INTRODUCTION TO EMBEDDED SYSTEMS

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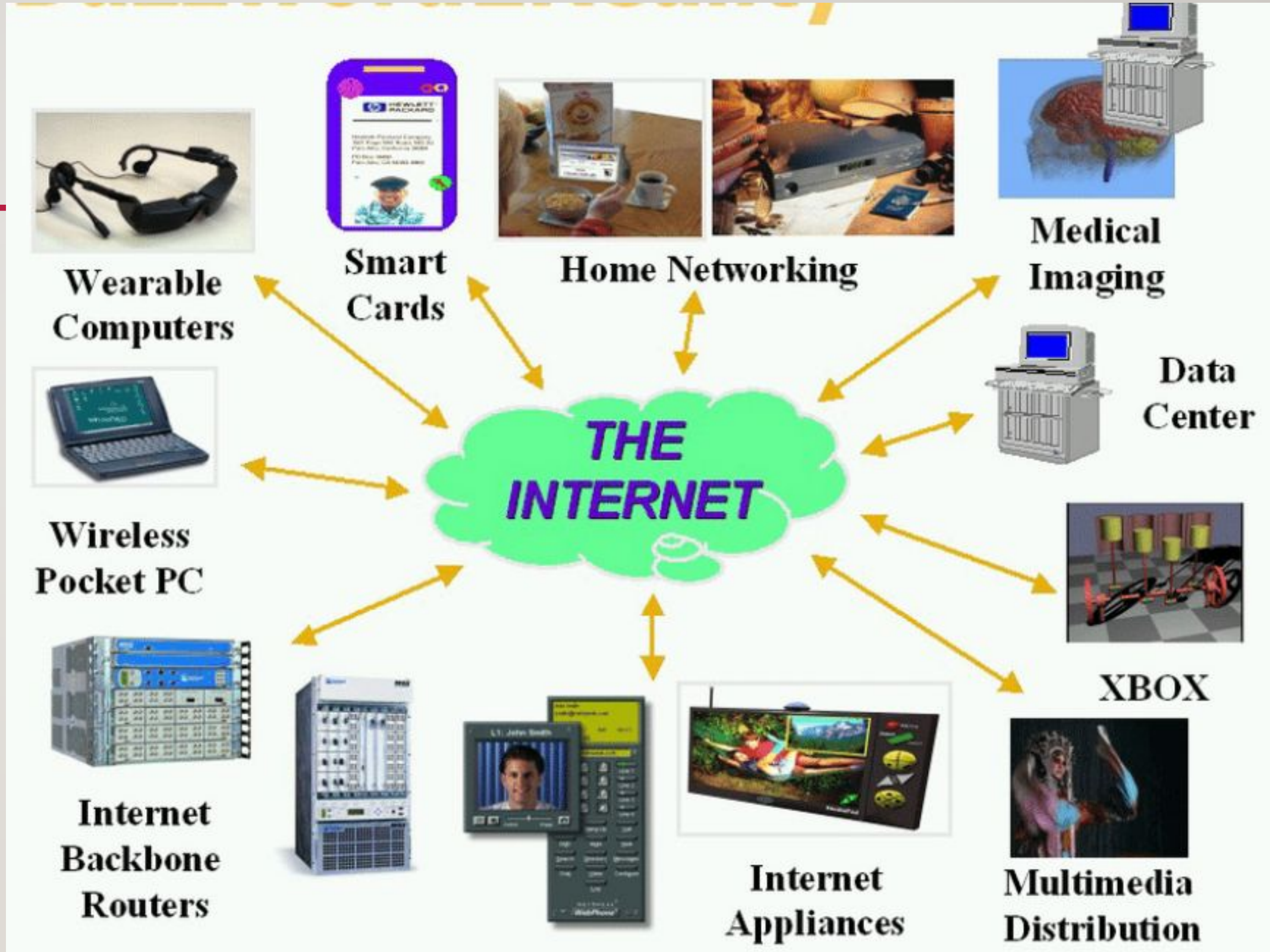
RVCE

