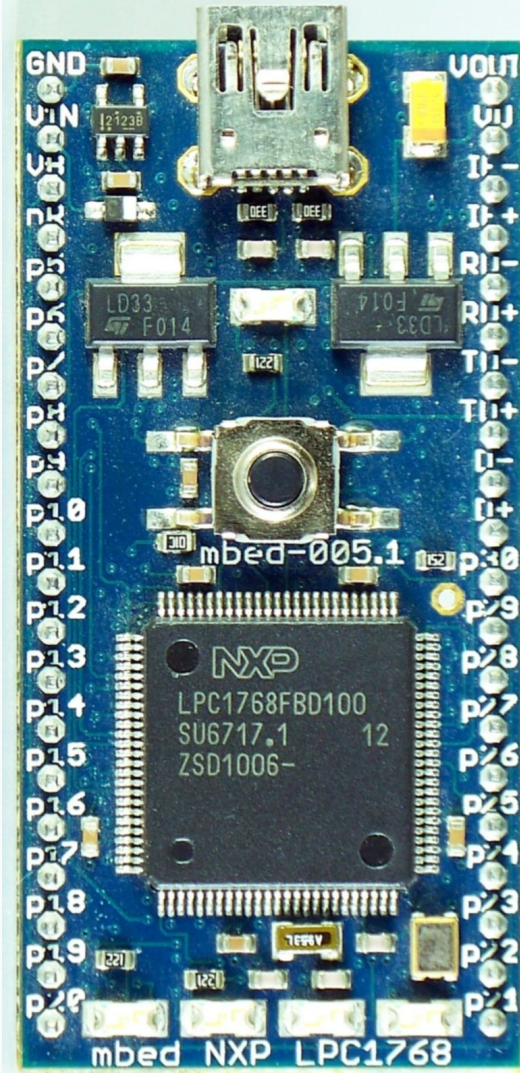


# Architecture Study: mbed

SY303 - Cyber Systems Architecture

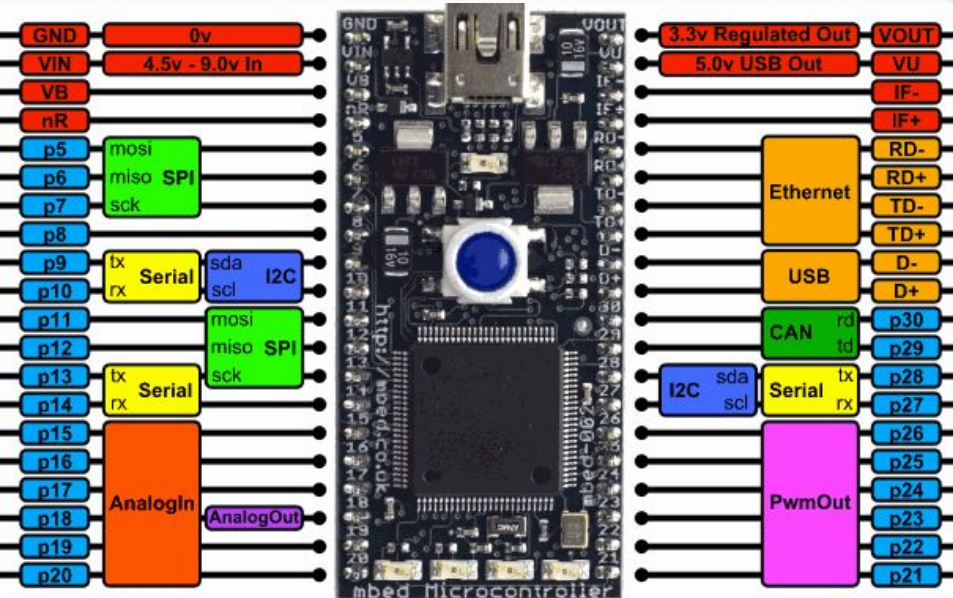


# mbed



- Description
- Features
- Architecture
- Memory Map
- Instruction Set Architecture

# Description



- Designed for embedded applications
- Low power consumption
- Enhanced debug features
- Slew of peripheral options
  - 2 Controller Area Network (CAN) channels
  - Ethernet
  - USB
  - Universal Asynchronous Receiver/Transmitters (UARTs)

