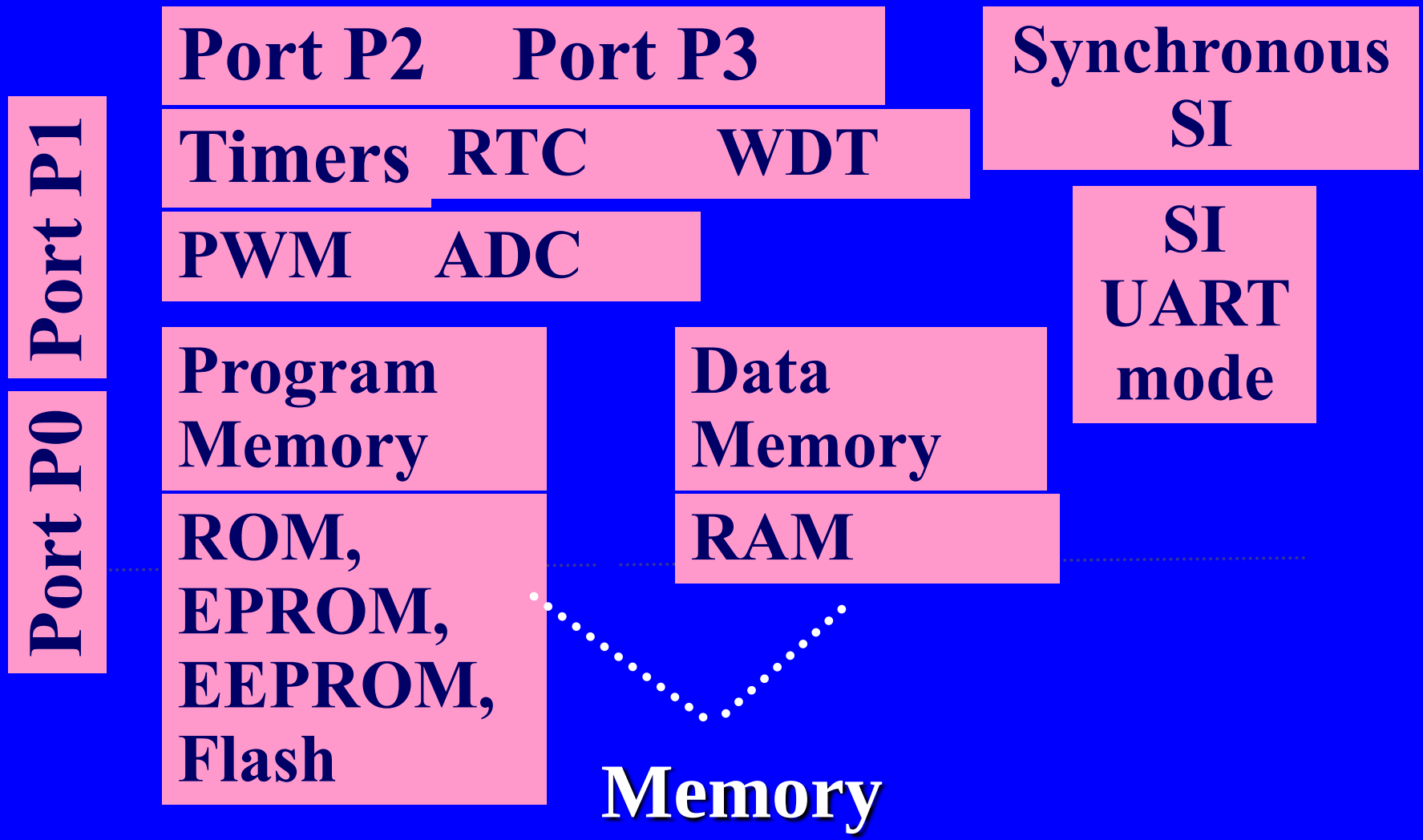
# Chapter 2

# Overview of Architecture and Microcontroller-Resources

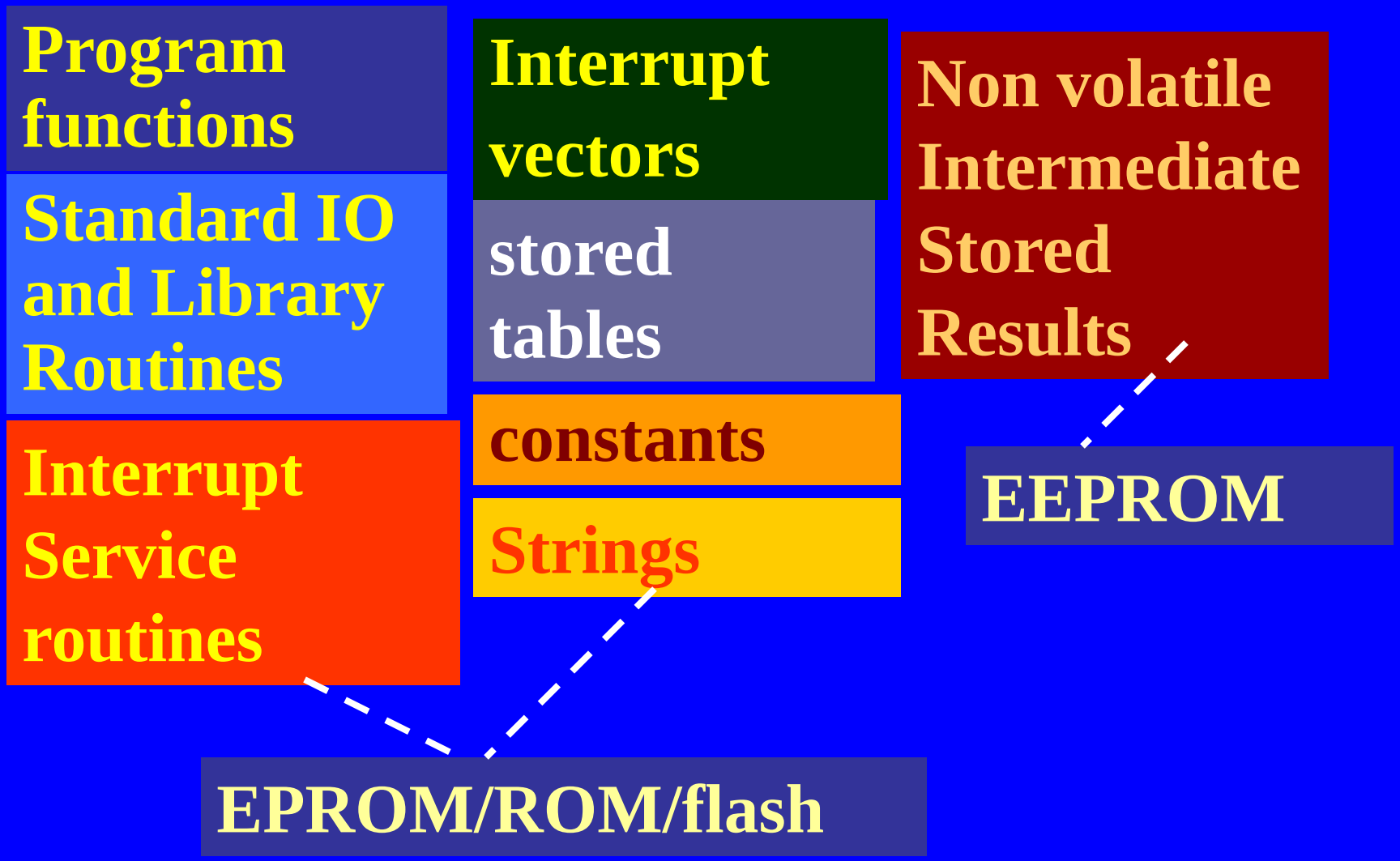
# Lesson 2

# Program and Data Memory, Ports, EEPROM and FLASH

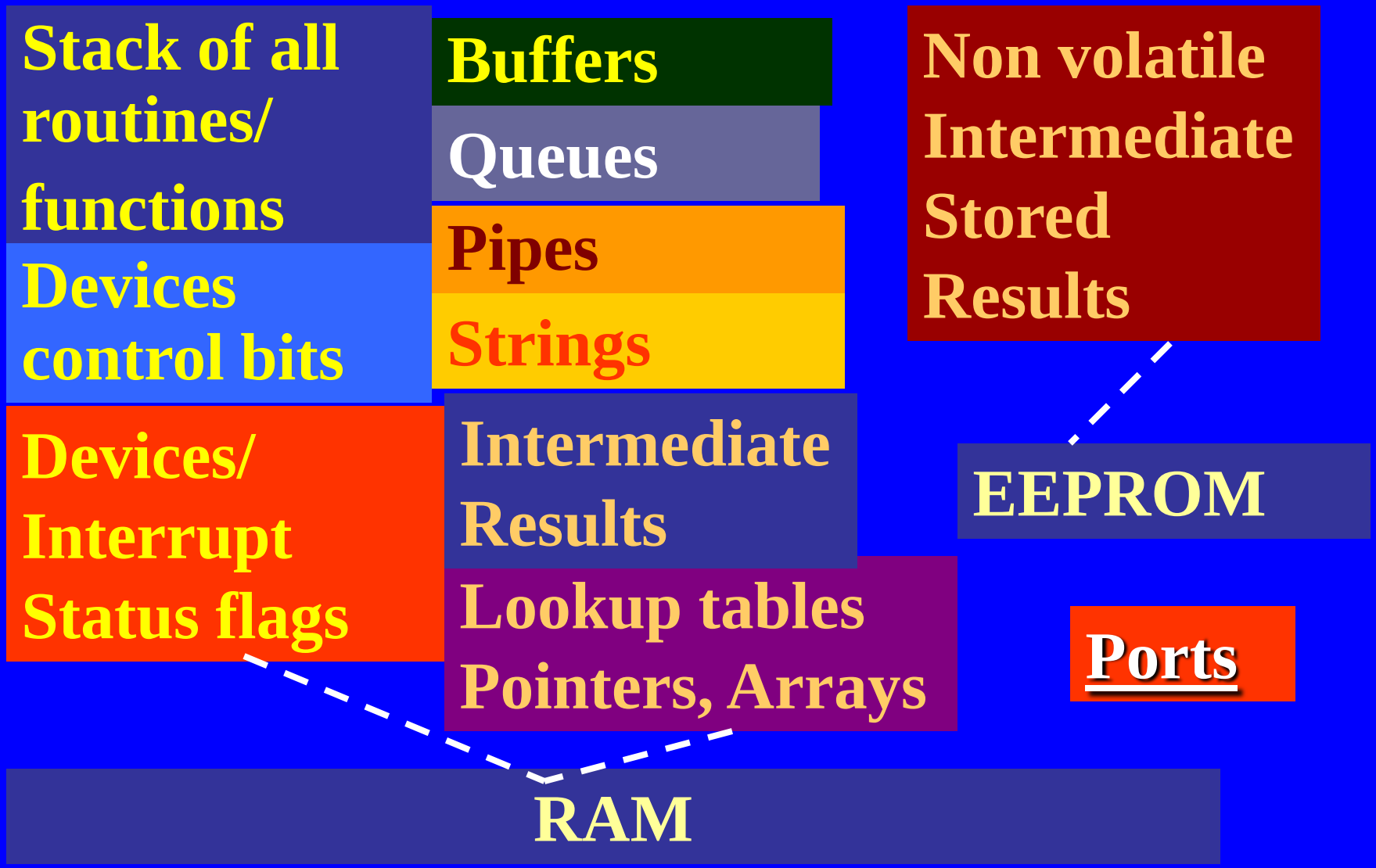



