mbed OS
Adding Storage Support

ARM

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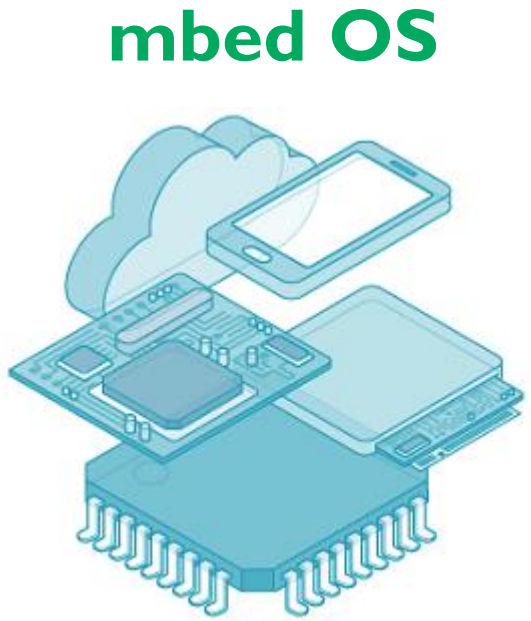
Agenda

- Mbed OS 5.4 Storage: What's New?
  - Block Device API.
  - FAT32 Filesystem SDCard Support.
  - Block Device examples.
  - Documentation.
- Storage Technical Overview.
  - Filesystem top down view.
  - Memory Technology Device bottom up view.
  - Block Device API.
  - The SDCard Driver (SDBlockDevice).
  - The SPI NOR Flash Driver (SPIFBlockDevice).
  - Resource Usage.
- Conclusions

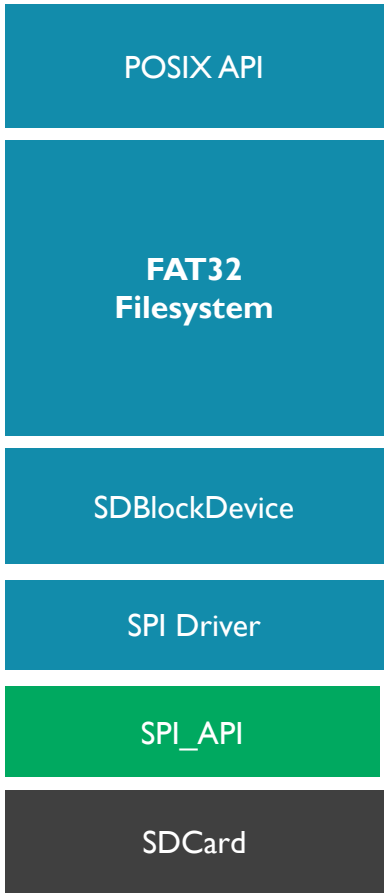


mbed OS 5.4 Storage
What's New?

Block Store API: class BlockDevice

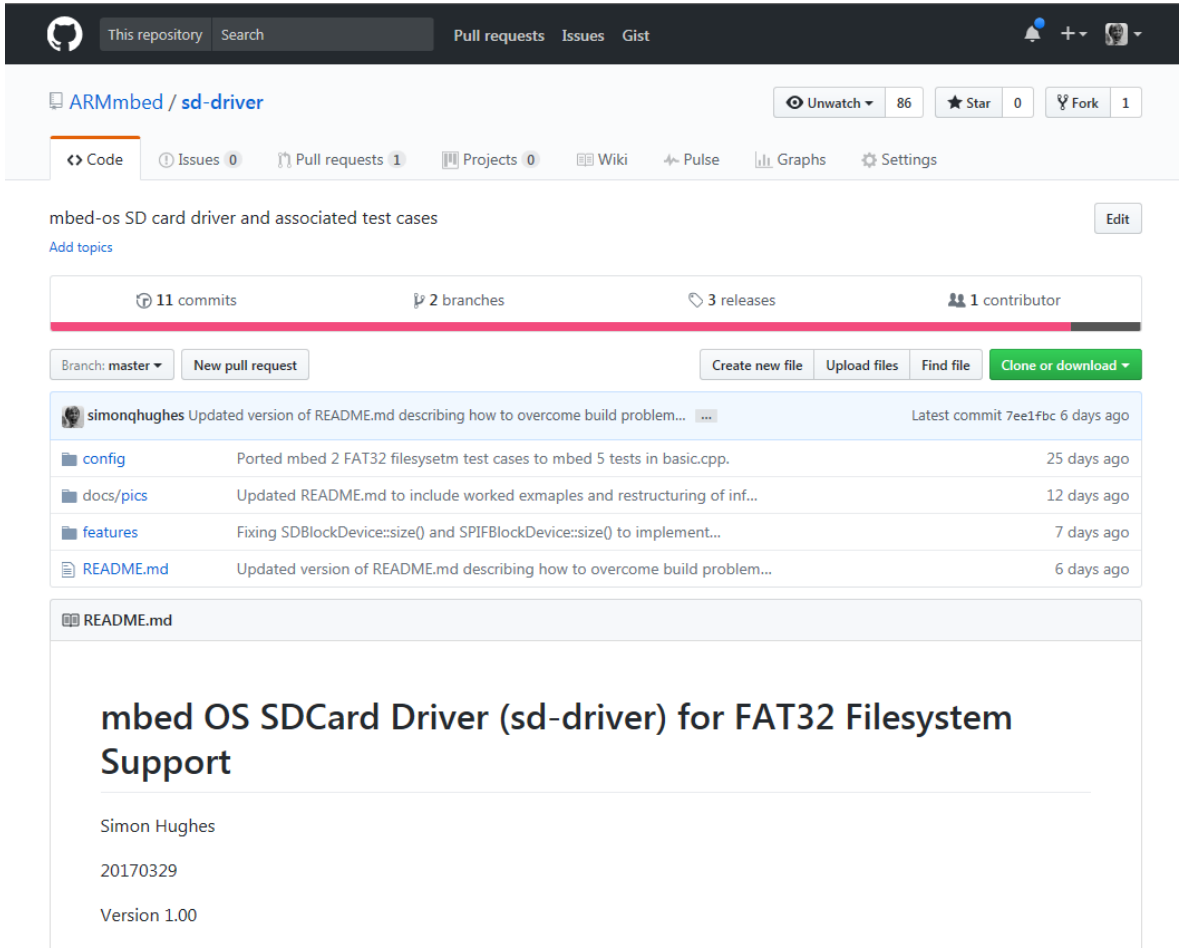
```
/** A hardware device capable of writing and reading blocks
 */
class BlockDevice
{
public:
    virtual ~BlockDevice() {};
    virtual int init() = 0;
    virtual int deinit() = 0;
    virtual int read(void *buffer, bd_addr_t addr, bd_size_t size) = 0;
    virtual int program(const void *buffer, bd_addr_t addr, bd_size_t size) = 0;
    virtual int erase(bd_addr_t addr, bd_size_t size) = 0;
    virtual bd_size_t get_read_size() const = 0;
    virtual bd_size_t get_program_size() const = 0;
    virtual bd_size_t get_erase_size() const = 0;
    virtual bd_size_t size() const = 0;
    bool is_valid_read(bd_addr_t addr, bd_size_t size) const;
    bool is_valid_program(bd_addr_t addr, bd_size_t size) const;
    bool is_valid_erase(bd_addr_t addr, bd_size_t size) const;
};
```

sd-driver repository: The SDCard Driver



The SDCard driver

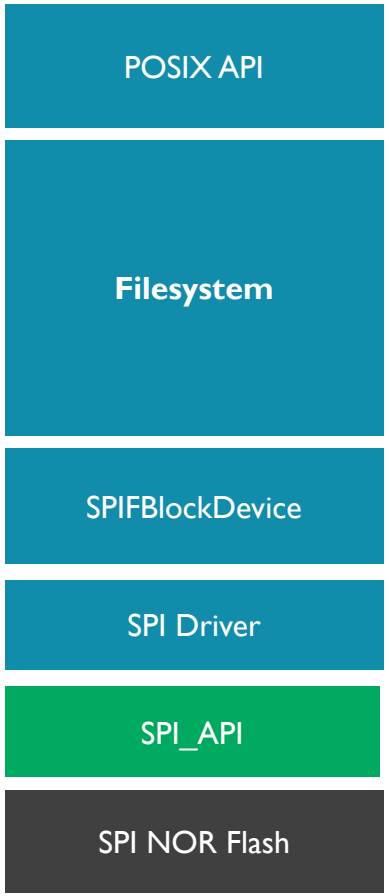
- SDBlockDevice: https://github.com/armmbed/sd-driver



