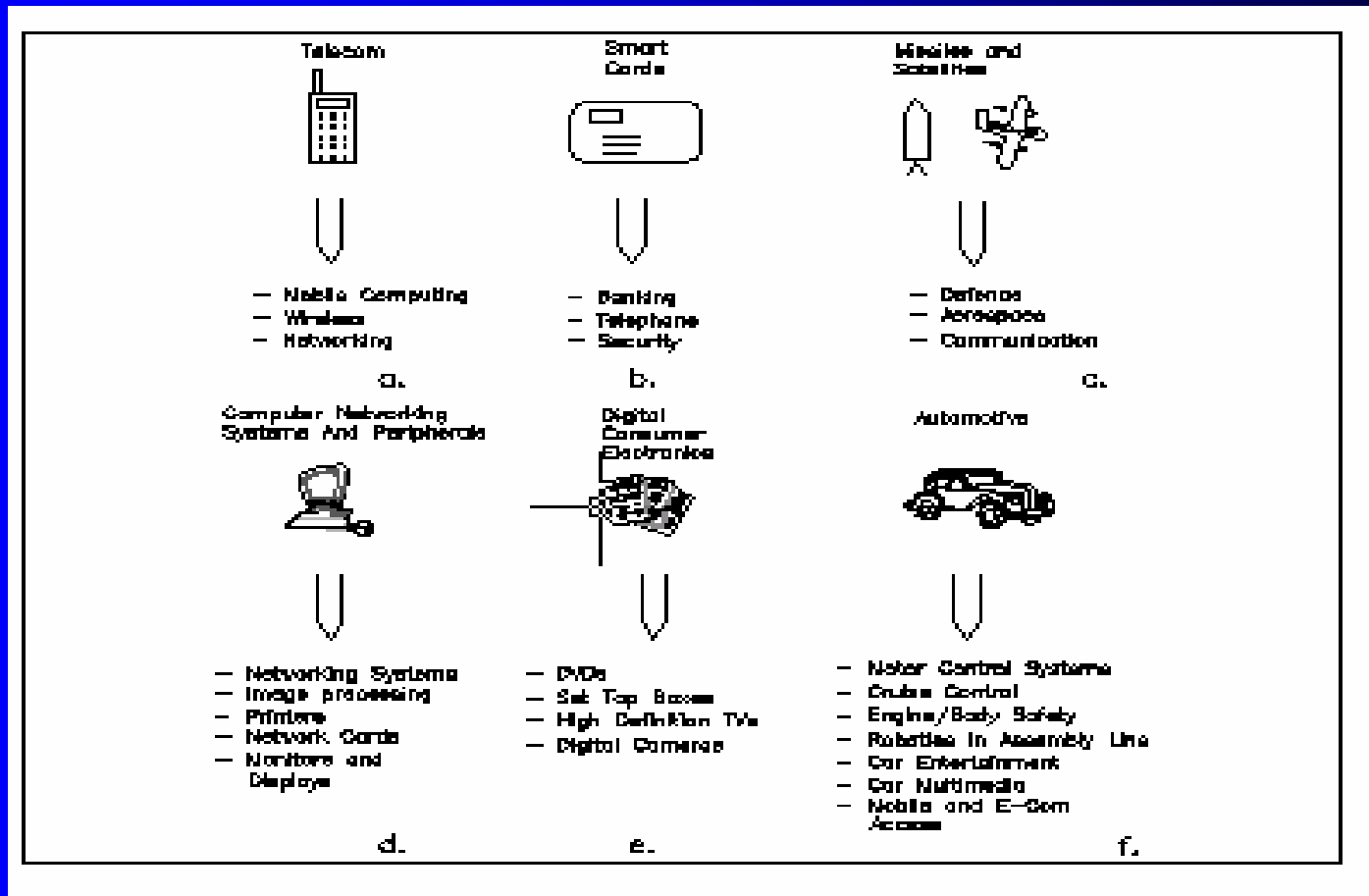
- Enables execution of concurrent processes or threads or tasks
- Provides a mechanism to let the processor run each process as per scheduling and to do context-switch between the various processes (threads or tasks)
- RTOS sets the rules during execution of application processes to enable finishing of a process within the assigned time interval and with assigned priority.

AN EMBEDDED SYSTEM

Contact – Less Smart Card Components



Exemplary Application Areas



– Also refer to Section 1.5

Chapter-1L01: "Embedded Systems - ", Raj Kamal,
 Publs.: McGraw-Hill Education

Sophisticated Embedded System Characteristics

- (1) Dedicated functions
- (2) Dedicated complex algorithms
- (3) Dedicated (GUIs) and other user interfaces for the application

(4) Real time operations— Defines the ways in which the system works, reacts to the events and interrupts, schedules the system functioning in real time and executes by following a plan to control the latencies and to meet the deadlines. [Latency — Waiting interval between the instance at which a need to run the codes arises for task (or interrupt service routine) following an event and instance of start executing the codes]

(5) Multi-rate operations — Different operations may take place at distinct rates. For example, the audio, video, network data or stream and events have the different rates and time constraints to finish associated processes.

Constraints of an Embedded System Design

- Available system-memory
- Available processor speed
- Limited power dissipation when running the system continuously in cycles of the system start, wait for event, wake-up and run, sleep and stop.

System design constraints

- Performance,
- power,
- size,
- non-recurring design cost, and
- manufacturing costs.

Summary

We learnt

- (i) Definitions of embedded system,
- (ii) Embedded hardware, application software and RTOS
- (iii) Exemplary application-areas

Summary...

We learnt

(iii) Sophisticated Embedded System
Characteristics

(iv) System Constraints

(v) Design Constraints

End of Lesson 1