# LPC 1768

## MBED MICROCONTROLLER

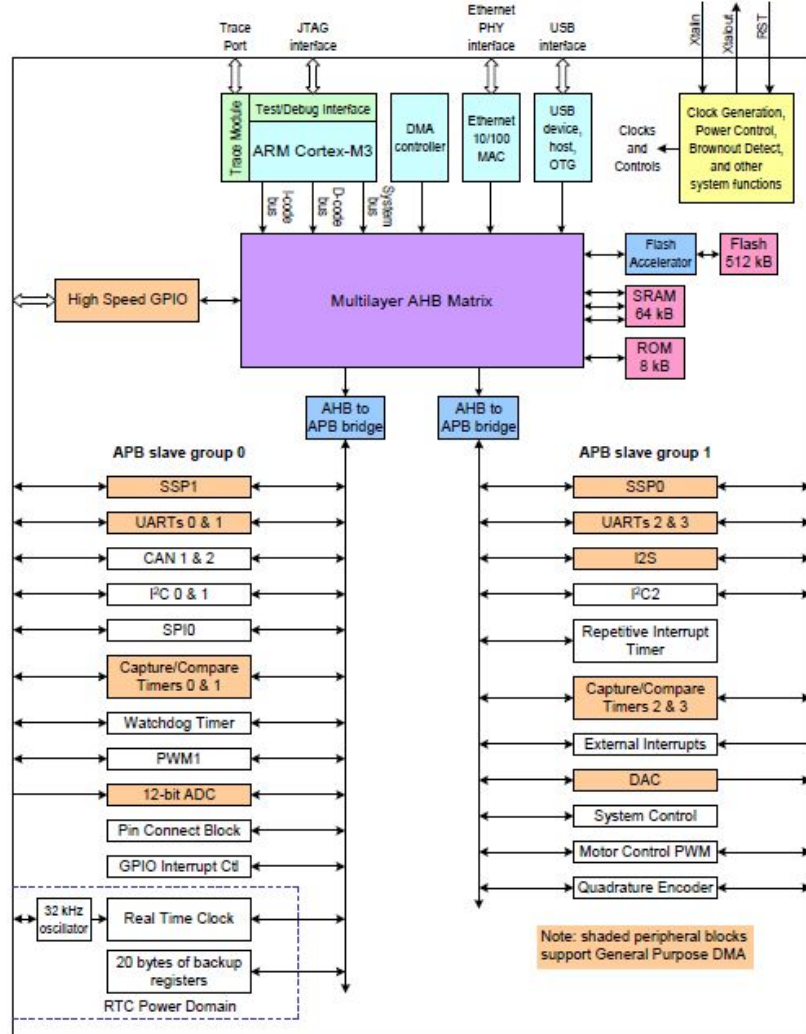


Fig 1. LPC1768 simplified block diagram

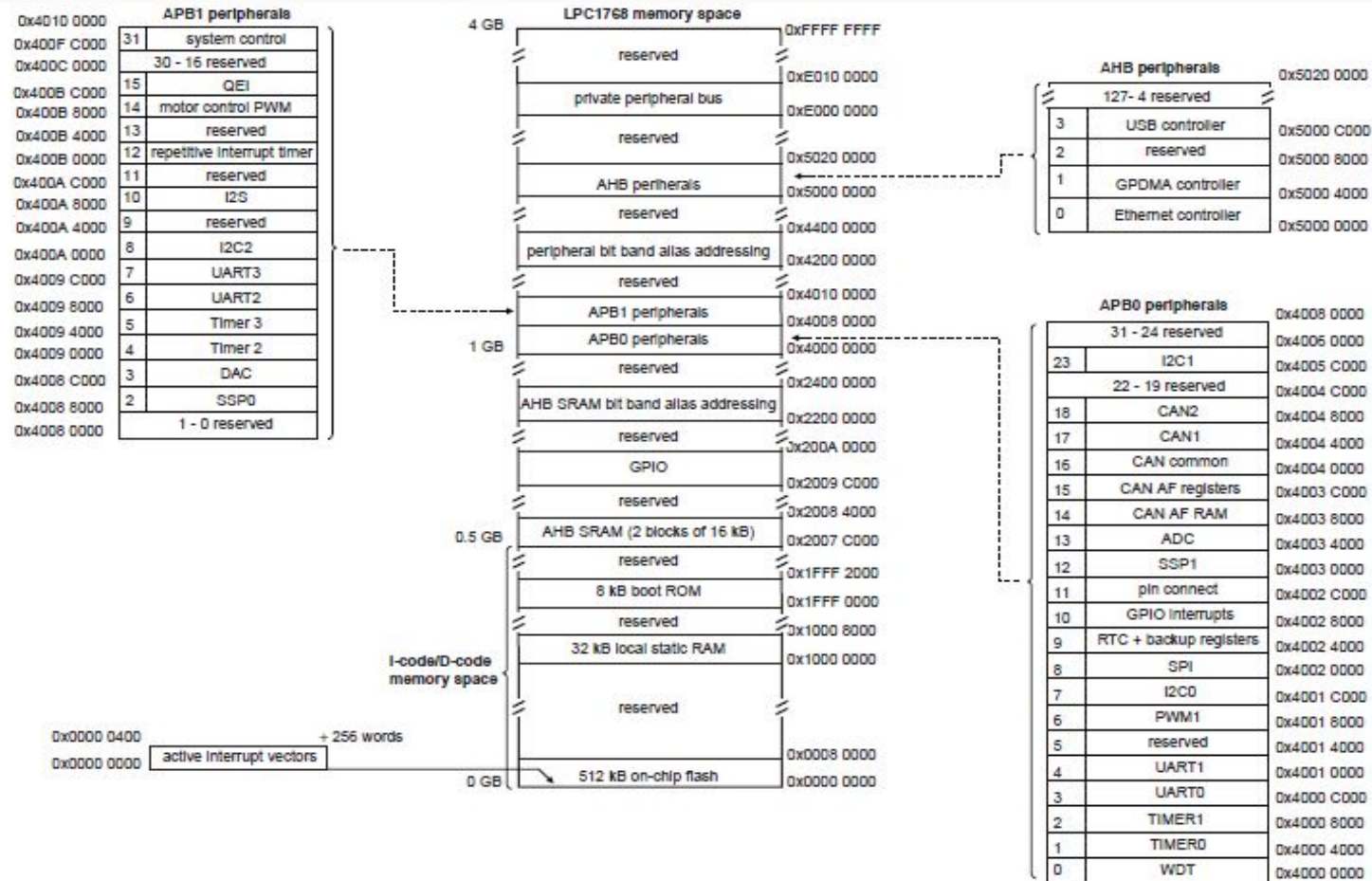


Fig 3. LPC176x/5x system memory map

# Features

- On-line programming!
- 8 Region Memory Protection Unit (MPU)
- Nested Vectored Interrupt Controller (NVIC)
- Direct Memory Access (DMA) controller
- Power-On Reset

# Features

- 12 bit Analog-to-Digital Converter (ADC)
- 10 bit Digital-to-Analog Converter (DAC)
- Real-Time Clock (RTC)
- Repetitive Interrupt Timer
- JTAG Debug Interface
- Non-Maskable Interrupt Input

# Architecture

- ARM Cortex-M3
- Up to 100 MHz
- 3-stage pipeline
- Harvard Architecture
  - Separate instruction/data buses
- Prefetch Unit
  - Speculative branching



# Architecture

- 70 GPIO pins
- Advanced High-Performance Bus (AHB) Matrix
  - System Bus
  - Instruction Fetch (I-code) Bus
  - Data Access (D-code) Bus
- Advanced Peripheral Bus (APB)
- 512kB flash memory
- 64kB SRAM

# Processor

- Cortex-M3
- Harvard Architecture
- NVIC
  - 256 Interrupt Priority Levels
  - Fast Interrupt Service Routines
- Power efficient sleep modes
- Debug & Trace
- MPU

# Instruction Set Architecture

- ARM Thumb