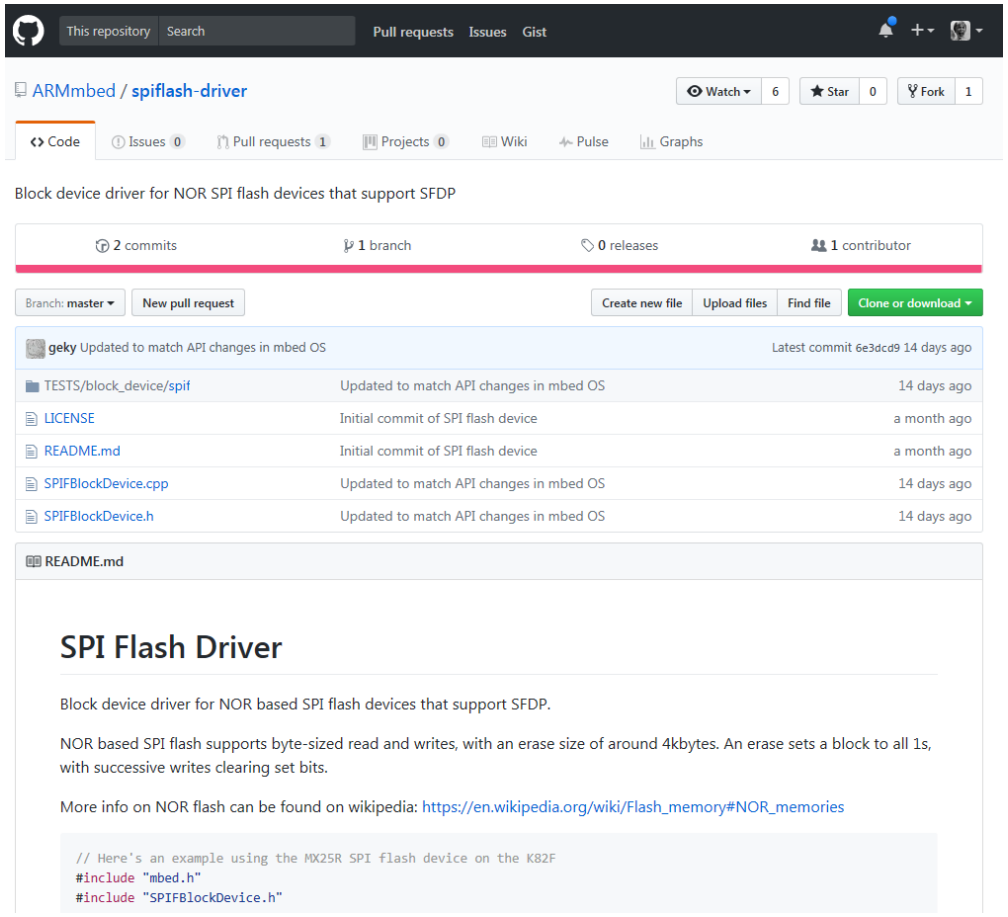
mbed OS Component | Partner Component | Hardware

ARM

spiflash-driver repository: SPI NOR Flash Driver



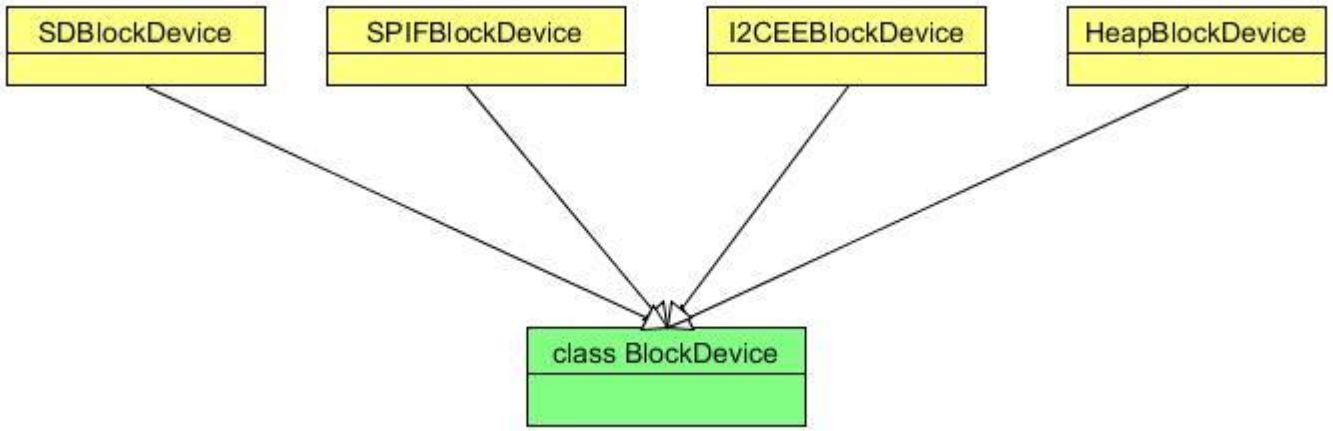
The SPI NOR driver



mbed OS Component | Partner Component | Hardware

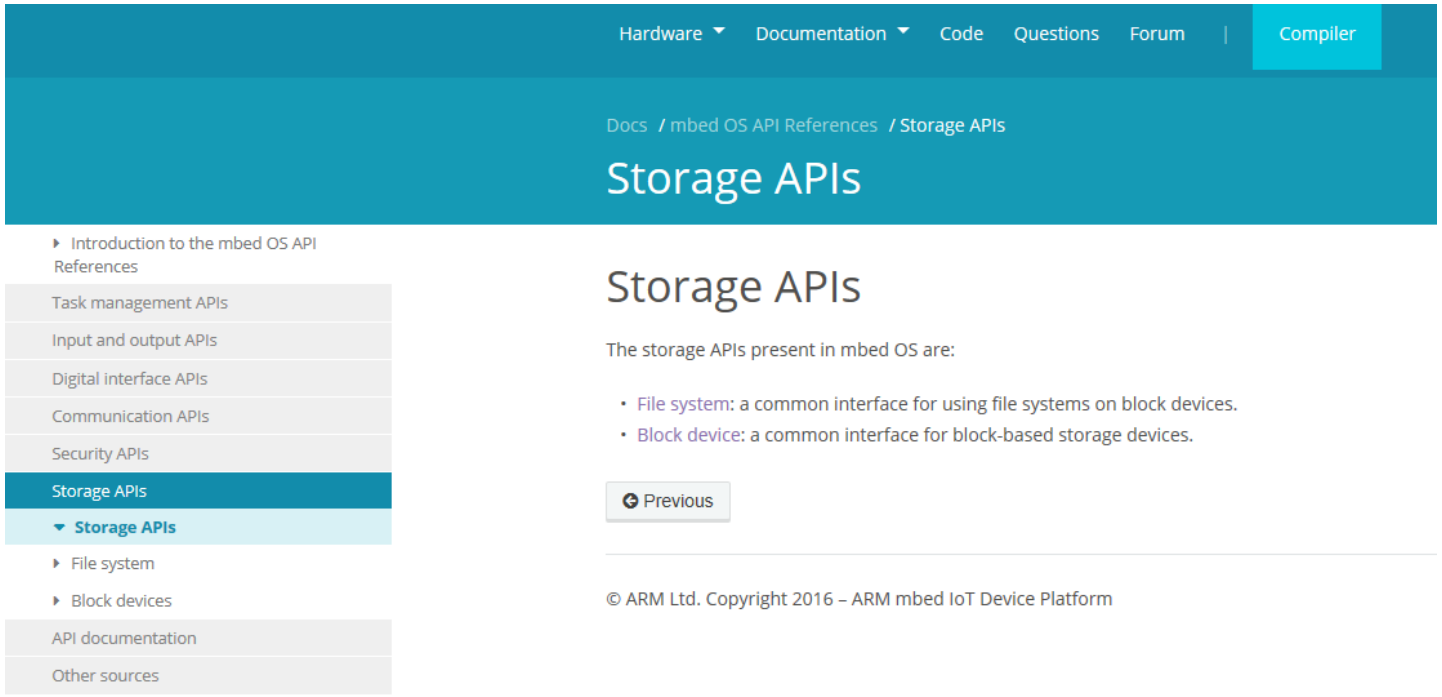
- SPIFBlockDevice: https://github.com/armmbed/spiflash-driver

Block Device Examples:



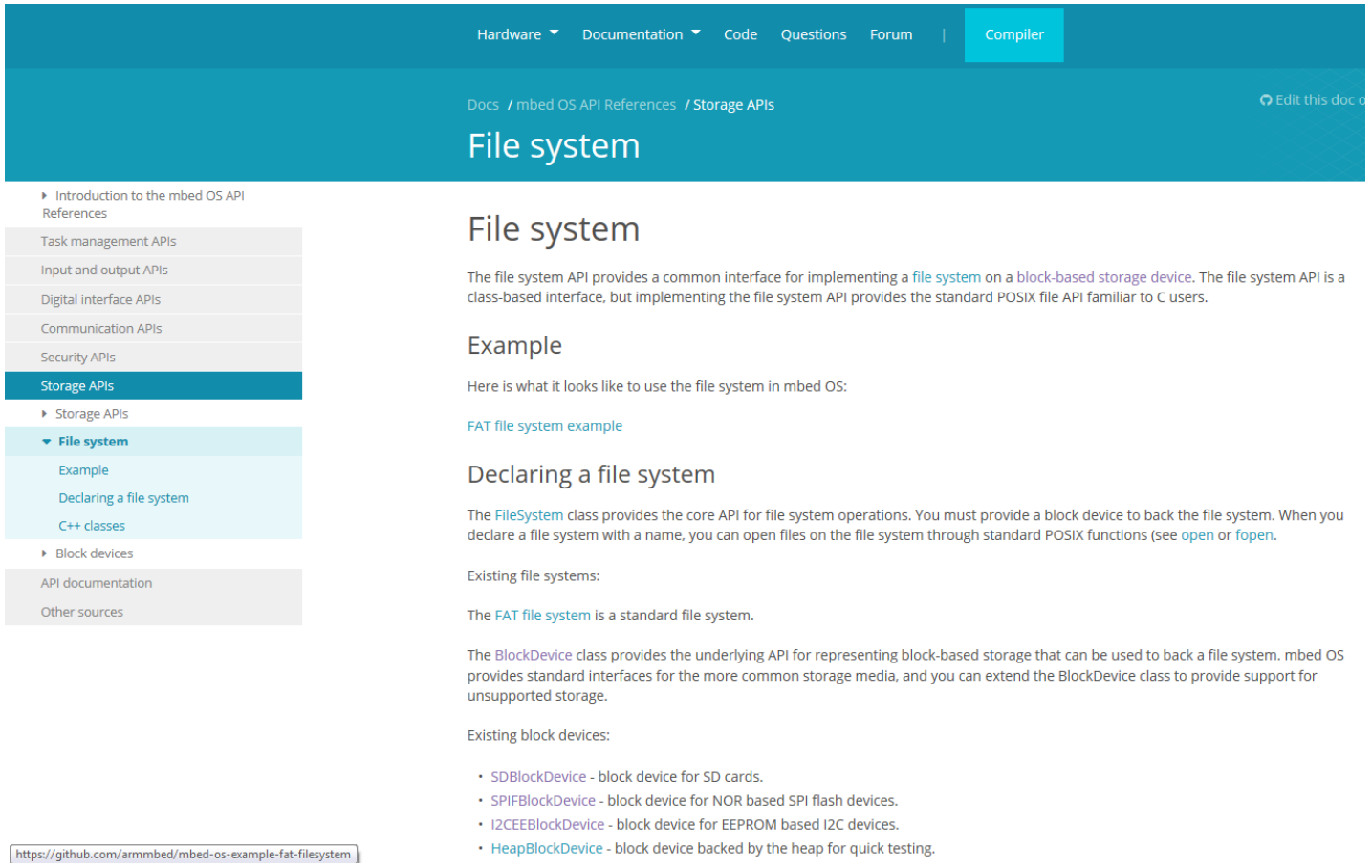
- SDBlockDevice example: https://github.com/armmbed/mbed-os-example-sd-driver
- SPIFBlockDevice example: https://github.com/armmbed/mbed-os-example-spiflash-driver
- I2CEEBlockDevice example: https://github.com/armmbed/mbed-os-example-i2ceeprom-driver
- HeapBlockDevice:
- https://github.com/ARMmbed/mbed-os/blob/master/features/filesystem/bd/HeapBlockDevice.h

Documentation: Storage APIs



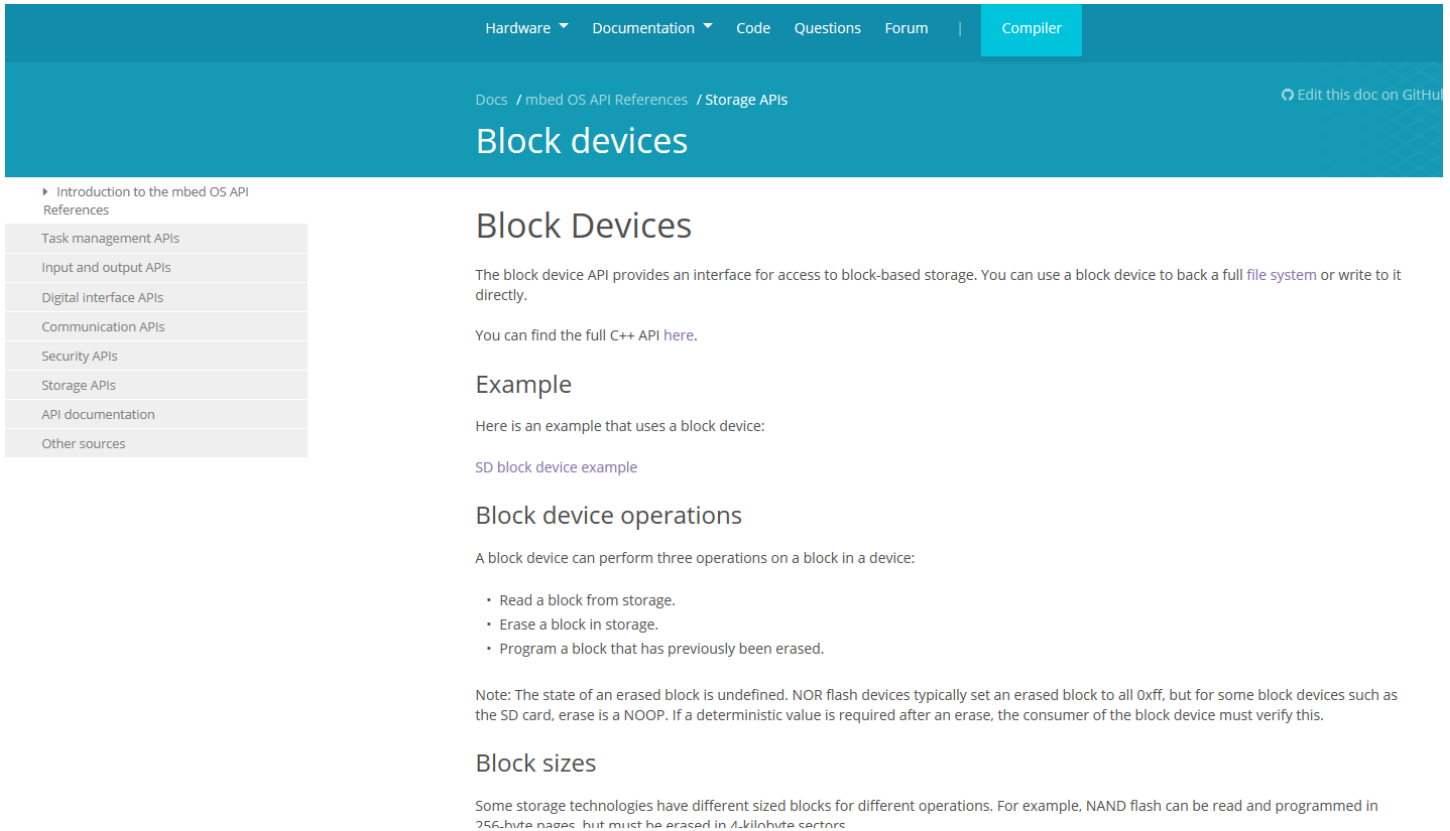
- https://docs.mbed.com/docs/mbed-os-api-reference/en/latest/APIs/storage/storage_index/

Documentation: File System



- https://docs.mbed.com/docs/mbed-os-api-reference/en/latest/APIs/storage/filesystem/

Documentation: Block Devices



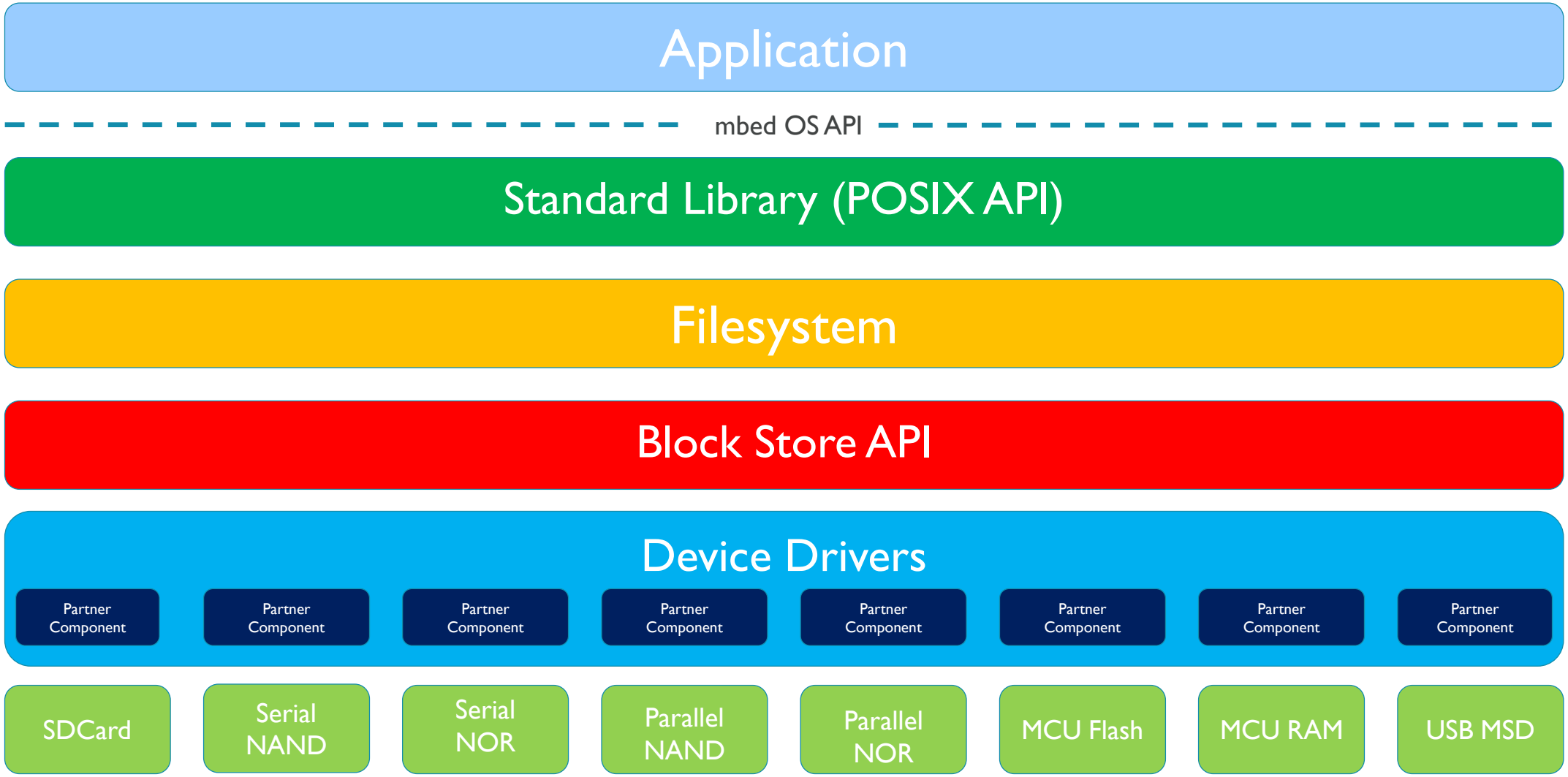
- https://docs.mbed.com/docs/mbed-os-api-reference/en/latest/APIs/storage/block_device/