Embedded System Products

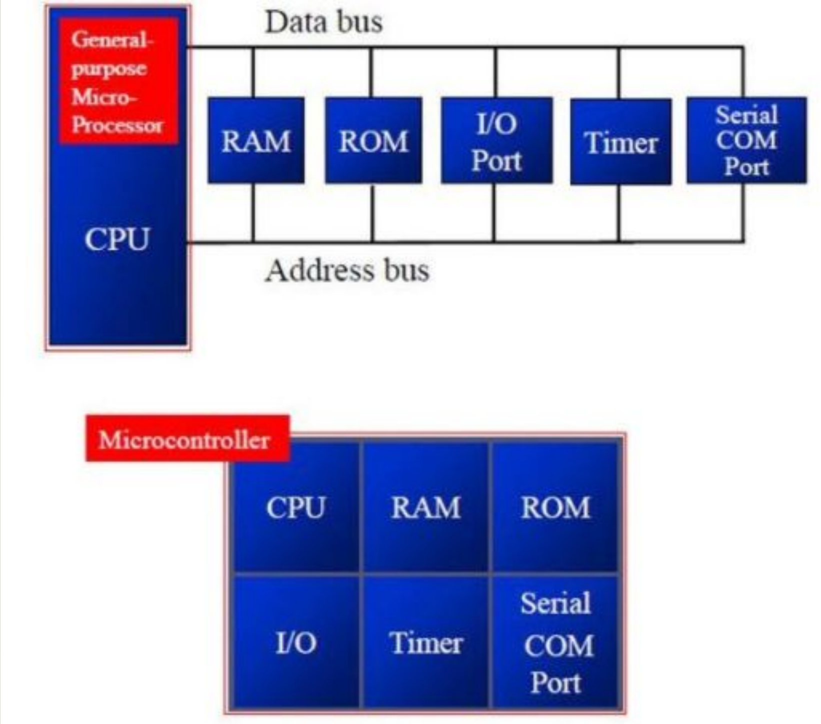
Examples of Embedded Systems

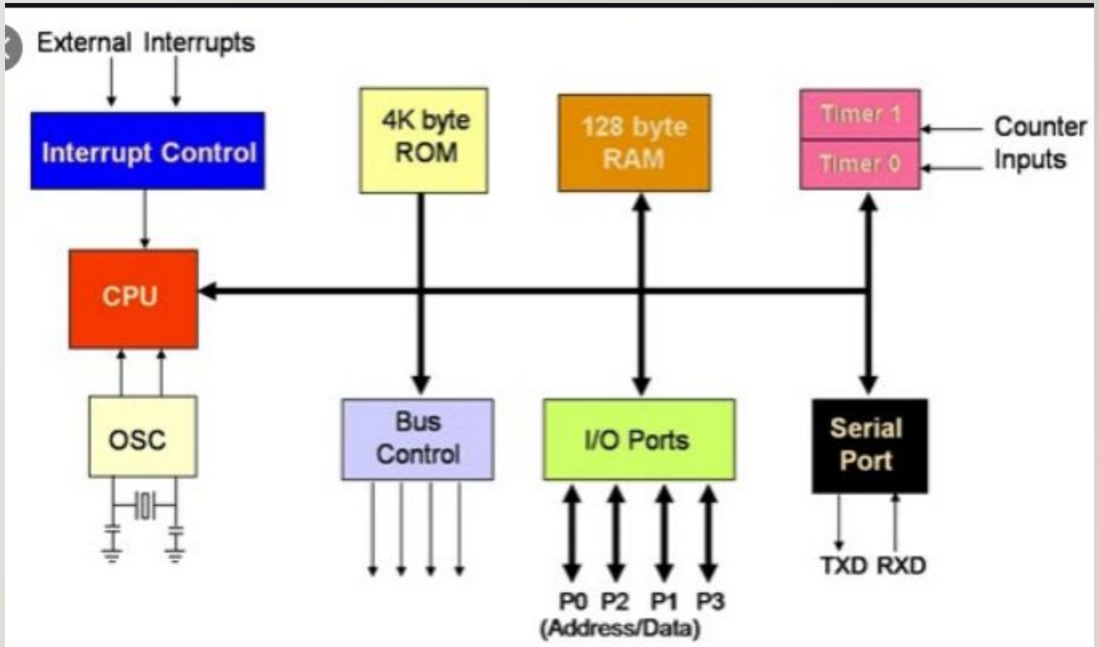
REMOT CONTROL
TELEVISION
REFRIGERATORS
VIDEO GAMES
ELEVATORS
SET-TOP BOX
PLANES
CARS