# Microcontroller-resources

# Program Memory Address Space



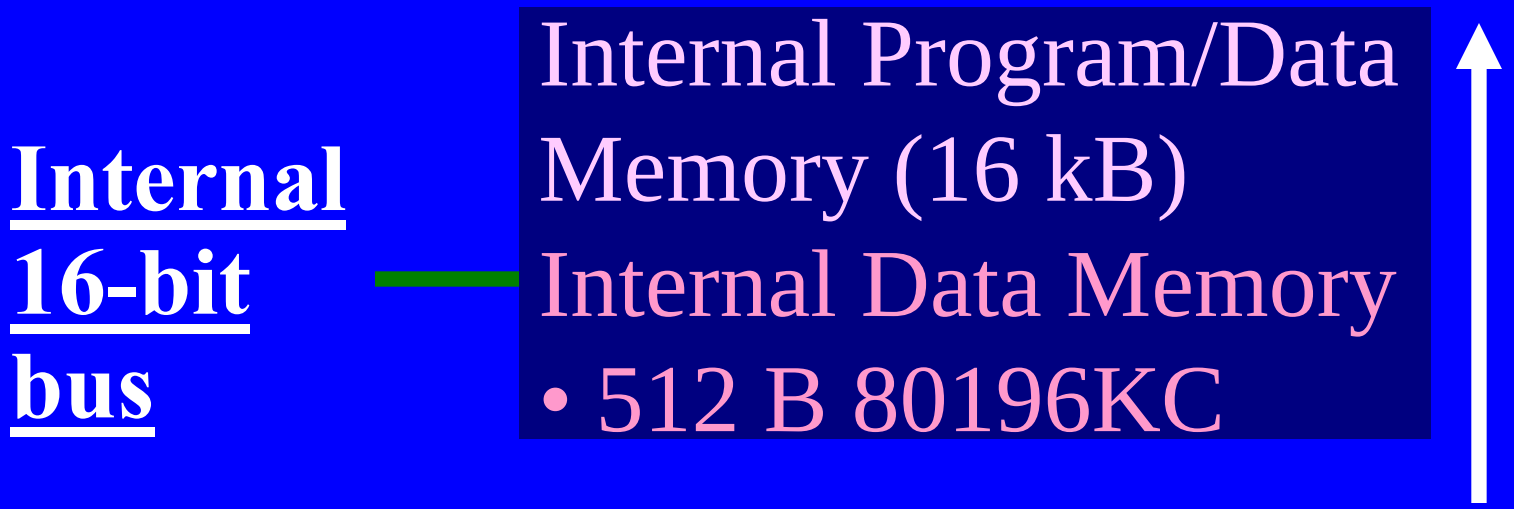
# Data Memory Address Space



# Memory Architecture

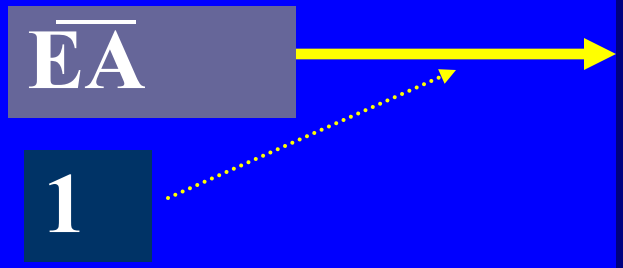
- Harvard Memory architecture - Separate memory address spaces for Data Memory and Program memory