Storage Technical Overview

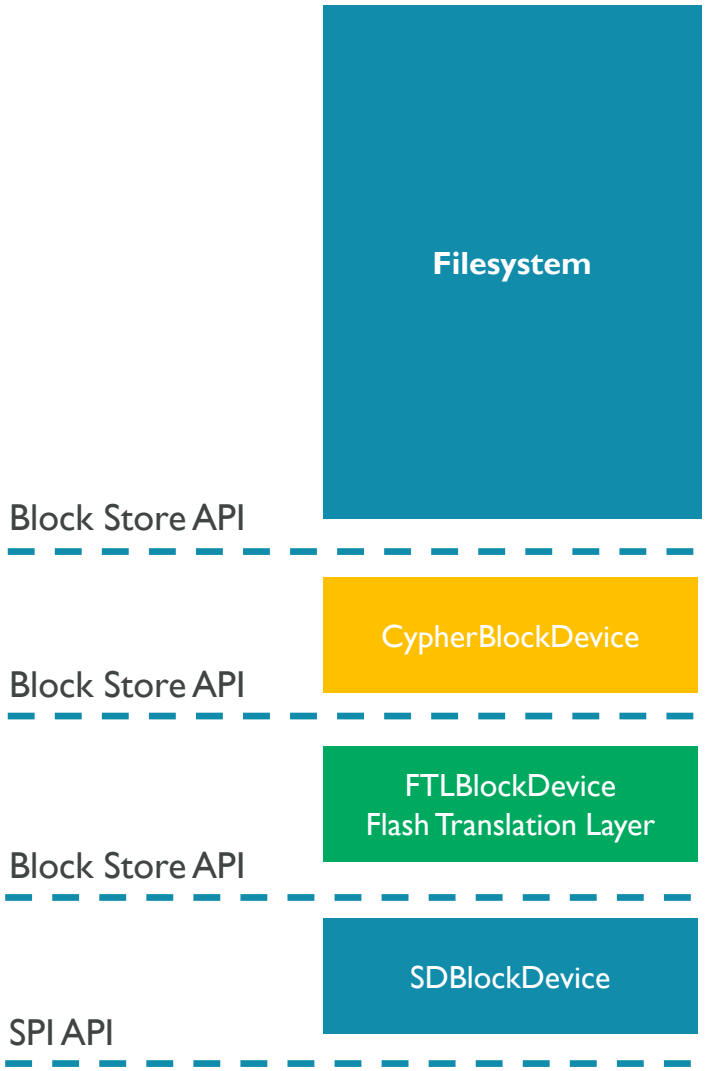
Storage: Overview

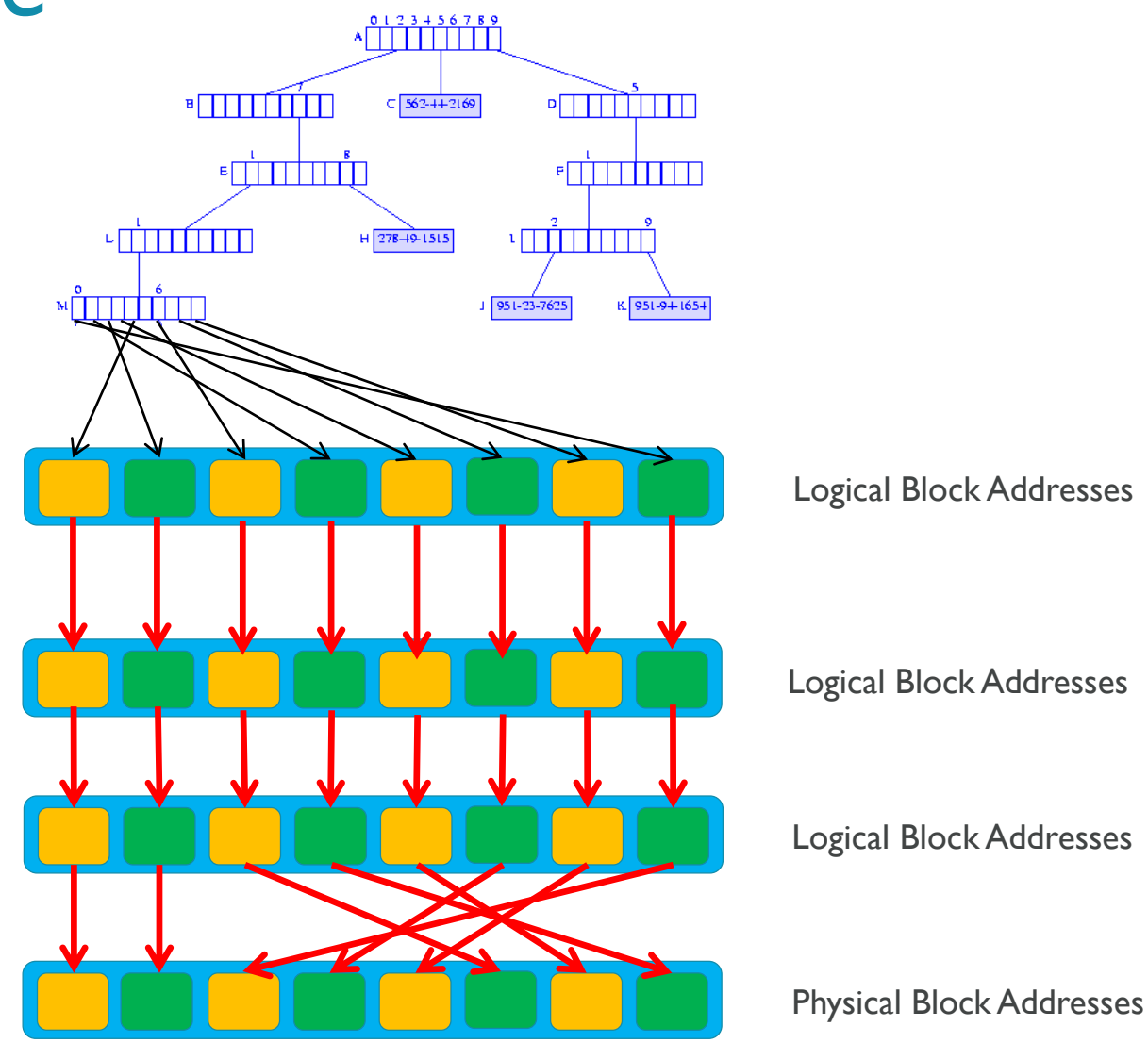
- Filesystem top down view:
  - Filesystem software stack.
  - Filesystem block storage and the rationale for the block device API.
- Flash Storage bottom-up view:
  - Memory Technology Devices (MTD) Characteristics.
  - Terminology (pages, sectors, blocks).
  - SPI NOR Flash.
- Block Device API.
- SDBlockDevice: the block device for SDCard.
  - How to use.
- SPIFBlockDevice: the block device for SPI NOR.
  - How to use.
- Filesystem Code size measurements.