- 32-bit Instructions
- Privilege Levels
- Main and Process Stacks
  - Full Descending
- Registers
  - 13 General Purpose
  - 8 Program Control
  - 4 System Control
- Little Endian Data Access

# Homework

## Monday

1. Discuss this introduction and seek out additional resources
2. Each student choose a feature to research
  - a. Write 2-3 paragraphs Discussion Board entry on it for Tuesday

## Tuesday

1. Present on your feature
  - a. Up to 5 min
2. Choose a different feature to analyze and write a question for
  - a. Make that question a comment on the original discussion board

## Thursday

1. Review all Discussion Board entries and associated questions.
2. Vote on best question (not yours!)

# Features To Research

- ❑ Nested Vectored Interrupt Controller
- ❑ General Purpose I/O
- ❑ Ethernet
- ❑ USB
- ❑ Universal Asynchronous Receiver Transmitter (UART)
- ❑ Controller Area Network (CAN)
- ❑ I<sup>2</sup>S Bus
- ❑ System Tick Timer
- ❑ Pulse Width Modulator
- ❑ Quadrature Encoder Interface
- ❑ Real Time Clock
- ❑ Watchdog Timer
- ❑ Analog to Digital Converter
- ❑ Digital to Analog Converter
- ❑ General Purpose DMA
- ❑ Flash Memory
- ❑ JTAG / Debugging