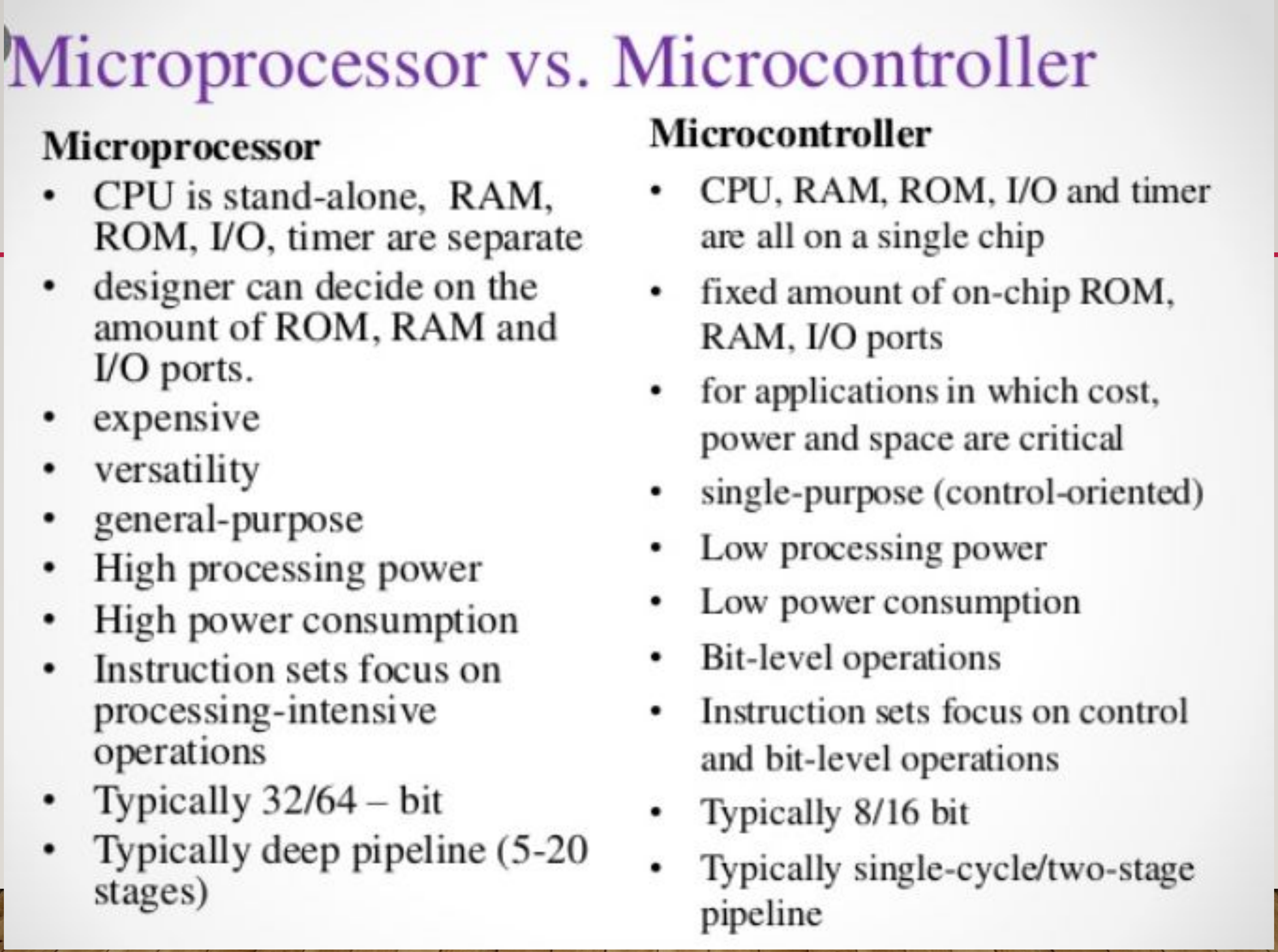

THE INTERNET
Wearable Computers
Smart Cards
Home Networking
Medical Imaging
Data Center
Wireless Pocket PC
XBOX
Internet Backbone Routers
Internet Appliances
Multimedia Distribution

