



Embedded Systems Concepts

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Memory used to store data.

There are **two** types of memory:

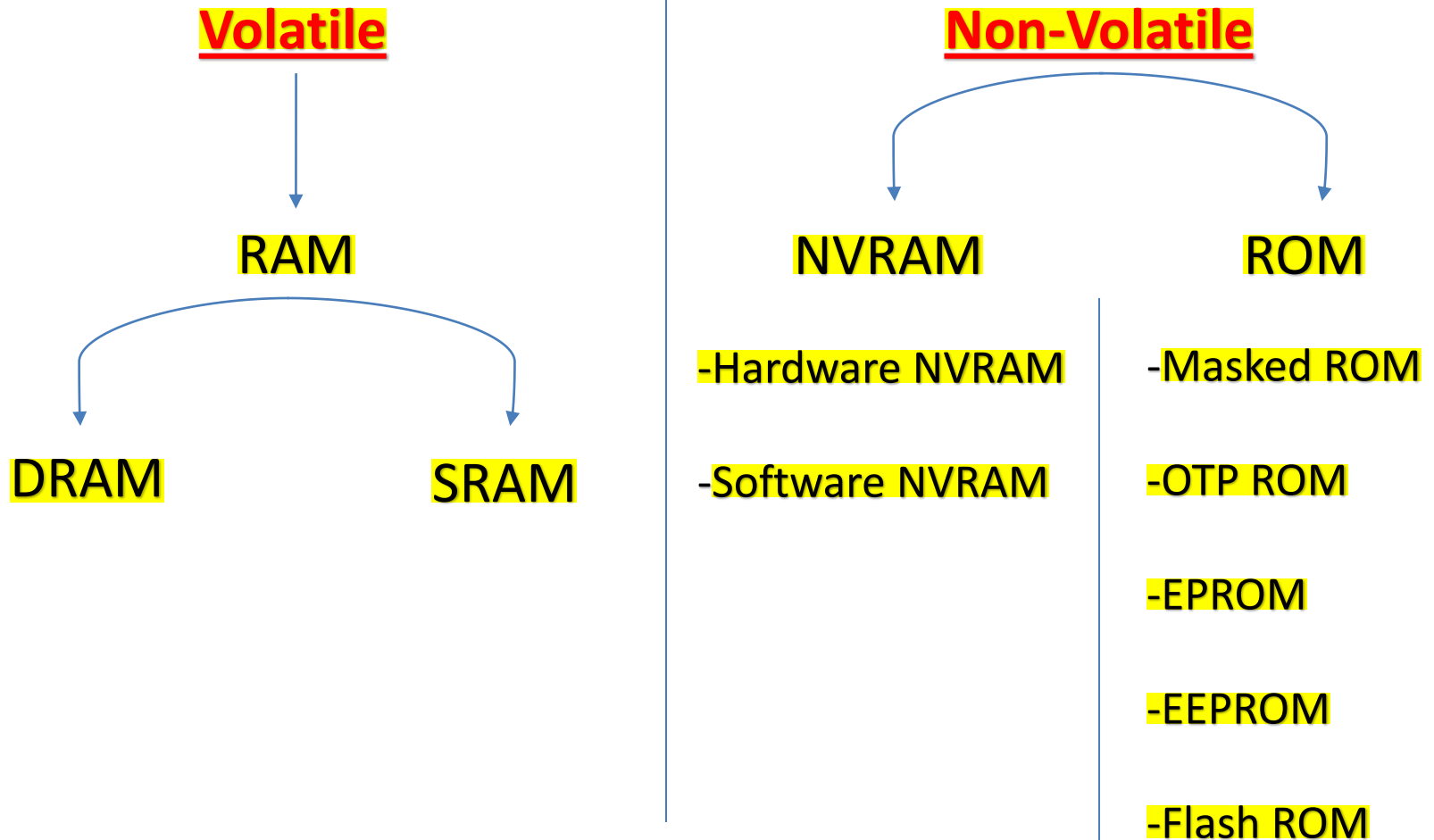
Volatile:

The memory will **lose** its data when the applied voltage **removed** “power off”.

Non-Volatile:

The memory will **never lose** its data when the applied voltage **removed** “power off”.

Memory



RAM “Random Access Memory”:

It called random access because the time which it takes to reach any address in the memory is constant. (no difference in access time between address 0x0000 and 0xFFFF).





SRAM “Static Random Access Memory”:

Based on Transistors.

DRAM “Dynamic Random Access Memory”:

Based on Capacitors.