- Princeton Memory architecture - Common memory address space for Data Memory and Program memory

# Common address spaces for program and data memory




16 kB Common address spaces for program and data memory

# Internal Memory Accessibility



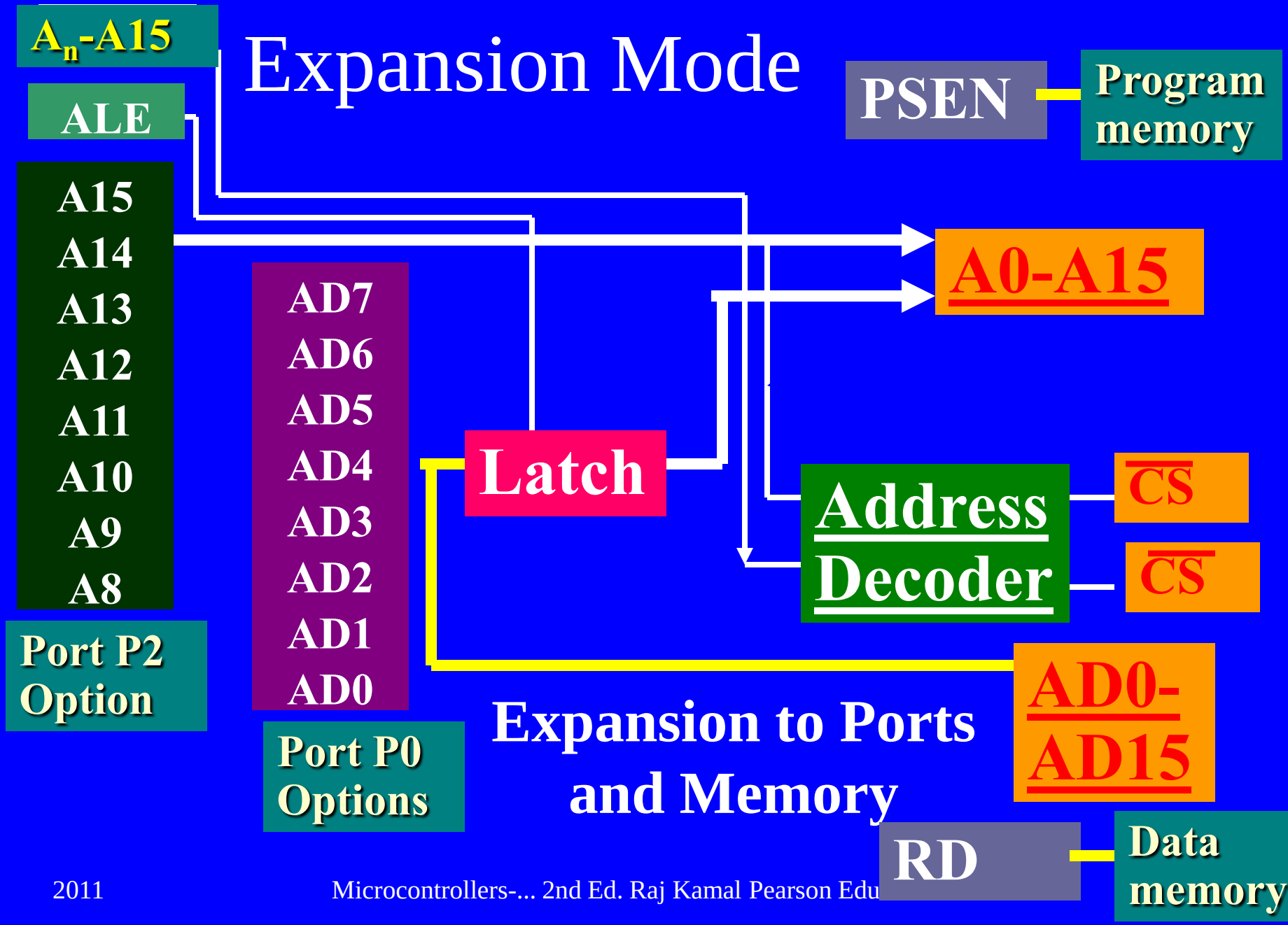

Internal Program Memory (1 kB)