27°C
POWERFUL
ON/OFF
MODE
TEMP
FAN
ECONO
SWING
COMFORT
OFF
CANCEL
ON
TIMER
ARC470A1

SIEMENS
iSensoric
Off
Super
Hygiene
Freshen Up
Jeans
Sportswear
Shirts/Business
Rinse
Spin/Drain
Cottons
Cottons 60°C
Synthetics
Mix
Delicates
Wool
Drum Descale
iQdrive 8kg 1400 rpm
iQ500
60
0:45
Temp.
Spin
Delay Start
varioSpeed
Easy Iron
Water Plus
Start/Reload
Status
ecoInfo


Data bus
General-purpose Micro-Processor
CPU
RAM
ROM
I/O Port
Timer
Serial COM Port
Address bus
Microcontroller
CPU
RAM
ROM
I/O
Timer
Serial COM Port


External Interrupts
Interrupt Control
4K byte ROM
128 byte RAM
Timer 1
Timer 0
Counter Inputs
CPU
OSC
Bus Control
I/O Ports
Serial Port
P0 P2 P1 P3
(Address/Data)
TXD RXD



Microprocessor vs. Microcontroller

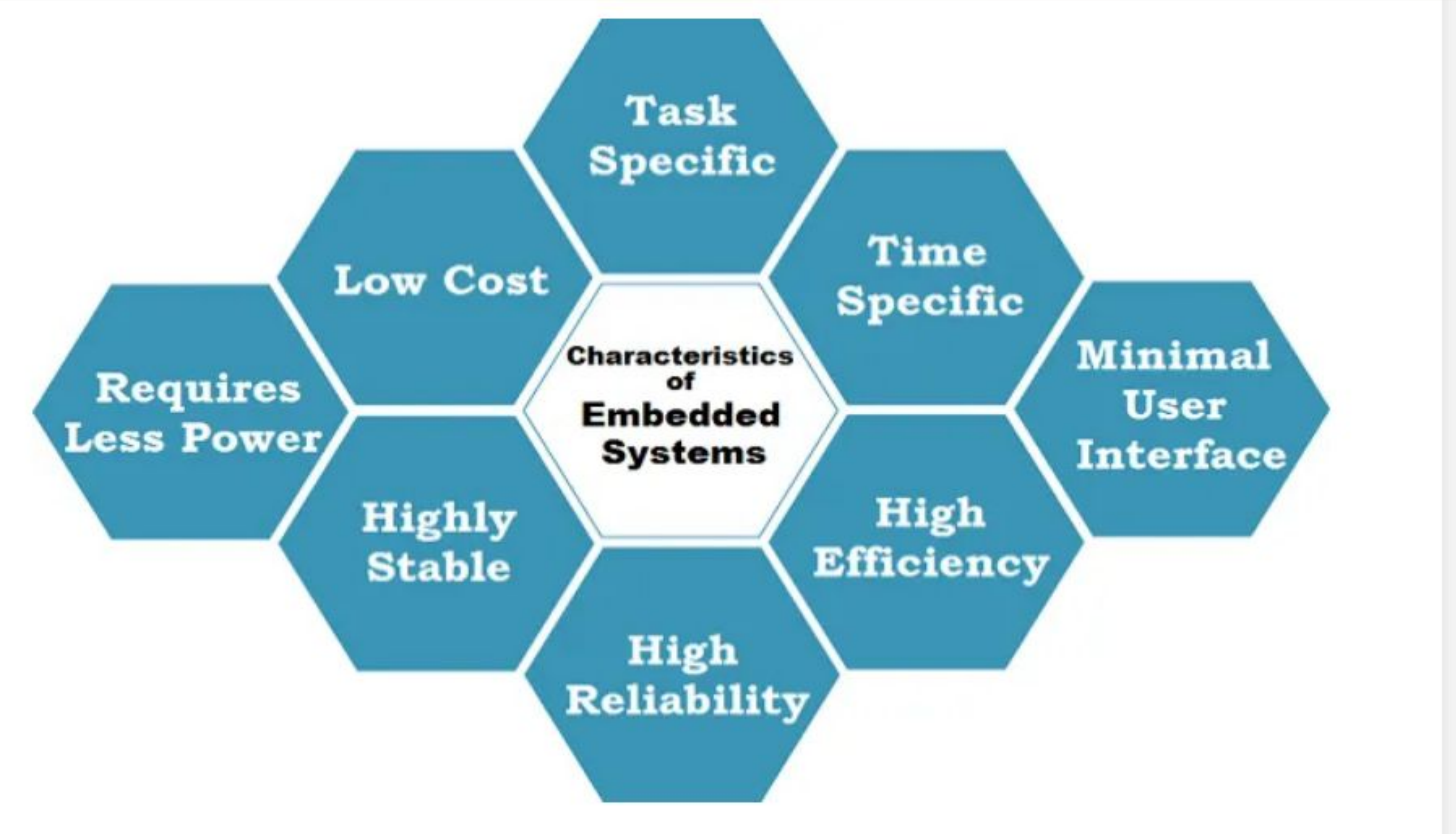
Microprocessor

- CPU is stand-alone, RAM, ROM, I/O, timer are separate
- designer can decide on the amount of ROM, RAM and I/O ports.
- expensive
- versatility
- general-purpose
- High processing power
- High power consumption
- Instruction sets focus on processing-intensive operations
- Typically 32/64 – bit
- Typically deep pipeline (5-20 stages)

Microcontroller

- CPU, RAM, ROM, I/O and timer are all on a single chip
- fixed amount of on-chip ROM, RAM, I/O ports
- for applications in which cost, power and space are critical
- single-purpose (control-oriented)
- Low processing power
- Low power consumption
- Bit-level operations
- Instruction sets focus on control and bit-level operations
- Typically 8/16 bit
- Typically single-cycle/two-stage pipeline

