Embedded System Concepts 2

Non-volatile memory

NVRAM (2 ways to implement):

1. **Using Hardware**: SRAM+ Battery:
   It has a separate battery to retain data on it when the main battery is turned off
   Drawbacks:
   Non-Durable
   Extra cost
   Extra size

   So its not used or preferable

2. **By software:** EEPROM is emulated using a Flash, a RAM and a brown-out reset circuit or BOR. should prevent random code execution by asserting reset prior to chip failure when the supply voltage starts dropping.

ROM (Read-Only-Memory):

1. **Masked ROM:** data is programmed during the manufacturing process and cannot be reprogrammed
2. **OTP ROM:** one-time programmable ROM
3. **EPROM:** Erase programmable ROM
4. **EEPROM:** Electrical Erasable programmable ROM
5. **Flash ROM:** Electrical Erasable programmable ROM

EEPROM and Flash ROM are similar in functionality the major differences are Flash is block-wise erasable, while EEPROM is byte-wise erasable. Flash is constantly rewritten, while other EEPROMs are seldom rewritten. Flash is used when large amounts are needed, while EEPROM is used when only small amounts are needed. Flash is less endurance than EEPROM.

	EEPROM	*Flash*
Performance	Fairly similar	
Accessing	Byte access	Block access
Cost	High	low
Endurance	100,000 to a million erasing/writing cycles	10,000 Erasing/Writing cycles

Any Microcontroller must have Flash and RAM, but not necessarily an EEPROM

Connection Between components:

1. Wire
2. Track (a connection between components on a PCB)
3. Tunnel (a connection between components on an IC)

Busses:

A bus is a group of connections, all processors have mainly 3 busses:

1. **Address Bus**
2. **Data Bus**
3. **Control Bus**

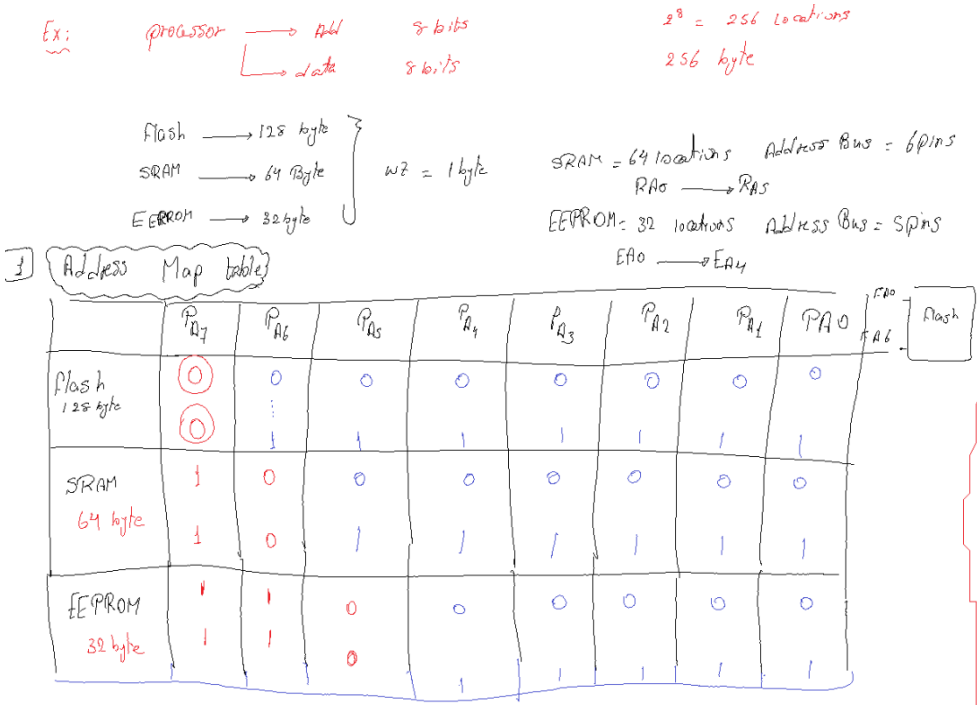
Memory: word size = Data Bus of memory (in bits)
Locations = Memory size/word size
Locations = $2^{\text{Address Bus (in bits)}}$

Condition to connect a processor and a memory

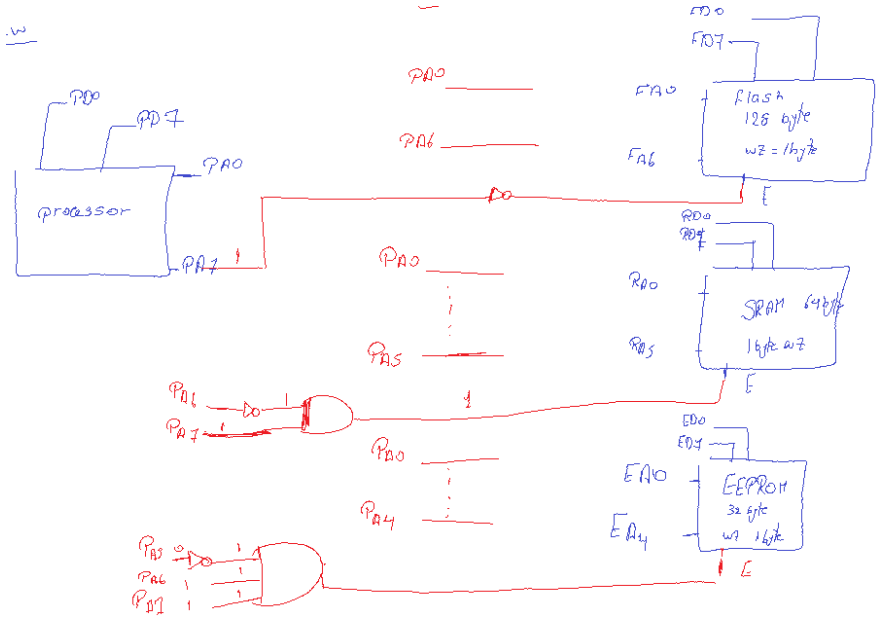
Address space of processor >= Memory locations

How to connect a processor to a memory:

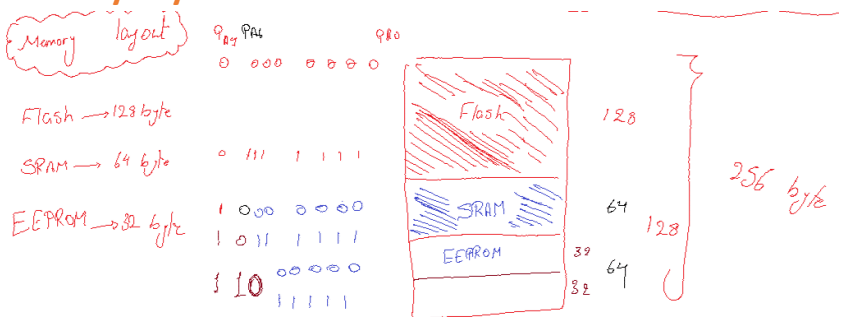
1. **Address map table**



2. H.W connection



3. Memory Layout



Memory Fragmentation is the phenomenon of having unused or wasted memory space between the allocated blocks