File System Software Stack



Filesystem Block Storage





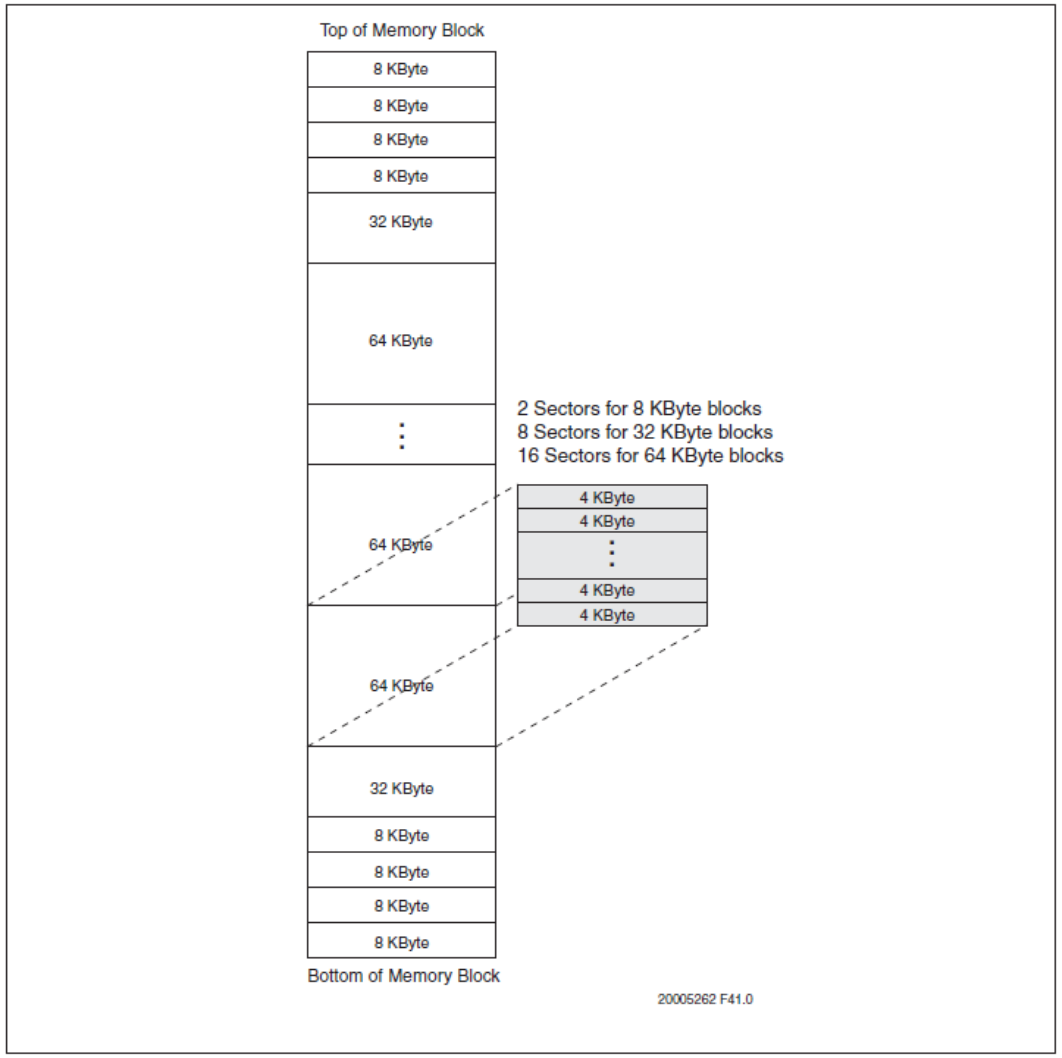
Memory Technology Devices (MTD)

Secure Digital (SD Card)	• Write/read semantic (no erase), page readable and writable. • On-board MCU to manage NAND properties (bad blocks, ECC). FAT Filesystems often supported. • Often connected via SPI protocol, or native SDCard protocol (supports 2 modes).
Serial/Parallel NOR FLASH	• Erase before write semantic. Byte readable, sometimes byte writable. • Having lower cycle endurance than NAND (e.g. 10000-100000 write erase cycles). • Being slower than NAND.
Serial/Parallel NAND Flash	• Erase before write semantic, being page readable and writable. • Higher cycle endurance than NOR (e.g. 100000-1000000 write erase cycles). • Faster than NAND. Requiring bad block management and ECC.
USB MSD (FLASH Disk)	• Used to plug in to devices (e.g. store files, dump logs, load firmware/settings). • Virtually always runs FAT Filesystem to interoperate with PC.
MCU FLASH	• Erase before write semantic, may have strictly sequential writing of sector after erase. • Not typically byte writable e.g. K64F program unit e.g. 8bytes.
MCU RAM	• Read/write semantic (no erase). • Used for data during run lifetime or for debugging. • With battery-backup, can be considered a non-volatile store.

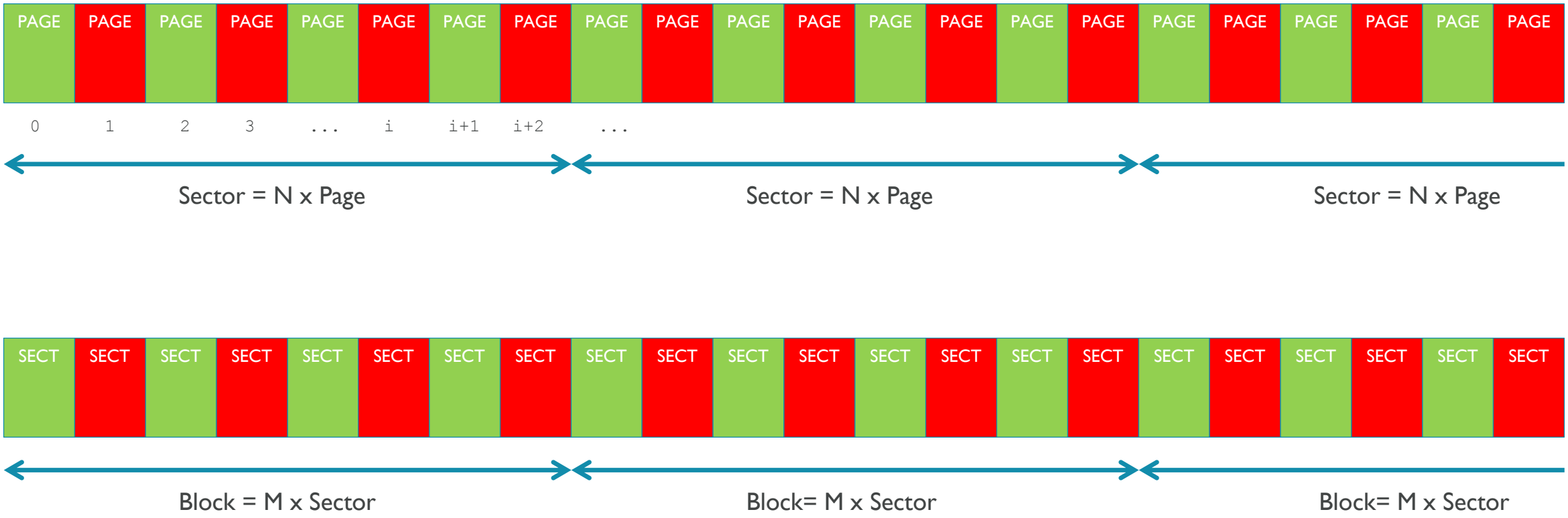
FS EASY FS MEDIUM FS HARD

SPI NOR Flash: Typical Geometry

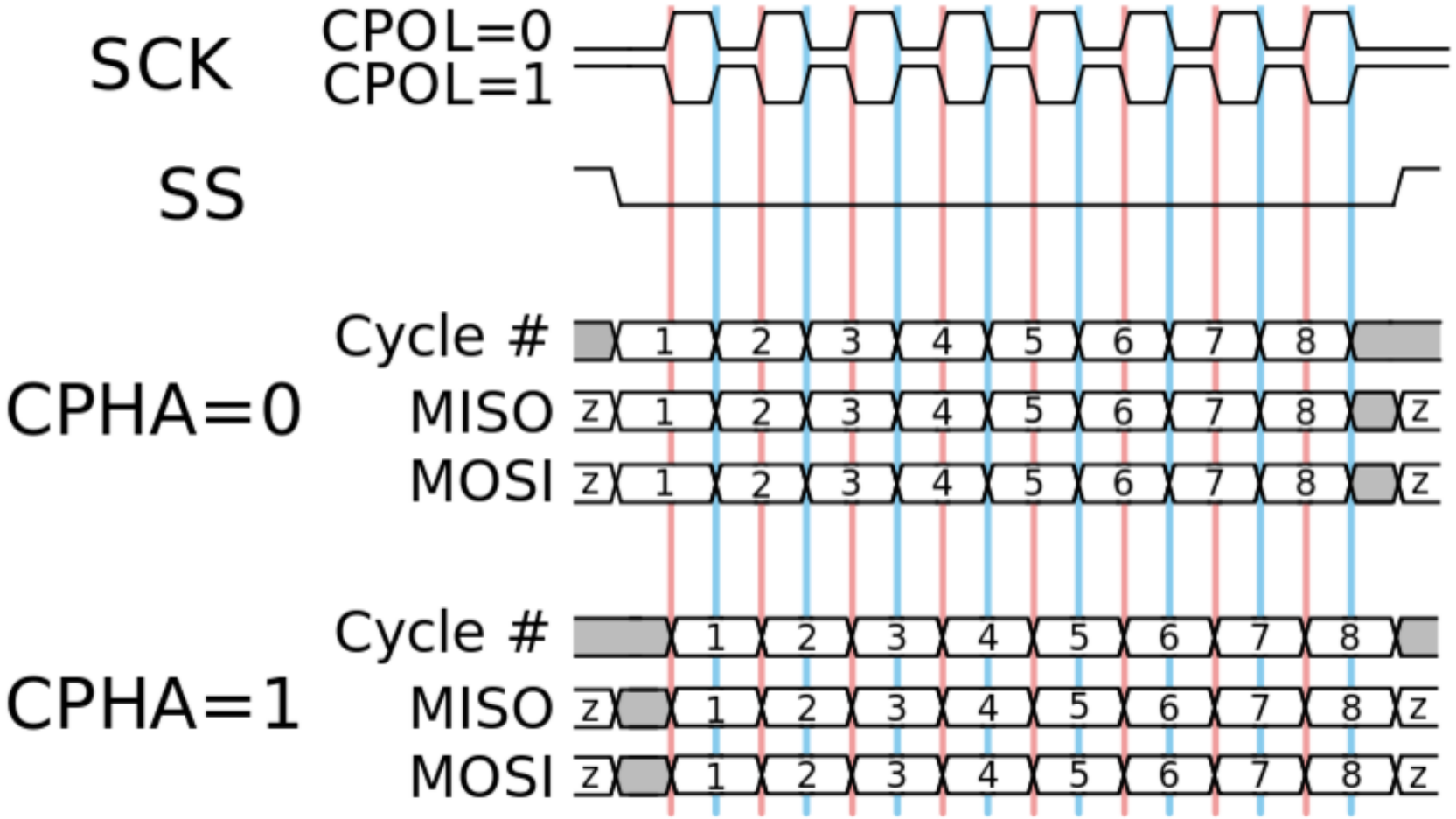
FIGURE 3-1: MEMORY MAP



Flash Terminology



SPI NOR Flash: SPI Bus Review



SPI NOR Flash Protocol: Read and Page Program

FIGURE 5-2: READ SEQUENCE (SPI)