Internal Data Memory
•64 B 8048

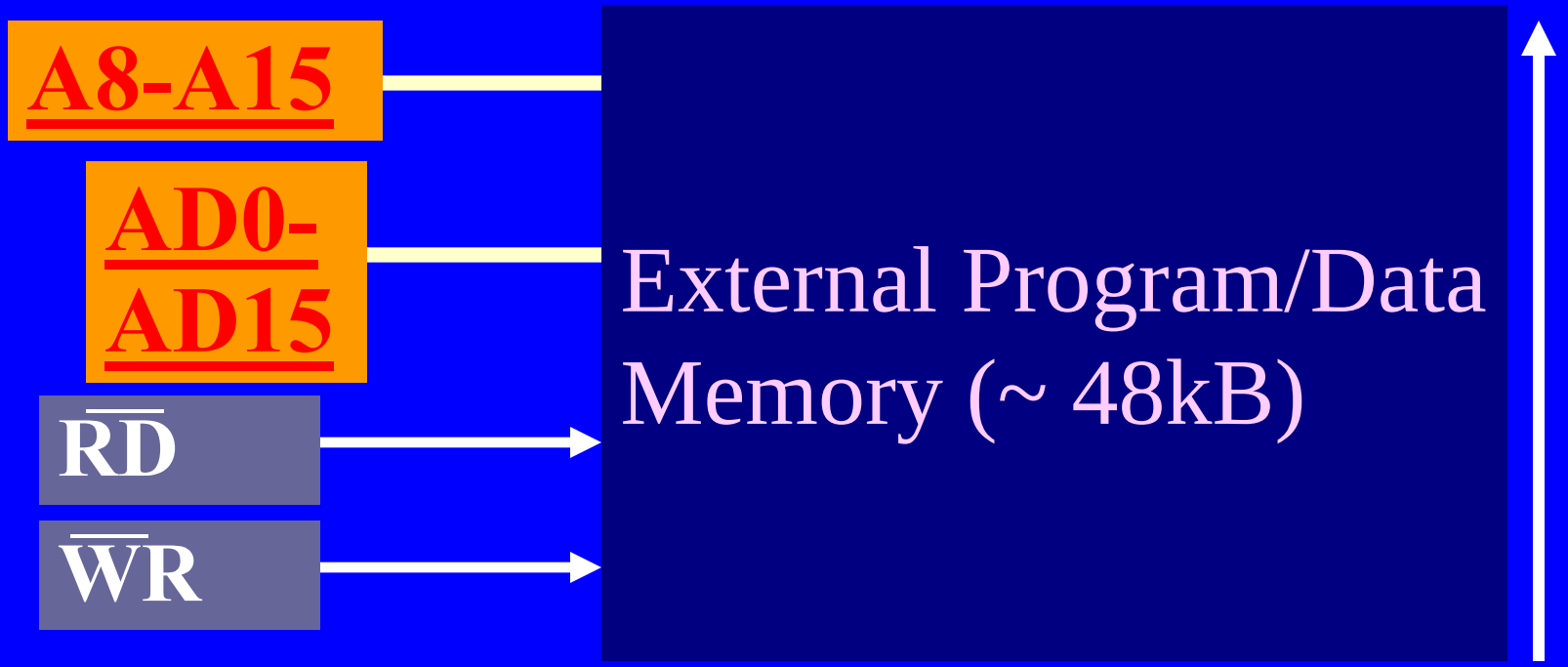
# MCU Expanded Mode used for interfacing

- External Data Memory
  and External Program memory

Interfaced using Ports

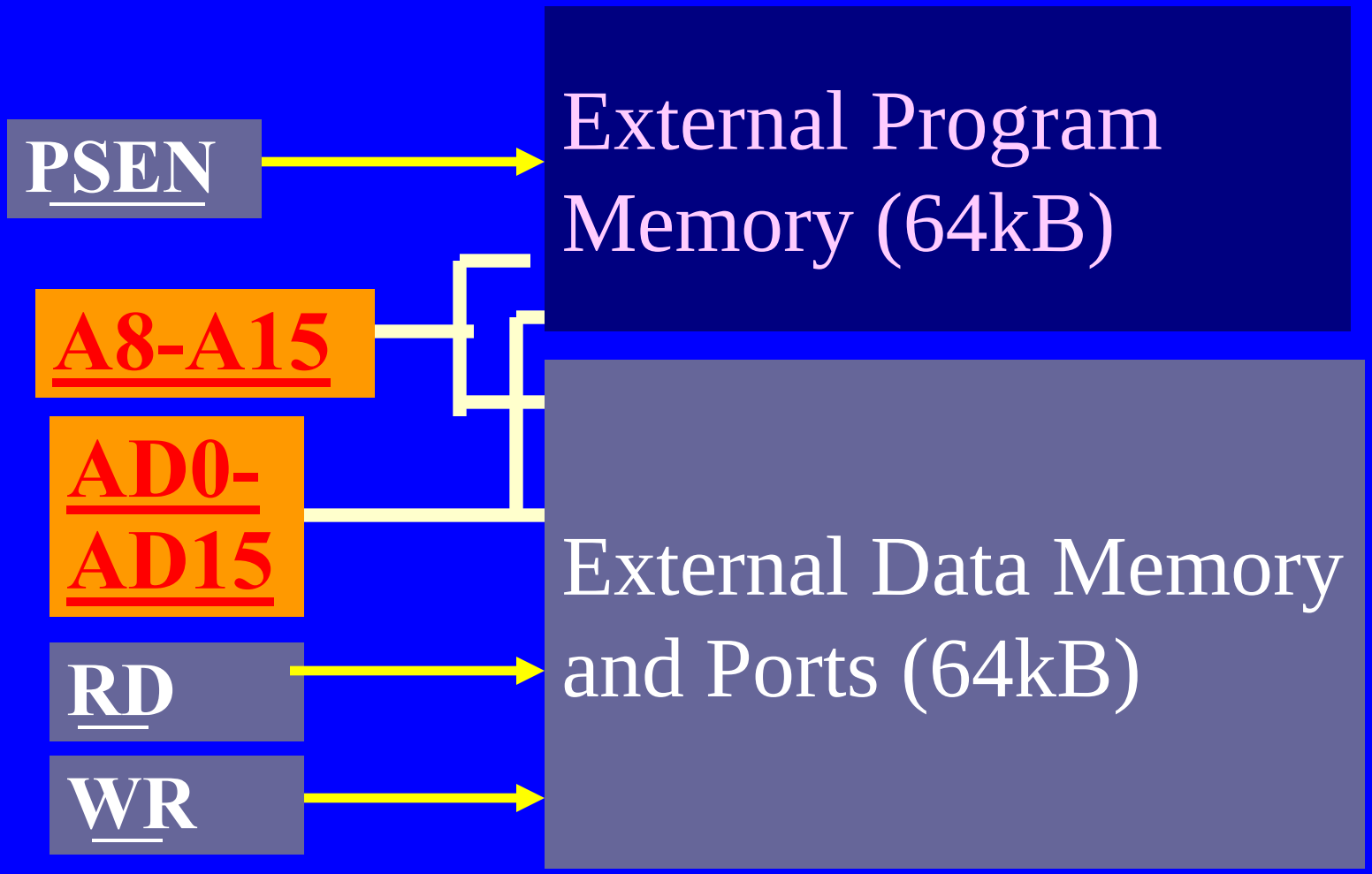

$A_n$-A15
ALE
A15
A14
A13
A12
A11
A10
A9
A8
Port P2 Option
AD7
AD6
AD5
AD4
AD3
AD2
AD1
AD0
Port P0 Options
Latch
Expansion Mode
PSEN
Program memory
A0-A15
Address Decoder
$\overline{CS}$
$\overline{CS}$
AD0-AD15
Expansion to Ports and Memory
RD
Data memory