CHARACTERISTICS OF EMBEDDED SYSTEMS



Characteristics of Embedded Systems

Task Specific

Time Specific

Minimal User Interface

High Efficiency

High Reliability

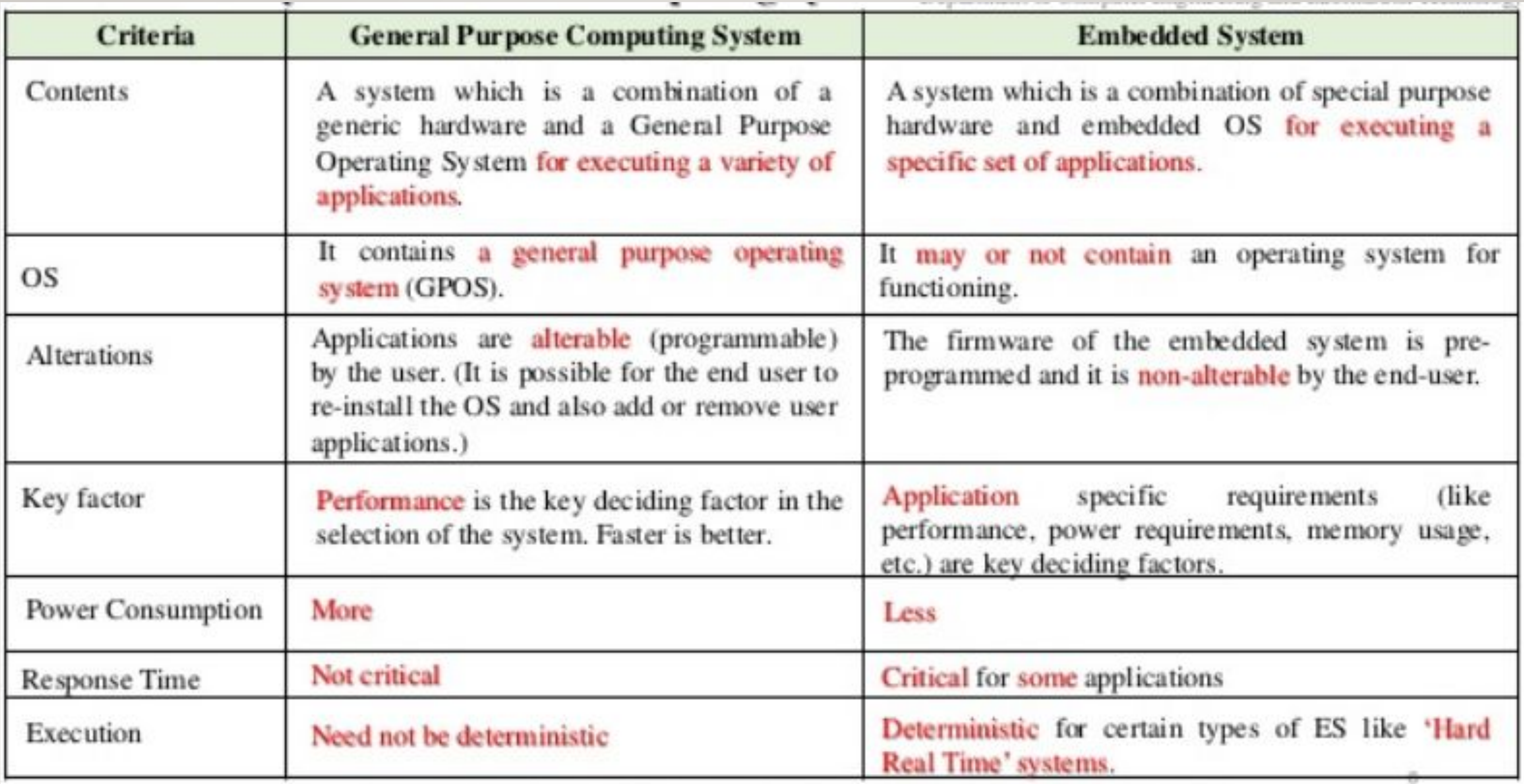
Highly Stable

Requires Less Power

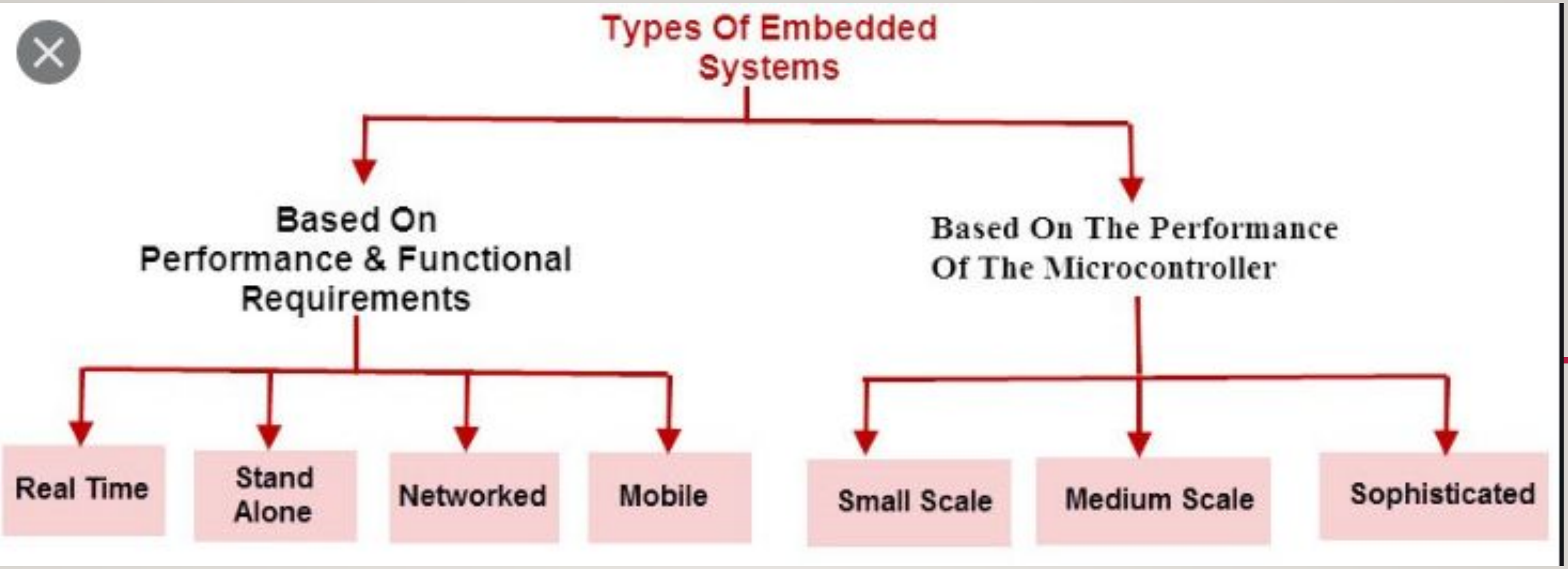
Low Cost

Some of the key characteristics of Embedded Systems are as mentioned below.

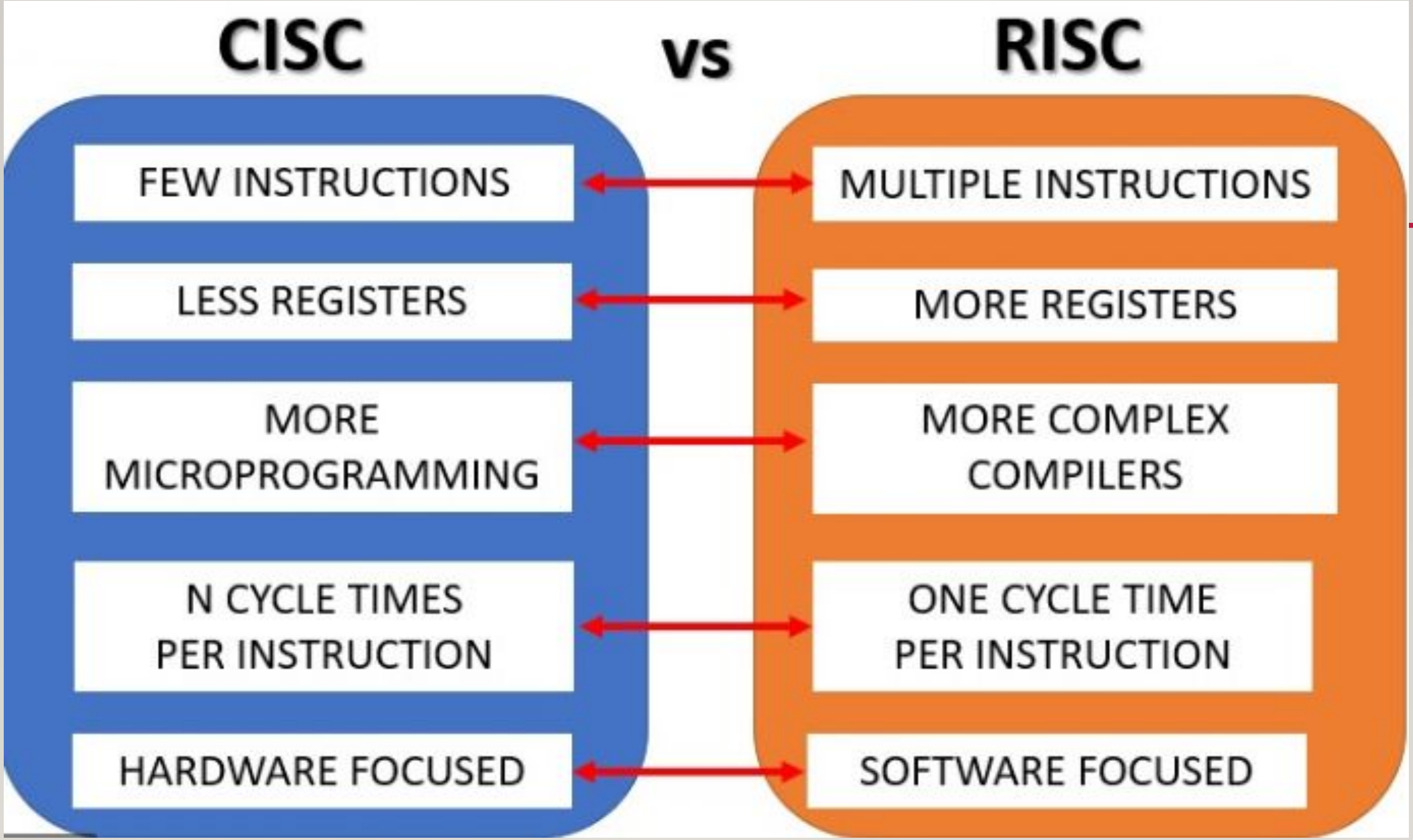
1. All Embedded Systems are task specific. They do the same task repeatedly /continuously over their lifetime. An mp3 player will function only as an mp3 player.
2. Embedded systems are created to perform the task within a certain time frame. It must therefore perform fast enough. A car's brake system, if exceeds the time limit, may cause accidents.
3. They have minimal or no user interface (UI). A fully automatic washing machine works on its own after the program is set and stops once the task is over.
4. Some embedded systems are designed to react to external stimuli and react accordingly. A thermometer, a GPS tracking device.
5. Embedded systems are built to achieve certain efficiency levels. They are small sized, can work with less power and are not too expensive.
6. Embedded systems cannot be changed or upgraded by the users. Hence, they must rank high on reliability and stability. They are expected to function for long durations without the user experiencing any difficulties.
7. Microcontroller or microprocessors are used to design embedded systems.
8. Embedded systems need connected peripherals to attach input & output devices.
9. The hardware of an embedded-system is used for security and performance. The Software is used for features.