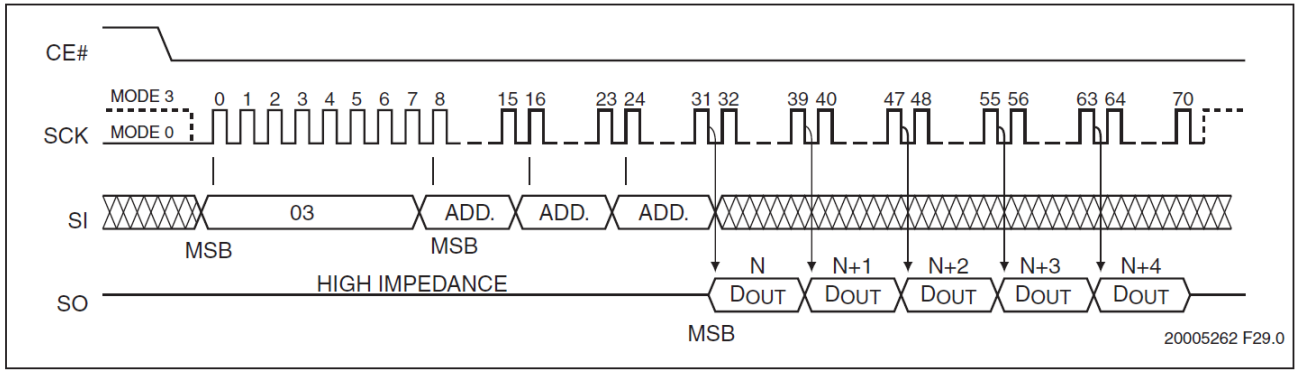
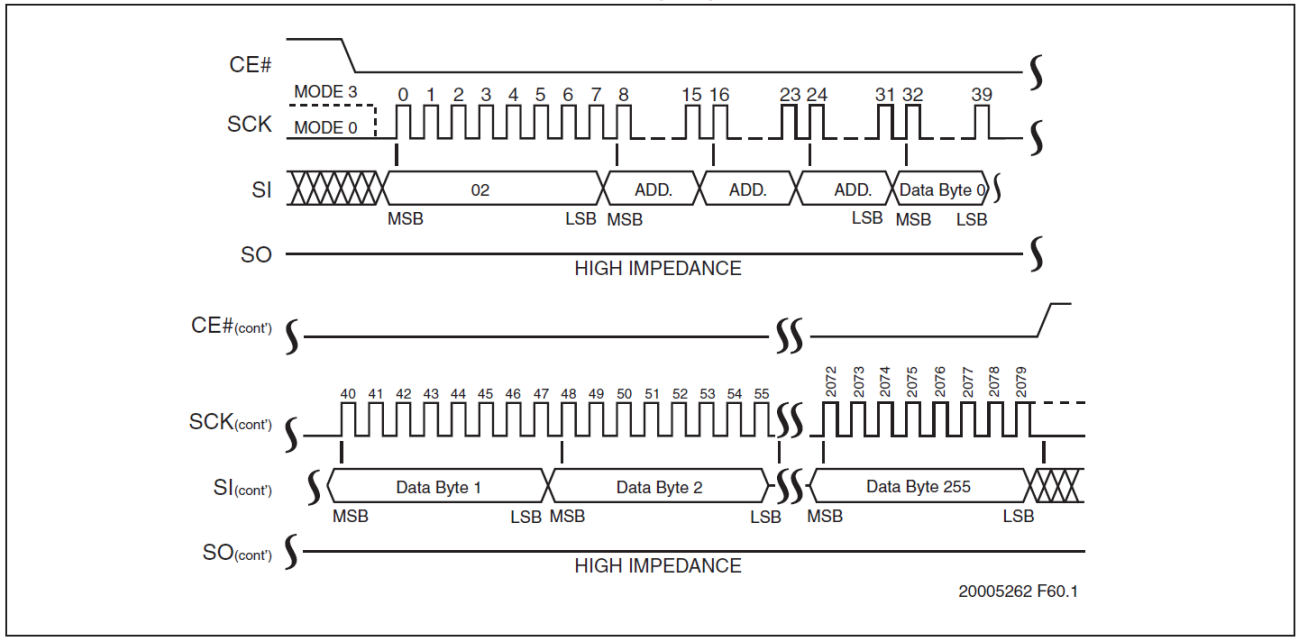


FIGURE 5-26: PAGE-PROGRAM SEQUENCE (SPI)



SPI NOR Flash: Protocol Standardisation

Command	Code (0x)	Description	Implied BlockDevice API
READ	03	Read 1-256 bytes	`read(block_store_id, read_buffer)`
PAGE PROGRAM	02	Program 1-256 bytes	`program(block_store_id, write_buffer)`
SECTOR ERASE	20	Reset sector storage to erase value (0xff)	`erase(block_store_id, flag=sector), block_store_id identifies the first block in sector`
BLOCK ERASE	D8	Erase set of sectors forming blocks	`erase(block_store_id, flag=block) where block_store_id identifies the first block in MT`
CHIP ERASE	C7	Erase all storage	`erase(block_store_id, flag=chip)`
SFDP	5A	Read Serial Flash Discoverable Parameters	`get_info(params)`

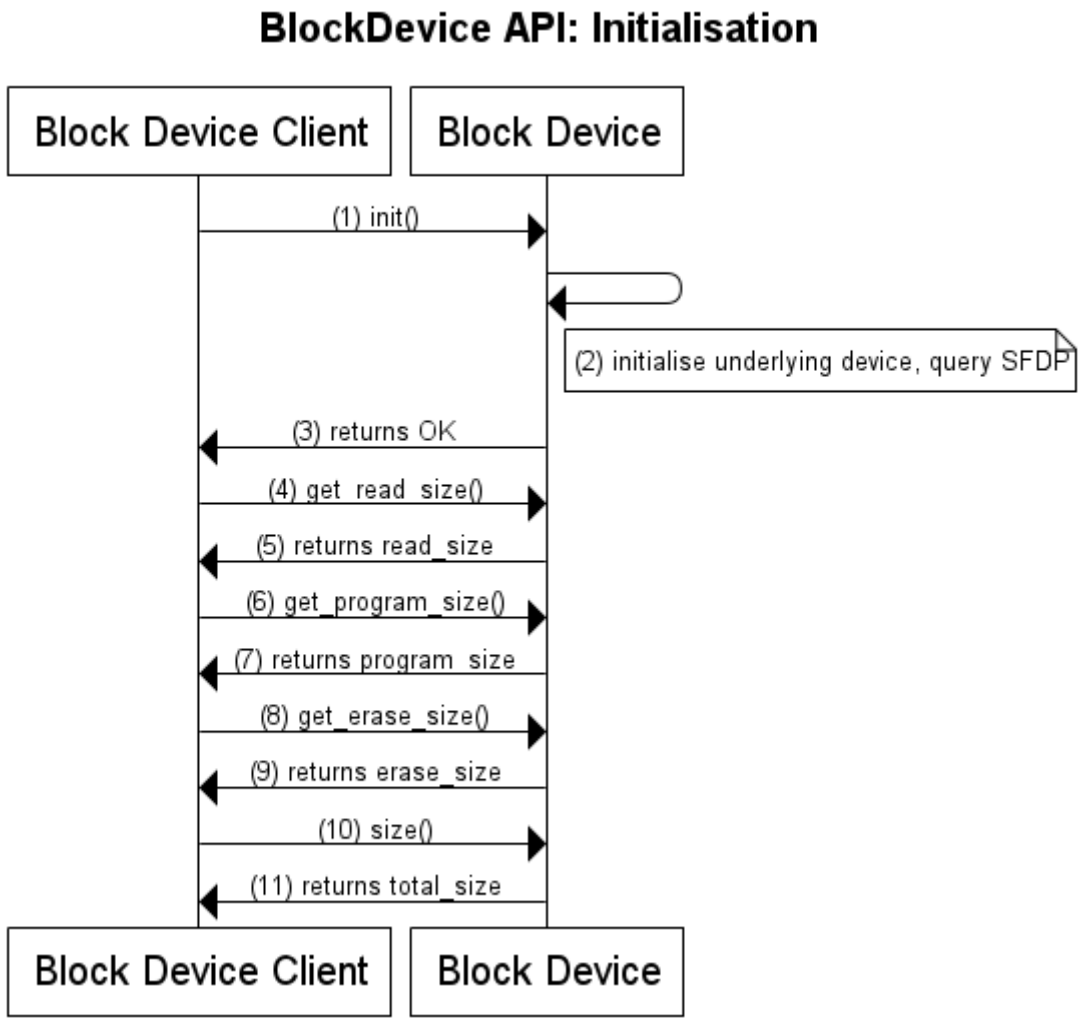
Block Store API: class BlockDevice

```
/** A hardware device capable of writing and reading blocks
 */
class BlockDevice
{
public:
    virtual ~BlockDevice() {};
    virtual int init() = 0;
    virtual int deinit() = 0;
    virtual int read(void *buffer, bd_addr_t addr, bd_size_t size) = 0;
    virtual int program(const void *buffer, bd_addr_t addr, bd_size_t size) = 0;
    virtual int erase(bd_addr_t addr, bd_size_t size) = 0;
    virtual bd_size_t get_read_size() const = 0;
    virtual bd_size_t get_program_size() const = 0;
    virtual bd_size_t get_erase_size() const = 0;
    virtual bd_size_t size() const = 0;
    bool is_valid_read(bd_addr_t addr, bd_size_t size) const;
    bool is_valid_program(bd_addr_t addr, bd_size_t size) const;
    bool is_valid_erase(bd_addr_t addr, bd_size_t size) const;
};
```

class BlockDevice: Initialisation and De-Initialisation

```
/** Initialize a block device
 *
 *  @return         0 on success or a negative error code on failure
 */
virtual int init() = 0;

/** Deinitialize a block device
 *
 *  @return         0 on success or a negative error code on failure
 */
virtual int deinit() = 0;
```

