ISC 502
Applications of Microcontroller

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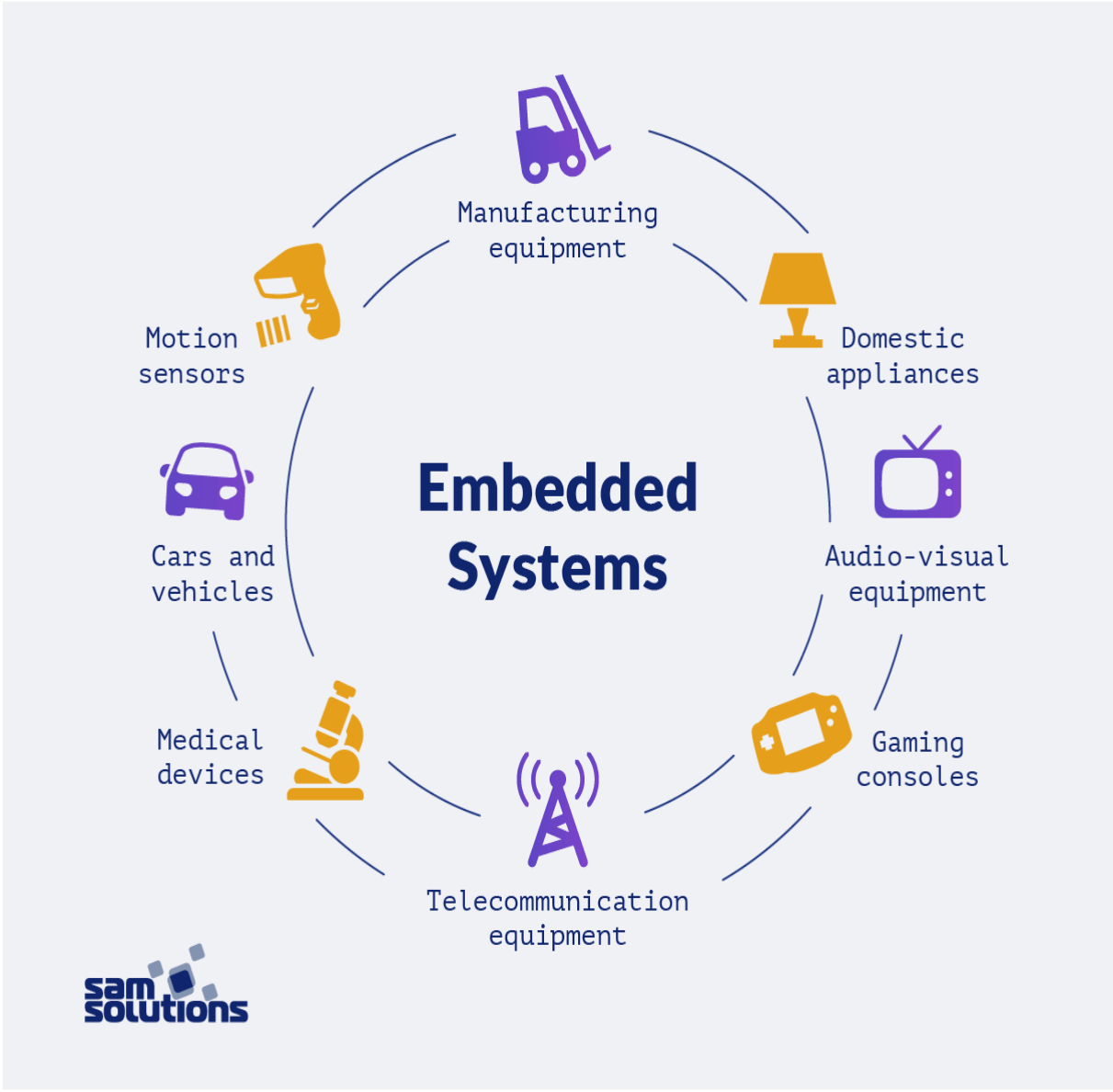
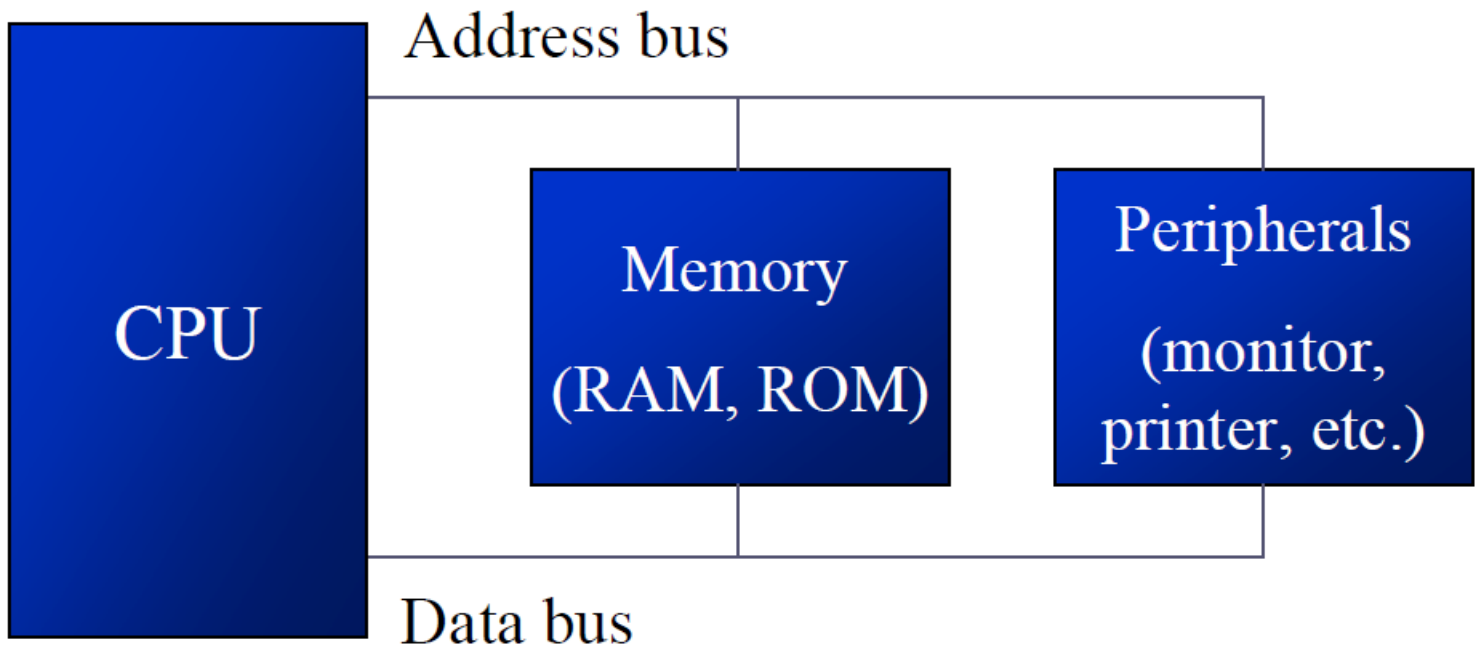
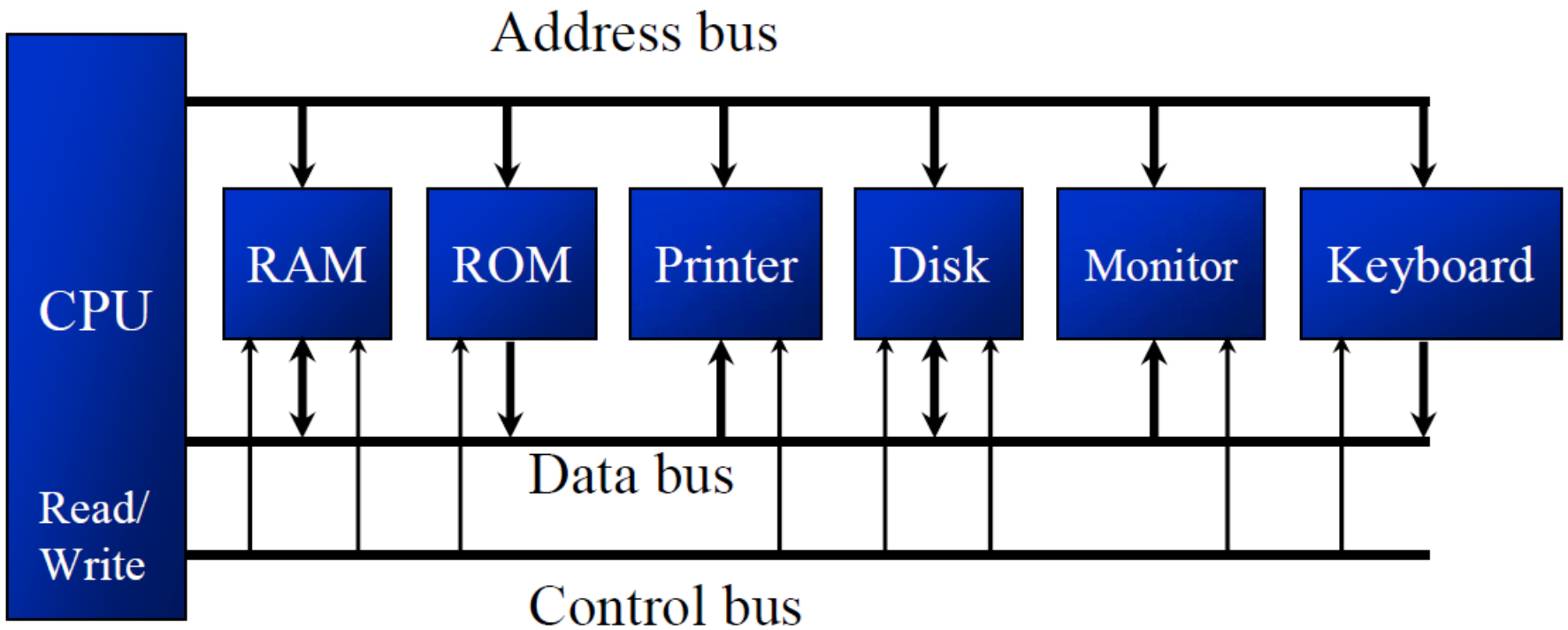
Embedded Systems – is a combination of computer hardware and software designed for a specific function.