Criteria	General Purpose Computing System	Embedded System
Contents	A system which is a combination of a generic hardware and a General Purpose Operating System for executing a variety of applications.	A system which is a combination of special purpose hardware and embedded OS for executing a specific set of applications.
OS	It contains a general purpose operating system (GPOS).	It may or not contain an operating system for functioning.
Alterations	Applications are alterable (programmable) by the user. (It is possible for the end user to re-install the OS and also add or remove user applications.)	The firmware of the embedded system is pre-programmed and it is non-alterable by the end-user.
Key factor	Performance is the key deciding factor in the selection of the system. Faster is better.	Application specific requirements (like performance, power requirements, memory usage, etc.) are key deciding factors.
Power Consumption	More	Less
Response Time	Not critical	Critical for some applications
Execution	Need not be deterministic	Deterministic for certain types of ES like 'Hard Real Time' systems.


Types Of Embedded Systems
Based On Performance & Functional Requirements
Based On The Performance Of The Microcontroller
Real Time
Stand Alone
Networked
Mobile
Small Scale
Medium Scale
Sophisticated

- **Real-Time Embedded Systems:**
  - Traffic control system
  - Military usage in defense sector
  - Medical usage in health sector
- **Stand Alone Embedded Systems** :
  - MP3 players
  - Microwave ovens
  - calculator
- **Networked Embedded Systems :**
  - Home security systems
  - ATM machine
  - Card swipe machine
- **Mobile Embedded Systems :**
  - MP3 player
  - Mobile phones
  - Digital Camera



CISC vs RISC

CISC	RISC
FEW INSTRUCTIONS	MULTIPLE INSTRUCTIONS
LESS REGISTERS	MORE REGISTERS
MORE MICROPROGRAMMING	MORE COMPLEX COMPILERS
N CYCLE TIMES PER INSTRUCTION	ONE CYCLE TIME PER INSTRUCTION
HARDWARE FOCUSED	SOFTWARE FOCUSED