BlockDevice Initialisation Sequence Diagram



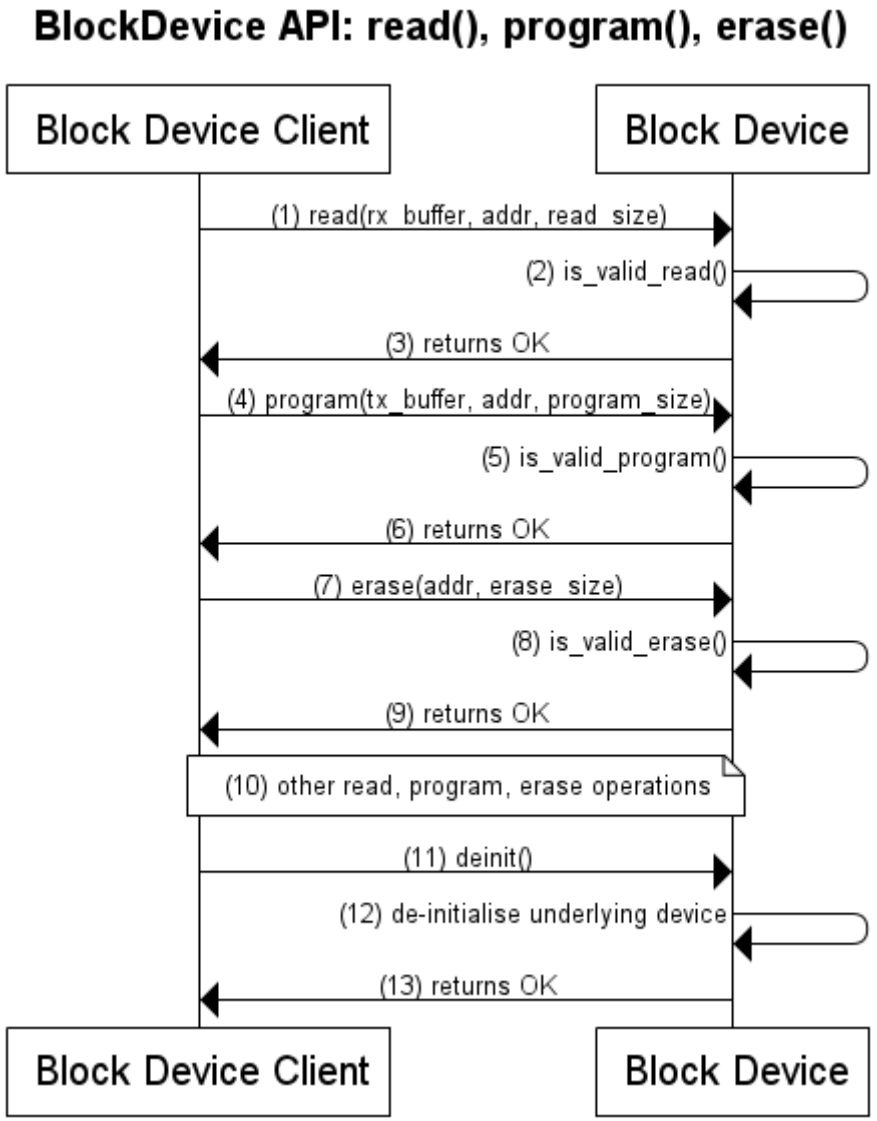
class BlockDevice::Informational Query Methods

```
/** Get the size of a readable block
 *  @return         Size of a readable block in bytes */
virtual bd_size_t get_read_size() const = 0;

/** Get the size of a programmable block
 *  @return         Size of a programmable block in bytes
 *  @note Must be a multiple of the read size */
virtual bd_size_t get_program_size() const = 0;

/** Get the size of a erasable block
 *  @return         Size of a erasable block in bytes
 *  @note Must be a multiple of the program size  */
virtual bd_size_t get_erase_size() const = 0;

/** Get the total size of the underlying device
 *  @return         Size of the underlying device in bytes */
virtual bd_size_t size() const = 0;
```

class BlockDevice::read() method

```
/** Read blocks from a block device
 *
 *  If a failure occurs, it is not possible to determine how many bytes succeeded
 *
 *  @param buffer   Buffer to write blocks to
 *  @param addr     Address of block to begin reading from
 *  @param size     Size to read in bytes, must be a multiple of read block size
 *  @return         0 on success, negative error code on failure
 */
virtual int read(void *buffer, bd_addr_t addr, bd_size_t size) = 0;
```

BlockDevice Read, Program, Erase Sequence Diagram



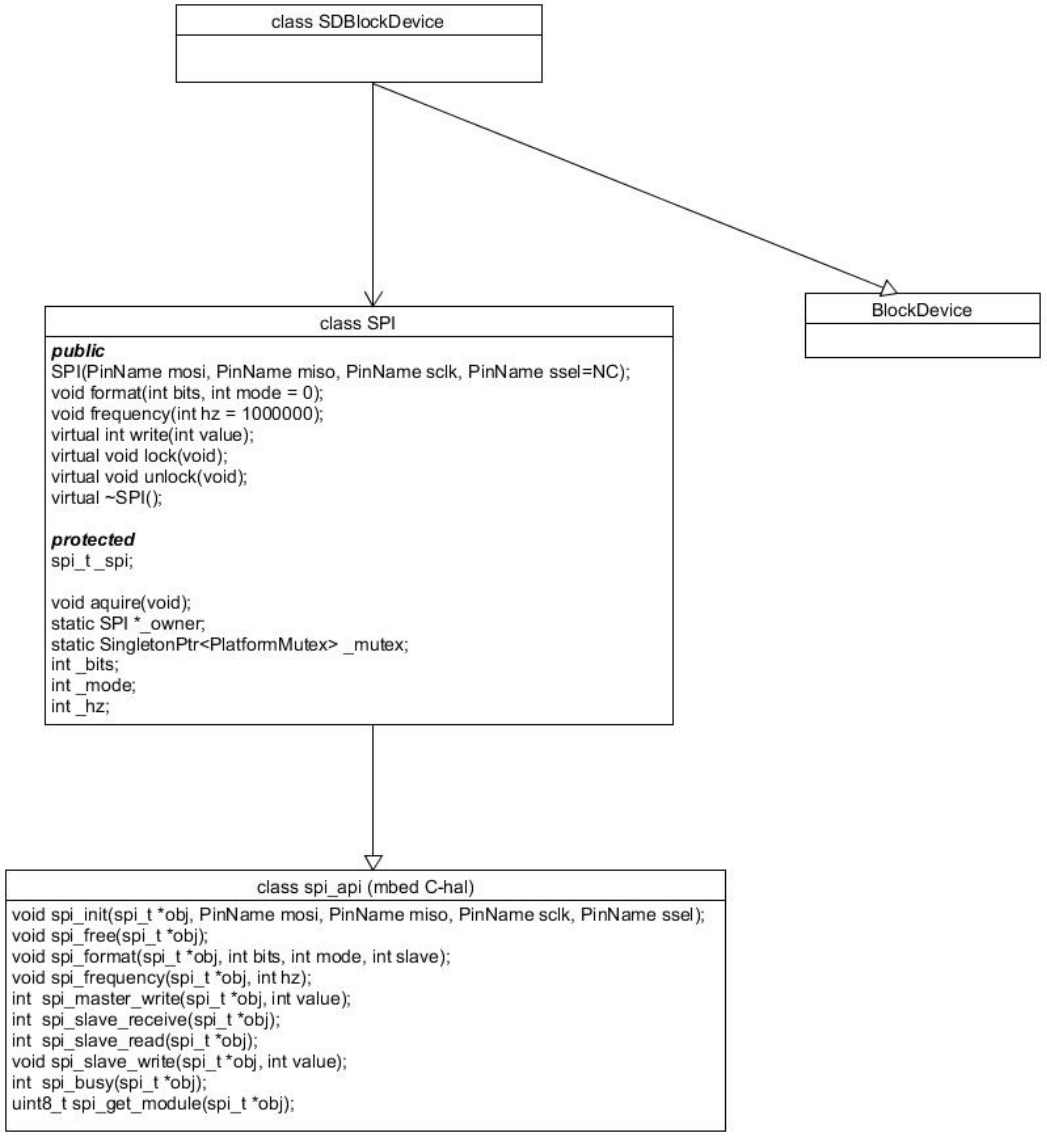
class BlockDevice::program() method

```
/** Program blocks to a block device
 *
 *  The blocks must have been erased prior to being programmed
 *
 *  If a failure occurs, it is not possible to determine how many bytes succeeded
 *
 *  @param buffer   Buffer of data to write to blocks
 *  @param addr     Address of block to begin writing to
 *  @param size     Size to write in bytes, must be a multiple of program block size
 *  @return         0 on success, negative error code on failure
 */
virtual int program(const void *buffer, bd_addr_t addr, bd_size_t size) = 0;
```

class BlockDevice::erase() method

```
/** Erase blocks on a block device
 *
 *  The state of an erased block is undefined until it has been programmed
 *
 *  @param addr     Address of block to begin erasing
 *  @param size     Size to erase in bytes, must be a multiple of erase block size
 *  @return         0 on success, negative error code on failure
 */
virtual int erase(bd_addr_t addr, bd_size_t size) = 0;
```