The system can be programmable or have a fixed functionality.

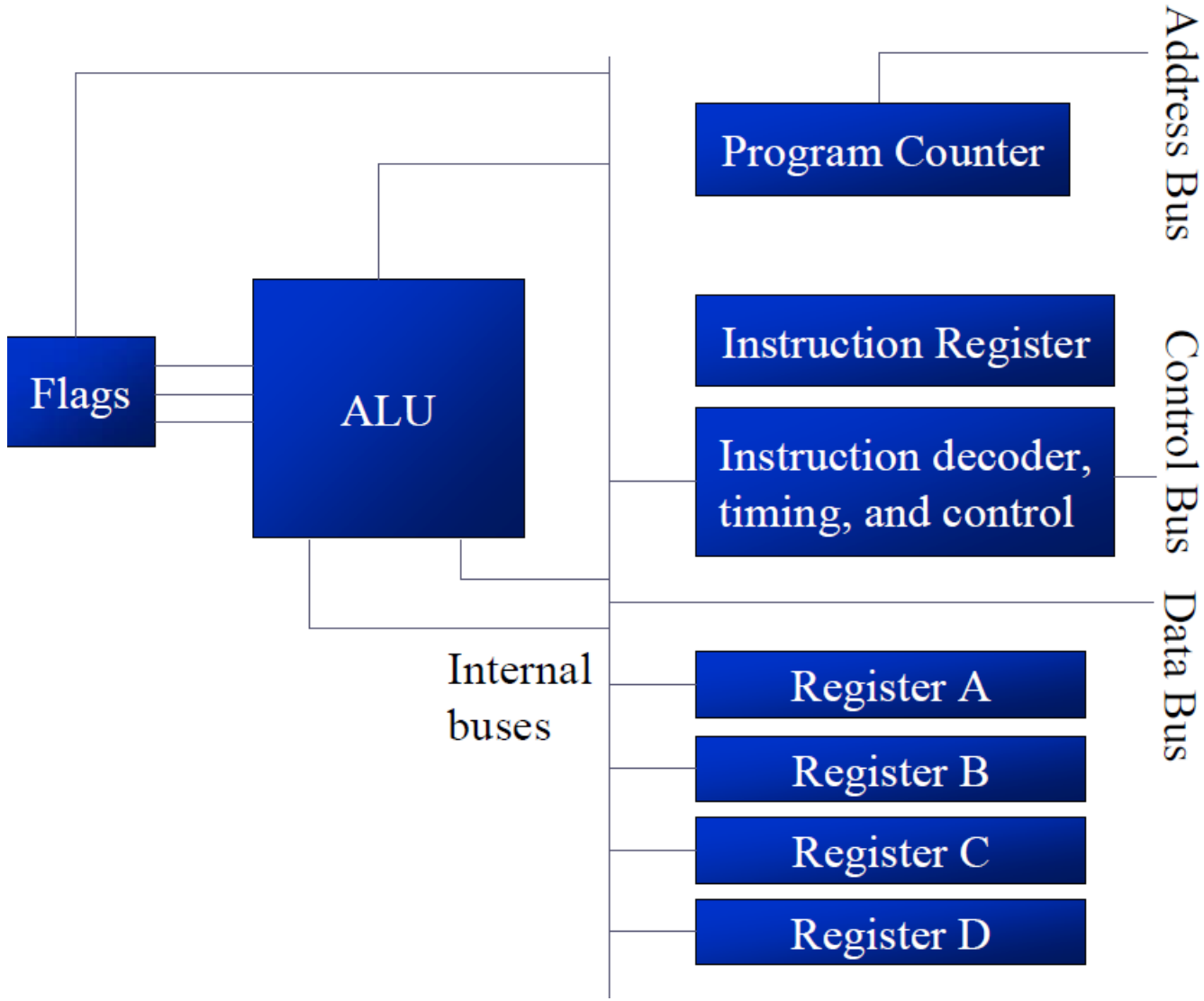



Address bus
CPU
Memory
(RAM, ROM)
Peripherals
(monitor,
printer, etc.)
Data bus


Address bus
CPU
RAM
ROM
Printer
Disk
Monitor
Keyboard
Read/
Write
Data bus
Control bus

- Address bus
  - For a device (memory or I/O) to be recognized by the CPU, it must be assigned an address
    - The address assigned to a given device must be unique
    - The CPU puts the address on the address bus, and the decoding circuitry finds the device
- Data bus
  - The CPU either gets data from the device or sends data to it
- Control bus
  - Provides read or write signals to the device to indicate if the CPU is asking for information or sending it information

- Registers
  - The CPU uses registers to store information temporarily
    - Values to be processed
    - Address of value to be fetched from memory
  - In general, the more and bigger the registers, the better the CPU
    - Registers can be 8-, 16-, 32-, or 64-bit
    - The disadvantage of more and bigger registers is the increased cost of such a CPU


Address Bus
Program Counter
Flags
ALU
Instruction Register
Control Bus
Instruction decoder, timing, and control
Data Bus
Internal buses
Register A
Register B
Register C
Register D

Ex. A CPU has registers A, B, C, and D and it has an 8-bit data bus and a 16-bit address bus. The CPU can access memory from addresses 0000 to FFFFH

Assume that the code for the CPU to move a value to register A is B0H and the code for adding a value to register A is 04H

The action to be performed by the CPU is to put 21H into register A, and then add to register A values 42H and 12H

...

Ex. (cont')

Action	*Code*	*Data*
Move value 21H into reg. A	B0H	21H
Add value 42H to reg. A	04H	42H
Add value 12H to reg. A	04H	12H

Mem. addr.	*Contents of memory address*
1400	(B0) code for moving a value to register A
1401	(21) value to be moved
1402	(04) code for adding a value to register A
1403	(42) value to be added
1404	(04) code for adding a value to register A
1405	(12) value to be added
1406	(F4) code for halt

...