# External Memory Princeton Architecture Example- 80196KC



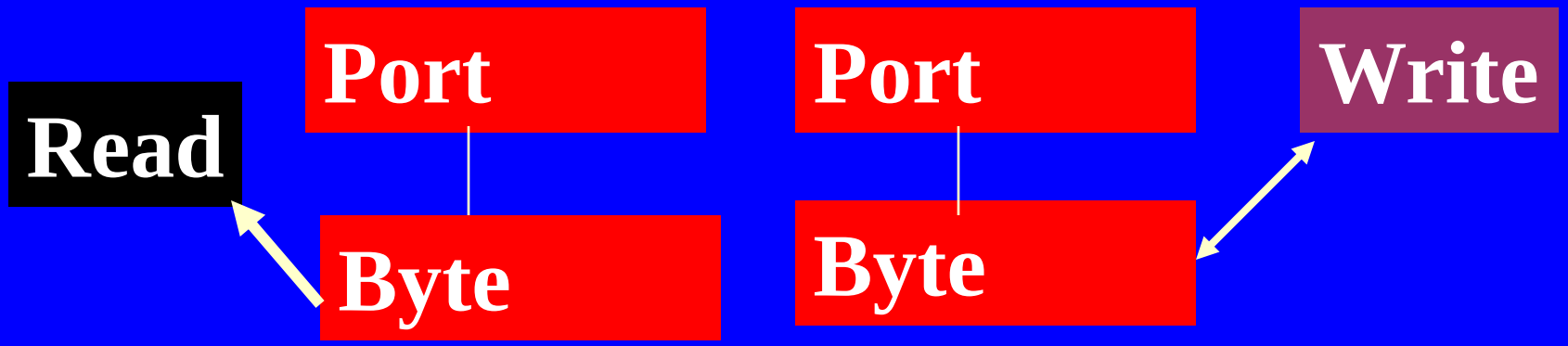

48 kB Common address spaces for program and data memory

# External Memory Harvard Architecture - 8048



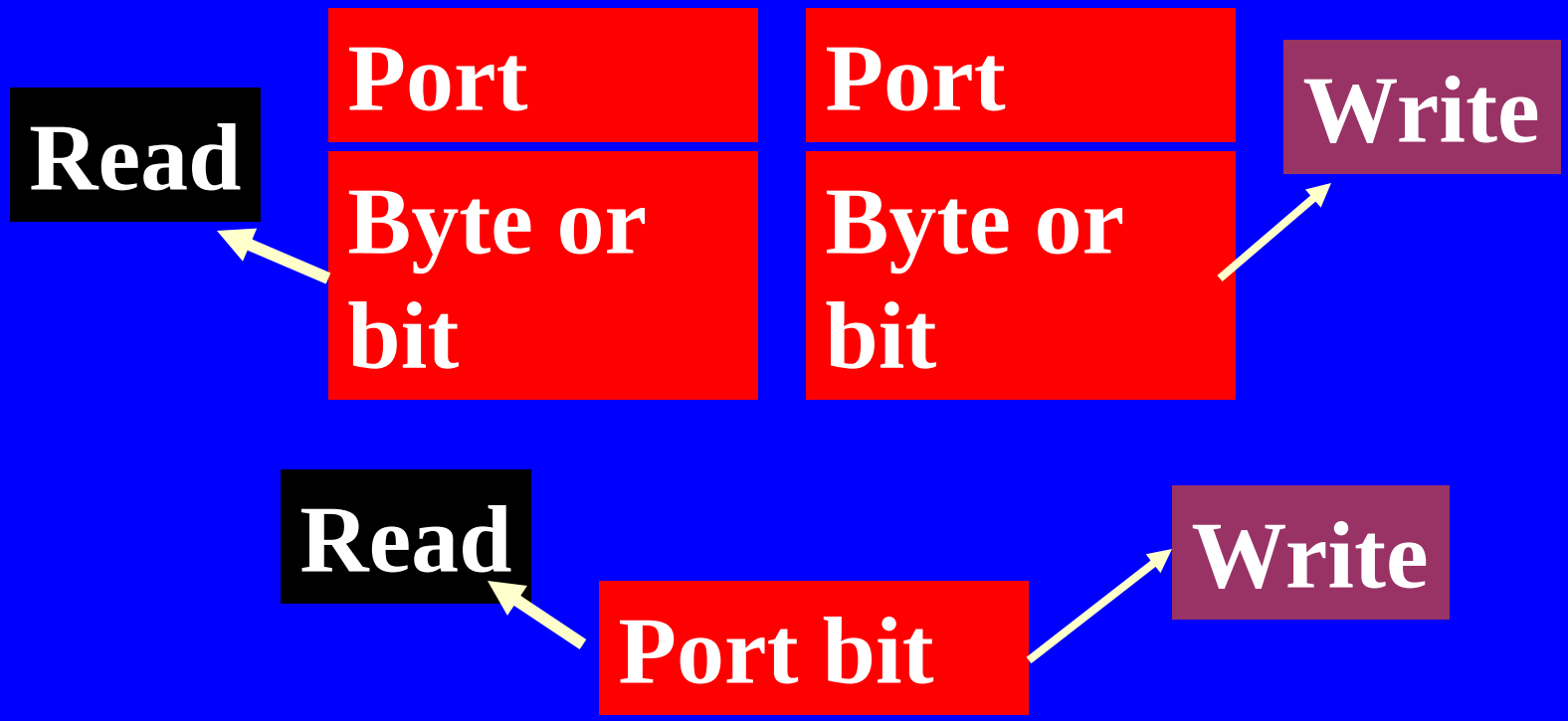