SRAM VS DRAM

	SRAM	DRAM
Cost		
Size		
Performance		
Power Consumption		Needs a refresh circuit to recharge capacitors.

So, DRAM is not applicable in embedded application because of high power consumption.

- **Masked ROM**: Designed and programmed by manufacturer.
- **OTP ROM** “**One Time Programmable ROM**”: Can be programmed only one time.
- **EPROM** “**Erasable Programmable ROM**”: Programmed many times and erased by **UV** “**Ultra Violet**”.
- **EEPROM** “**Electrically Erasable Programmable ROM**”: Programmed and erased by electrical signals.
- **Flash ROM**

FLASH VS EEPROM

FLASH

EEPROM

Access

Block of bytes access

Byte access

Cost



Size



Performance

Good for Block

Good for Byte

Power Consumption



Endurance

10,000
times to die

100,000 to 11000,000
times to die

Memory Conclusion

RAM:

for “Run Time” because it is faster than ROM.

ROM:

for “Code” because it doesn’t lose its data after power off.

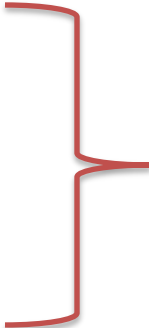
Note:

Every Embedded system must have FLASH and SRAM and may have EEPROM.