- Intel’s microprocessor family x86

8086, 80286, 80386, 80486 and the Pentium

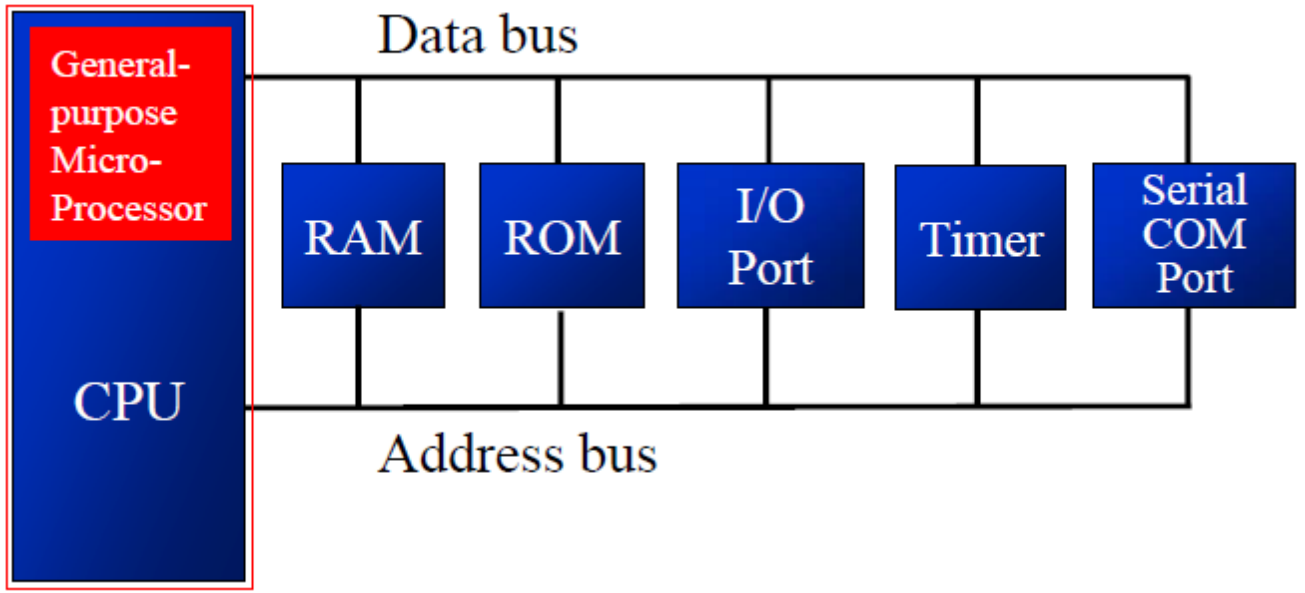
- Motorola’s 680x0 family

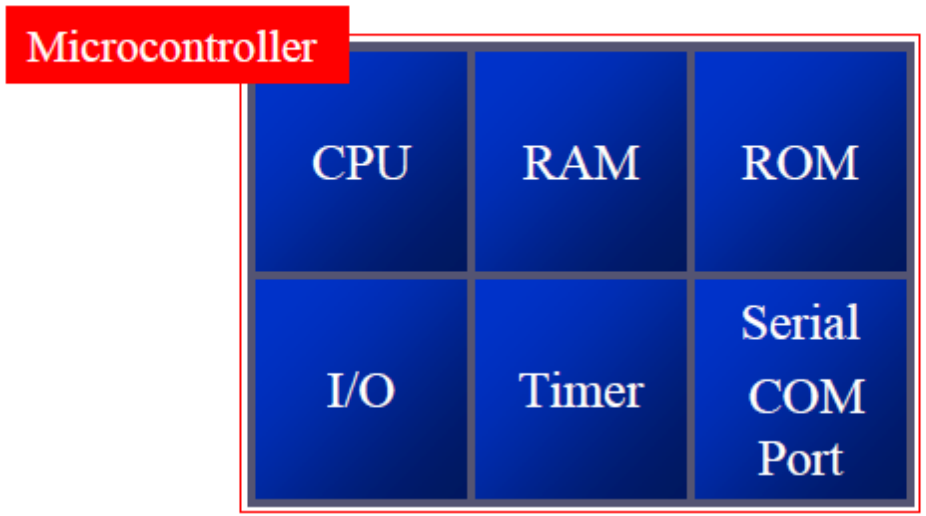
68000, 68010, 68020, 68030, 68040 etc.

These microprocessors contain no RAM, no ROM, and no I/O ports on the chip itself.

General-purpose microprocessors

Microprocessors are tasked with executing specific and repeatable actions whereas a CPU is tasked with executing a wide and diverse range of tasks





- General-purpose microprocessors contains
  - No RAM
  - No ROM
  - No I/O ports
- Microcontroller has
  - CPU (microprocessor)
  - RAM
  - ROM
  - I/O ports
  - Timer
  - ADC and other peripherals

- General-purpose microprocessors
  - Must add RAM, ROM, I/O ports, and timers externally to make them functional
  - Make the system bulkier and much more expensive
  - Have the advantage of versatility on the amount of RAM, ROM, and I/O ports
- Microcontroller
  - The fixed amount of on-chip ROM, RAM, and number of I/O ports makes them ideal for many applications in which cost and space are critical
  - In many applications, the space it takes, the power it consumes, and the price per unit are much more critical considerations than the computing power

- 8-bit microcontrollers
  - Motorola's 6811
  - Intel's 8051
  - Zilog's Z8
  - Microchip's PIC
- There are also 16-bit and 32-bit microcontrollers made by various chip makers

- Meeting the computing needs of the task at hand efficiently and cost effectively
  - Speed
  - Packaging
  - Power consumption
  - The amount of RAM and ROM on chip
  - The number of I/O pins and the timer on chip
  - How easy to upgrade to higher-performance or lower power-consumption versions
  - Cost per unit