# Ports

# Ports in Data Memory space

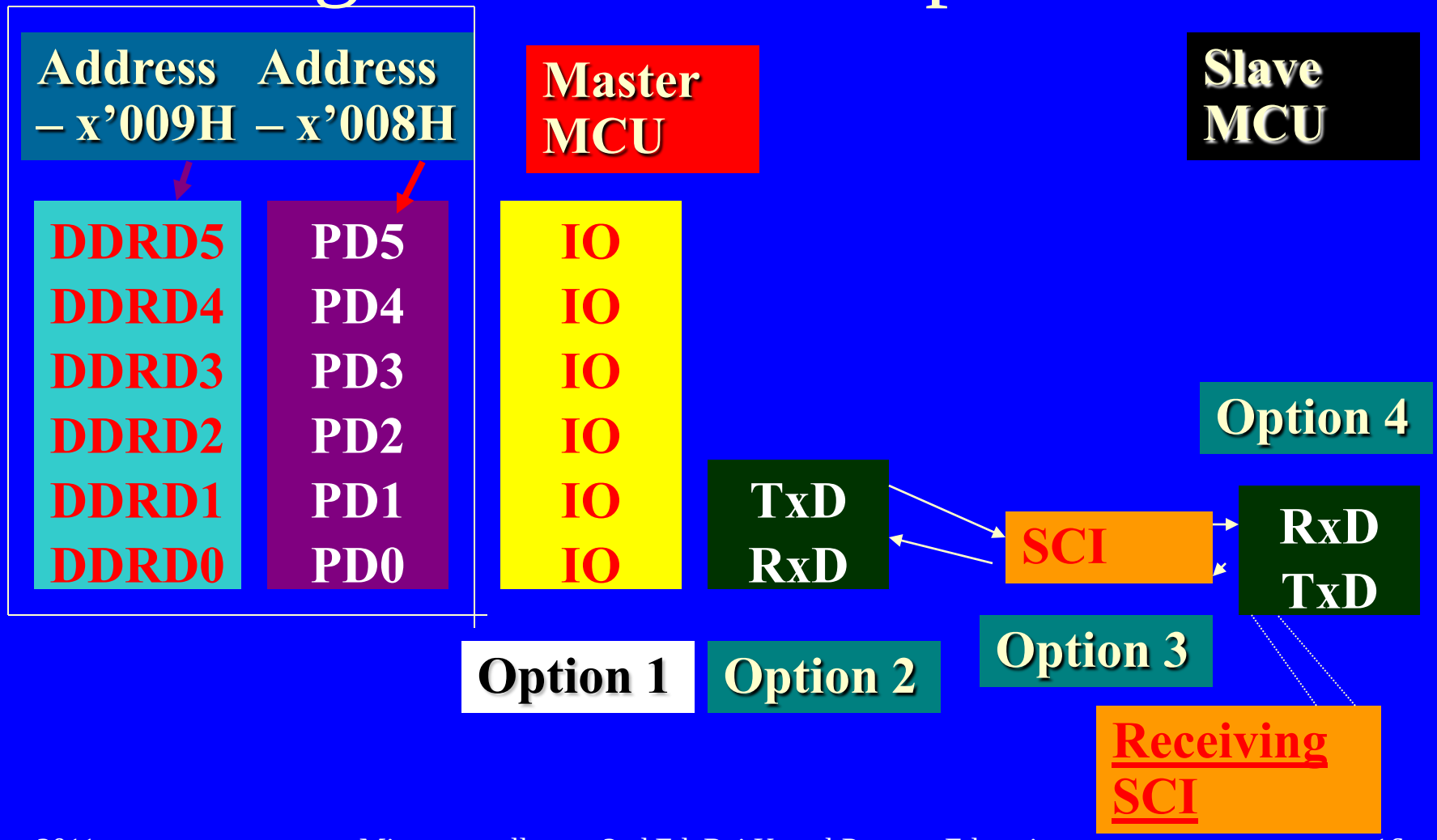



**There may or may not be separate addresses for each port bit in an MCU**

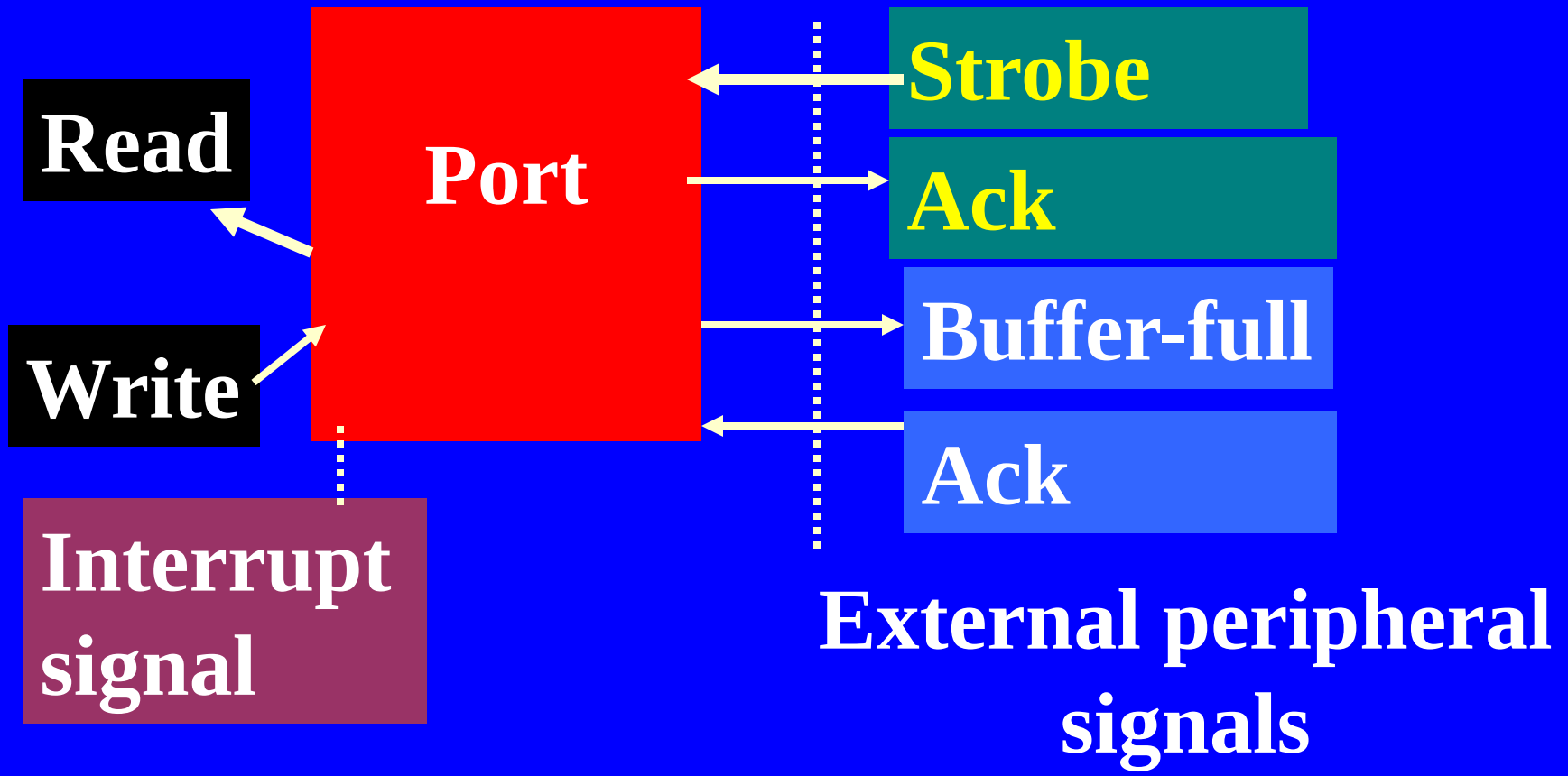
# Port bits can be either input port only, output port only, or a bi-direction port in Data Memory space