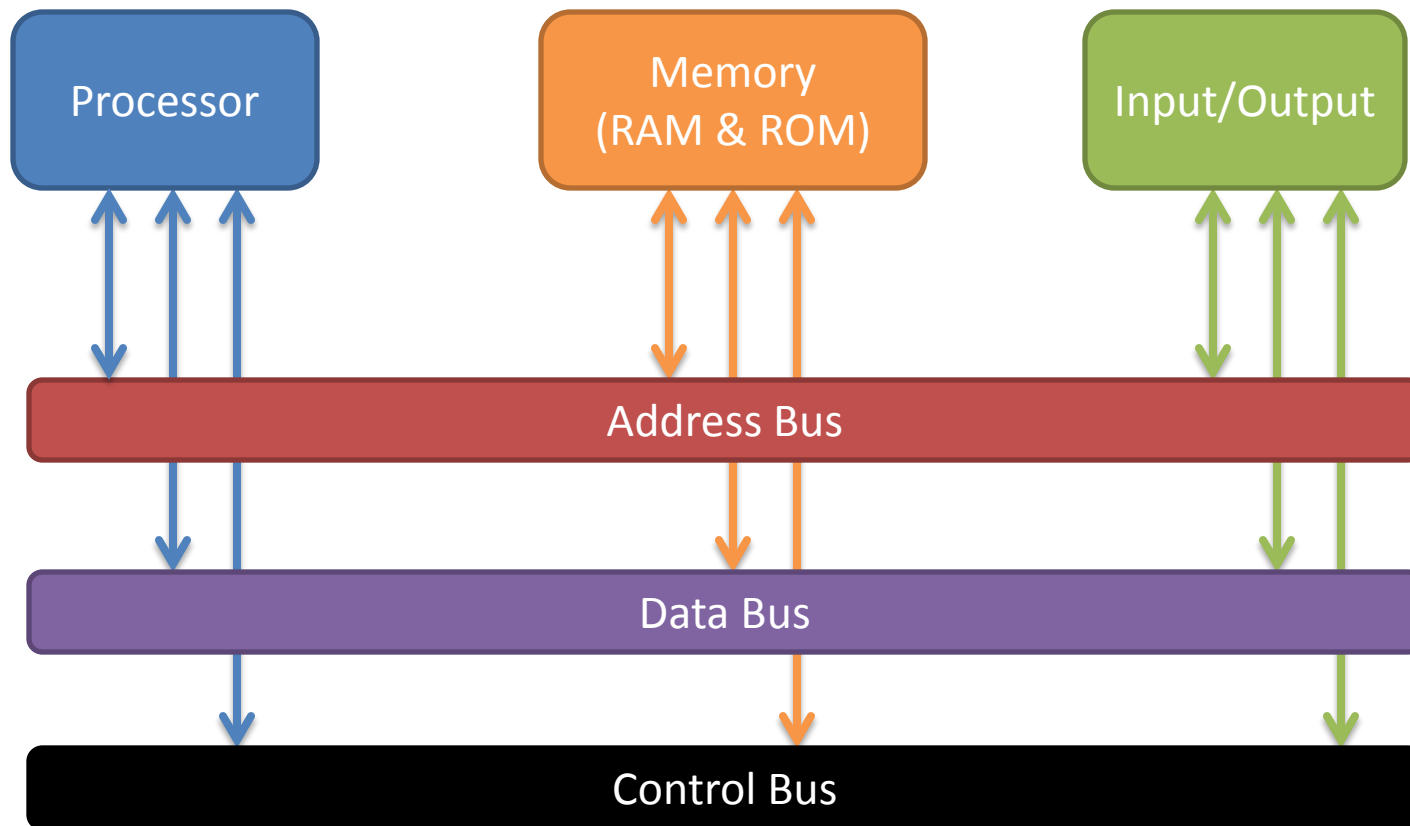
Input Output Peripherals

Input and output peripherals as a channel between the user and the processor.

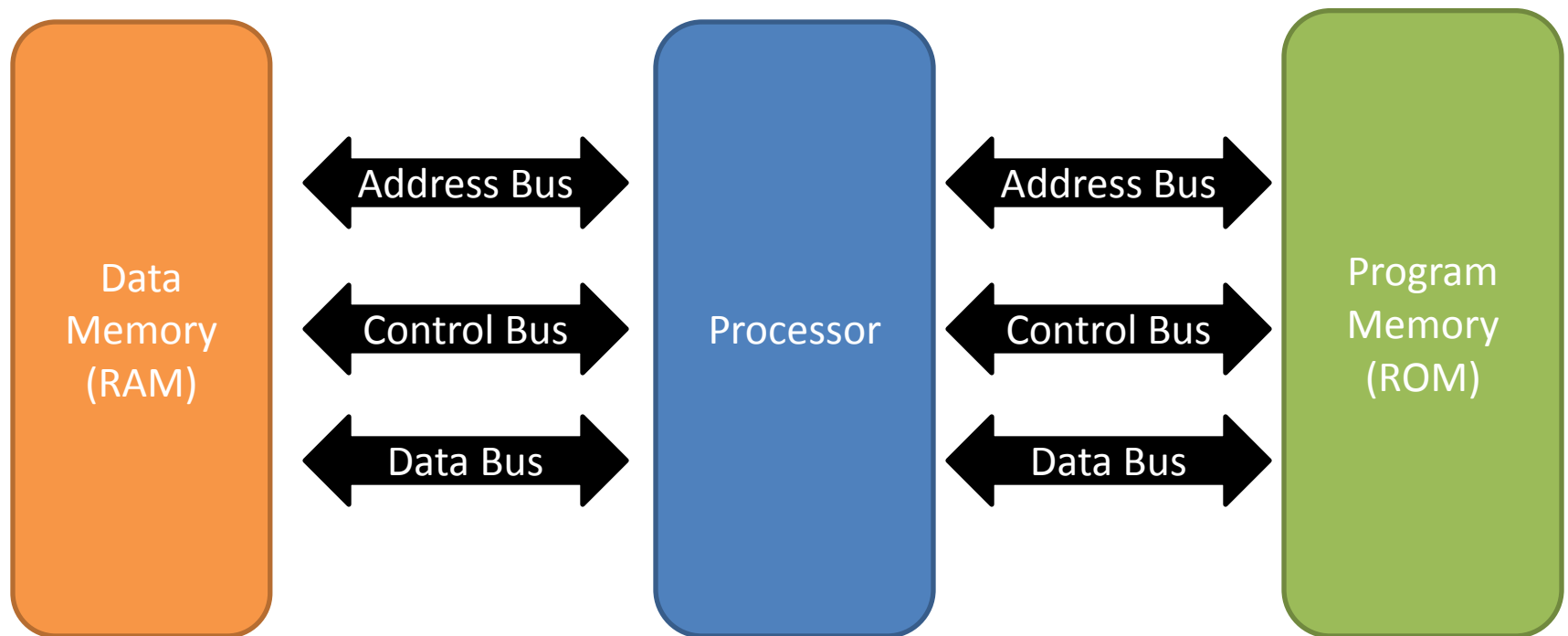
Examples

- 1- Digital Input Output (DIO)
 - 2- Analog to Digital Converter (ADC)
 - 3- Digital to Analog Converter (DAC)
 - 4- Timers and Pulse Width Modulators (PWM)
 - 5- Universal Asynchronous Receiver Transmitter (UART)
 - 6- Serial Peripheral Interface (SPI)
 - 7- Inter Integrated Circuit (I2C)
- 
- Serial
Communication
Protocols

2- Voneuman Architecture



2- Harvard Architecture



The End ...





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