# Port bits with Data Direction bits in a register -An example

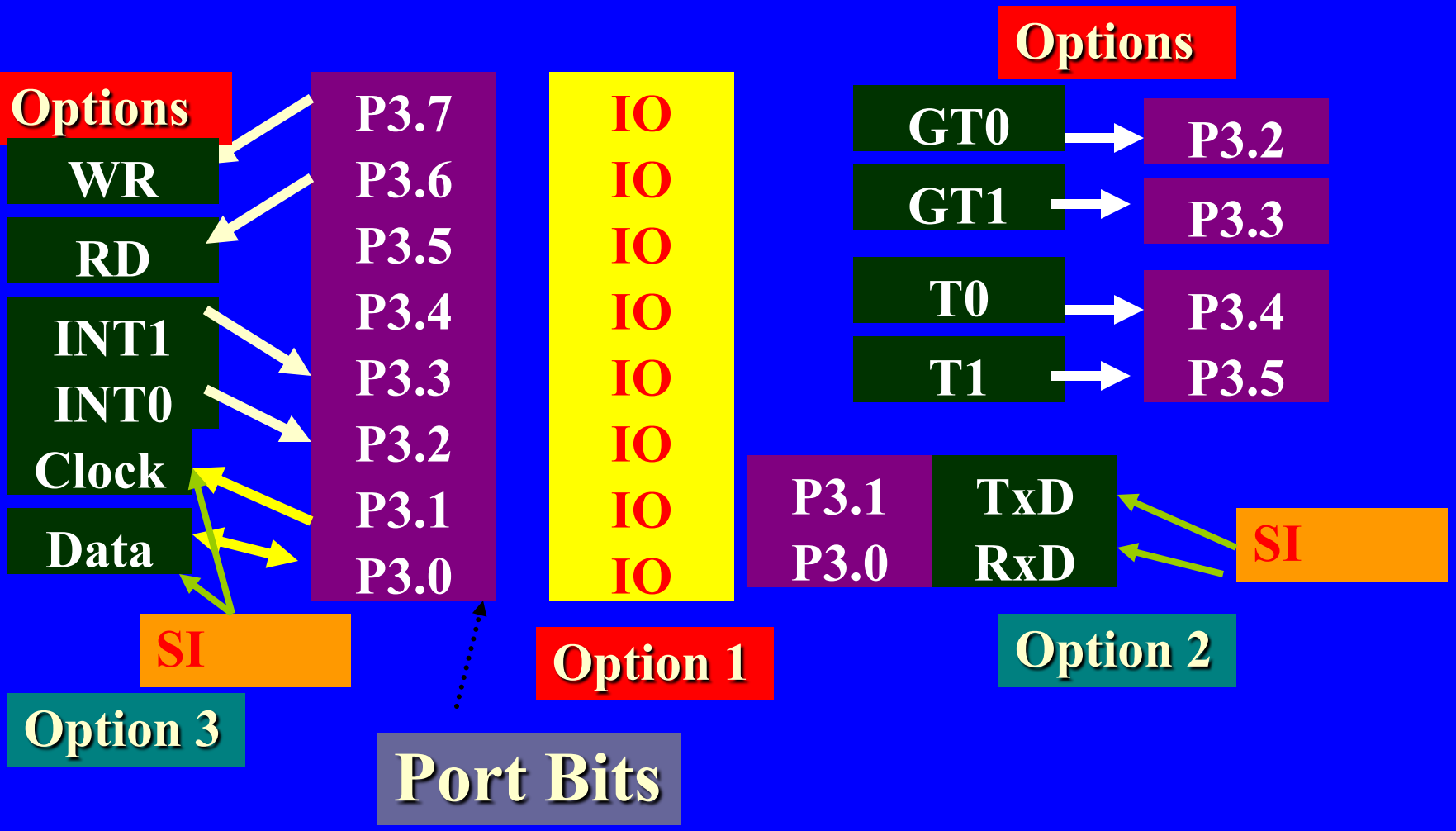


# Port use in handshake mode



# Port in Data Memory space - Options for port, address and data bus

# Port in Data Memory space - Exemplary Options for port bits



# EEPROM

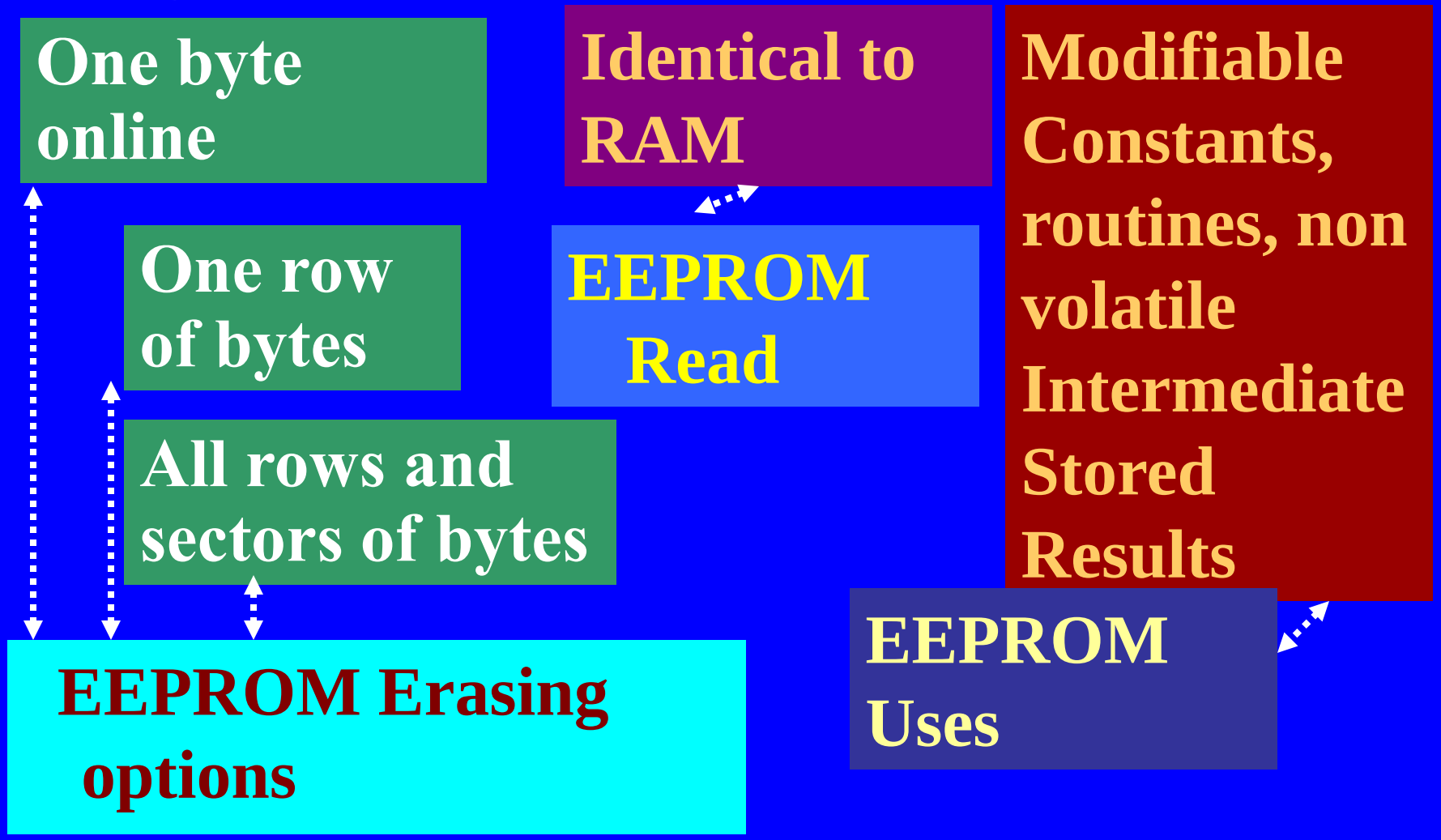
**1. EEPROM like ROM is Non-volatile - means no change in bytes on power switch off**

**2. Erasing means writing 1s at an address(es)**

**3. Programming means writing bytes (1s and 0s) at the addresses for non-volatile uses**

**4. Programming is by writing one byte in one write cycle at an erased address**

# EEPROM- Electrically Erasable and Programmable Memory



# FLASH

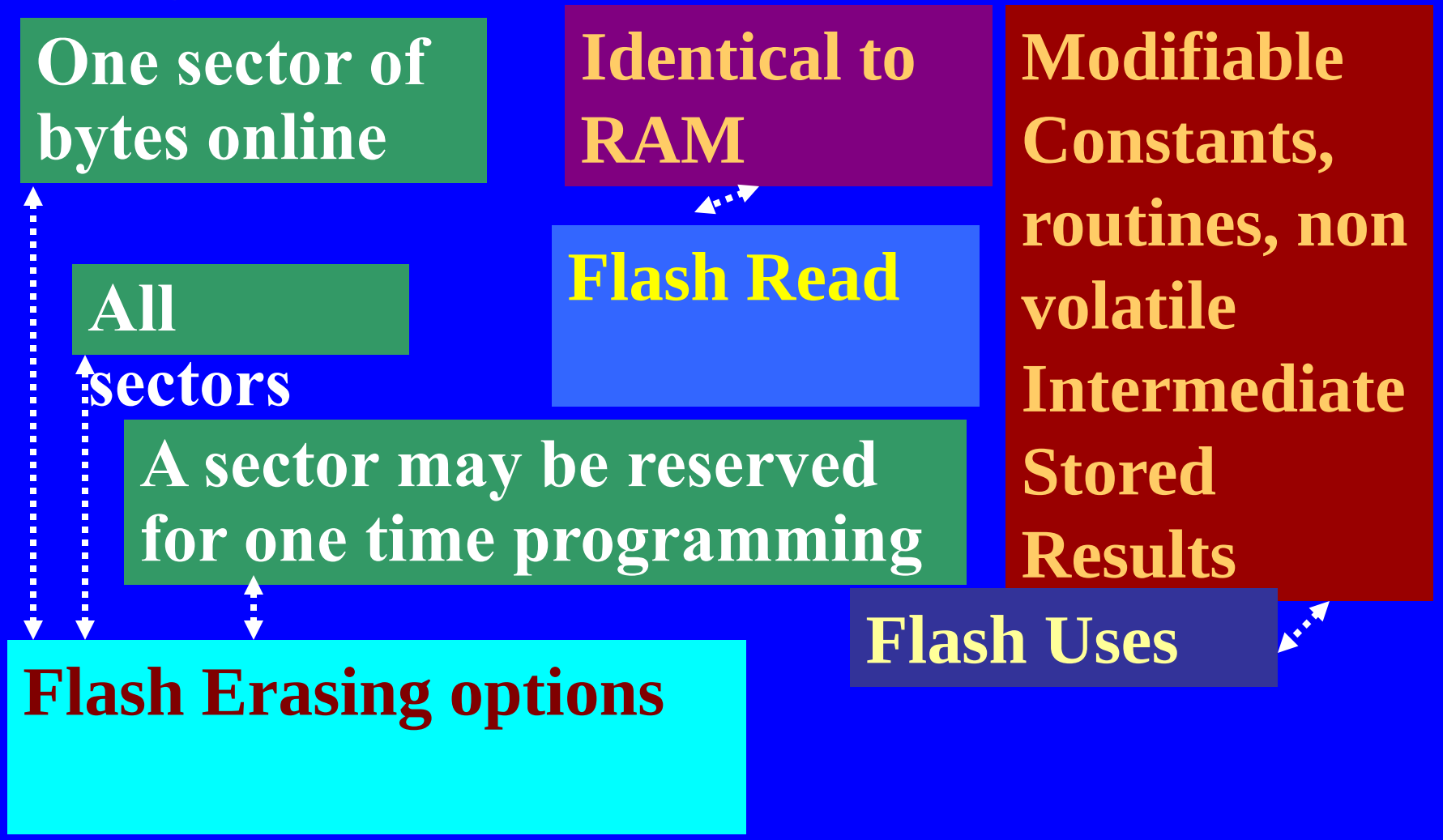
**1. Flash like EEPROM is Non-volatile - means no change in bytes on power switch off**

**2. Erasing means writing 1s at a sector addresses**

**3. Programming means writing bytes (1s and 0s) at the addresses for non-volatile uses**

**4. Programming is by writing one byte in one write cycle at an erased address**

# Flash- An Electrically Erasable and Programmable Memory



# Summary

## We learnt

- Data Memory Space- Stacks,Ports and temporary data,queues, lookup tables, strings, control bits, status flags
- Program Memory - Programs,constants, stored tables,constant strings

# We learnt

- Memory
- ROM
- EEPROM
- Flash
- RAM

# We learnt

- Internal Data Memory and Internal Program Memory - Princeton Architecture (Common address space)
- External Data Memory and Internal Program Memory - Princeton Architecture (Common address space)

# We learnt

- Internal Data Memory - Harvard Architecture
- Internal Program Memory - Harvard Architecture
- External Program Memory - Harvard Architecture
- External Data Memory - Harvard Architecture