SDBlockDevice UML



SDBlockDevice

SDCard Reference Specification Part 1 Physical Layer Available for download: Chapter 7. SPI Mode

Available for download: https://members.sdcard.org/downloads/pls/simplified_specs/part1_410.pdf

SD Specifications
Part 1
Physical Layer
Simplified Specification

Version 4.10

January 22, 2013

SD Group

Panasonic Corporation
SanDisk Corporation
Toshiba Corporation

Technical Committee
SD Card Association

mbed OS File API Example: How To Use

```
#include "mbed.h"
#include "FATFileSystem.h"
#include "SDBlockDevice.h"
#include <stdio.h>
#include <errno.h>
/* mbed_retarget.h is included after errno.h so symbols are mapped to
 * consistent values for all toolchains */
#include "platform/mbed_retarget.h"

SDBlockDevice sd(MBED_CONF_APP_SPI_MOSI, MBED_CONF_APP_SPI_MISO,
MBED_CONF_APP_SPI_CLK, MBED_CONF_APP_SPI_CS);
FATFileSystem fs("sd", &sd);
void return_error(int ret_val);
void errno_error(void* ret_val);

int main()
{
    int error = 0;
    printf("Welcome to the filesystem example.\n");

    printf("Opening a new file, numbers.txt.");
    FILE* fd = fopen("/sd/numbers.txt", "w+");
    errno_error(fd);

    for (int i = 0; i < 20; i++){
        printf("Writing decimal numbers to a file (%d/20)\r", i);
        fprintf(fd, "%d\n", i);
    }
    printf("Writing decimal numbers to a file (20/20) done.\n");
    printf("Closing file.");
    fclose(fd);
    printf(" done.\n");

    printf("Re-opening file read-only.");
    fd = fopen("/sd/numbers.txt", "r");
    errno_error(fd);

    printf("Dumping file to screen.\n");
    char buff[16] = {0};
    while (!feof(fd)){
        int size = fread(&buff[0], 1, 15, fd);
        fwrite(&buff[0], 1, size, stdout);
    }
    printf("EOF.\n");

    printf("Closing file.");
    fclose(fd);
    printf(" done.\n");

    while (true) {}
}

// return_error() and errno_error() not shown to convserve space
```

SDBlockDevice: How To Use

```
#include "mbed.h"
#include "SDBlockDevice.h“
#include <stdio.h>


SDBlockDevice sd(MBED_CONF_APP_SPI_MOSI, MBED_CONF_APP_SPI_MISO, MBED_CONF_APP_SPI_CLK, MBED_CONF_APP_SPI_CS);


int main() {
    printf("sd test\n");

    // Initialize the SDCard device and print the memory layout
    sd.init();
    printf("sd size: %llu\n",         sd.size());
    printf("sd read size: %llu\n",    sd.get_read_size());
    printf("sd program size: %llu\n", sd.get_program_size());
    printf("sd erase size: %llu\n",   sd.get_erase_size());

    // Write "Hello World!" to the first block
    char *buffer = (char*) malloc(sd.get_erase_size());
    sprintf(buffer, "Hello World!\n");
    sd.program(buffer, 0, sd.get_erase_size());

    // Read back what was stored
    sd.read(buffer, 0, sd.get_erase_size());
    printf("%s", buffer);

    // Deinitialize the device
    sd.deinit();
}
```

SPIFBlockDevice: How To Use

```
#include "mbed.h"
#include "SPIFBlockDevice.h"

SPIFBlockDevice spif(D11, D12, D13, D10);


int main() {
    printf("spif test\n");

    // Initialize the SPI flash device and print the memory layout
    spif.init();
    printf("spif size: %llu\n",         spif.size());
    printf("spif read size: %llu\n",    spif.get_read_size());
    printf("spif program size: %llu\n", spif.get_program_size());
    printf("spif erase size: %llu\n",   spif.get_erase_size());

    // Write "Hello World!" to the first block
    char *buffer = (char*) malloc(spif.get_erase_size());
    sprintf(buffer, "Hello World!\n");
    spif.erase(0, spif.get_erase_size());
    spif.program(buffer, 0, spif.get_erase_size());

    // Read back what was stored
    spif.read(buffer, 0, spif.get_erase_size());
    printf("%s", buffer);

    // Deinitialize the device
    spif.deinit();
}
```

FS Code Sizes: measured using GCC_ARM

```
Keil Embedded FS Summary Results
================================
Total size of Keil EFS .text symbols:            6396
Total size of KeilFS wrappers .text symbols:     732

Keil FATFS Summary Results
==========================
Total size of Keil FATFS .text symbols:          13836
Total size of Keil FATFS .rodata symbols:        1341
Total size of KeilFS wrappers .text symbols:     741

ChanFS Summary Results
======================
Total size of ChanFS .text symbols:                      8960
Total size of sdcard .text symbols:                      4830
Total size of wrappers .text symbols:                    8479
Total size of rodata:                                    1180
Total size of BSS:                                       3227
Total size of .text(chanfs+sdcard+wrappers)+.rodata:     23449
```

ChanFS FAT32 RAM requirement ~1.5kB (1kB + size of 1 SDBlockDevice Erase Block (0.5kB)).

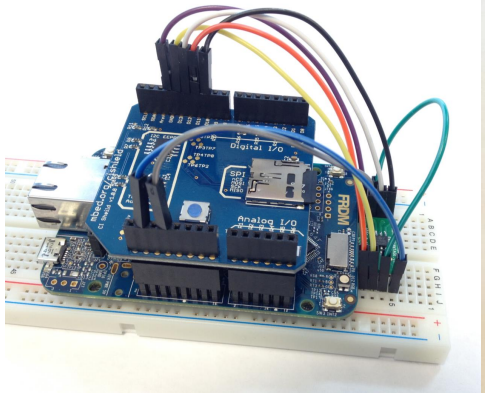
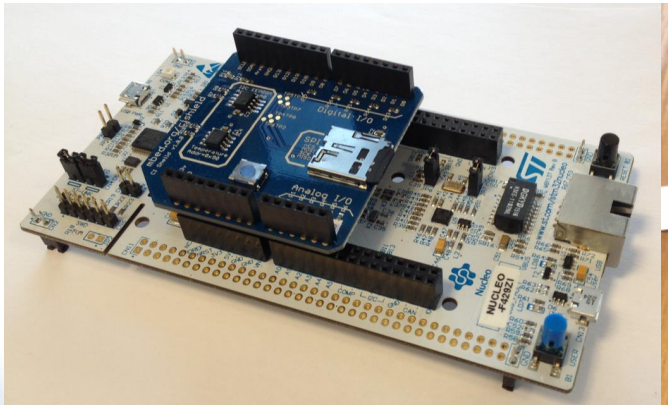
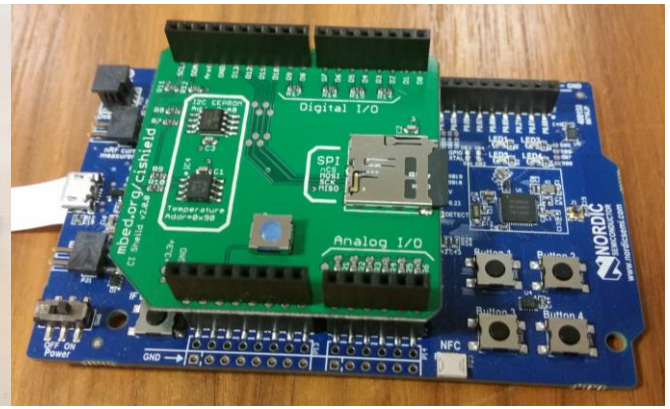
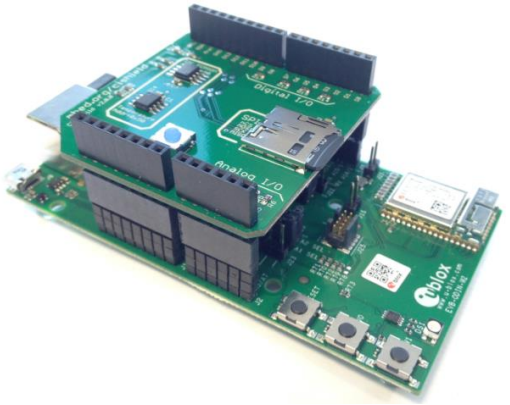
Storage: Conclusion

- Filesystem software stack.
  - Rationale for the block device API.
- Memory Technology Devices (MTD)
  - SPI NOR parts.
- Block Device API.
- How to use the SDBlockDevice, the block device for SDCard
- How to use the SPIFBlockDevice, the block device for SPI NOR.
- Resource Usage Measurements.

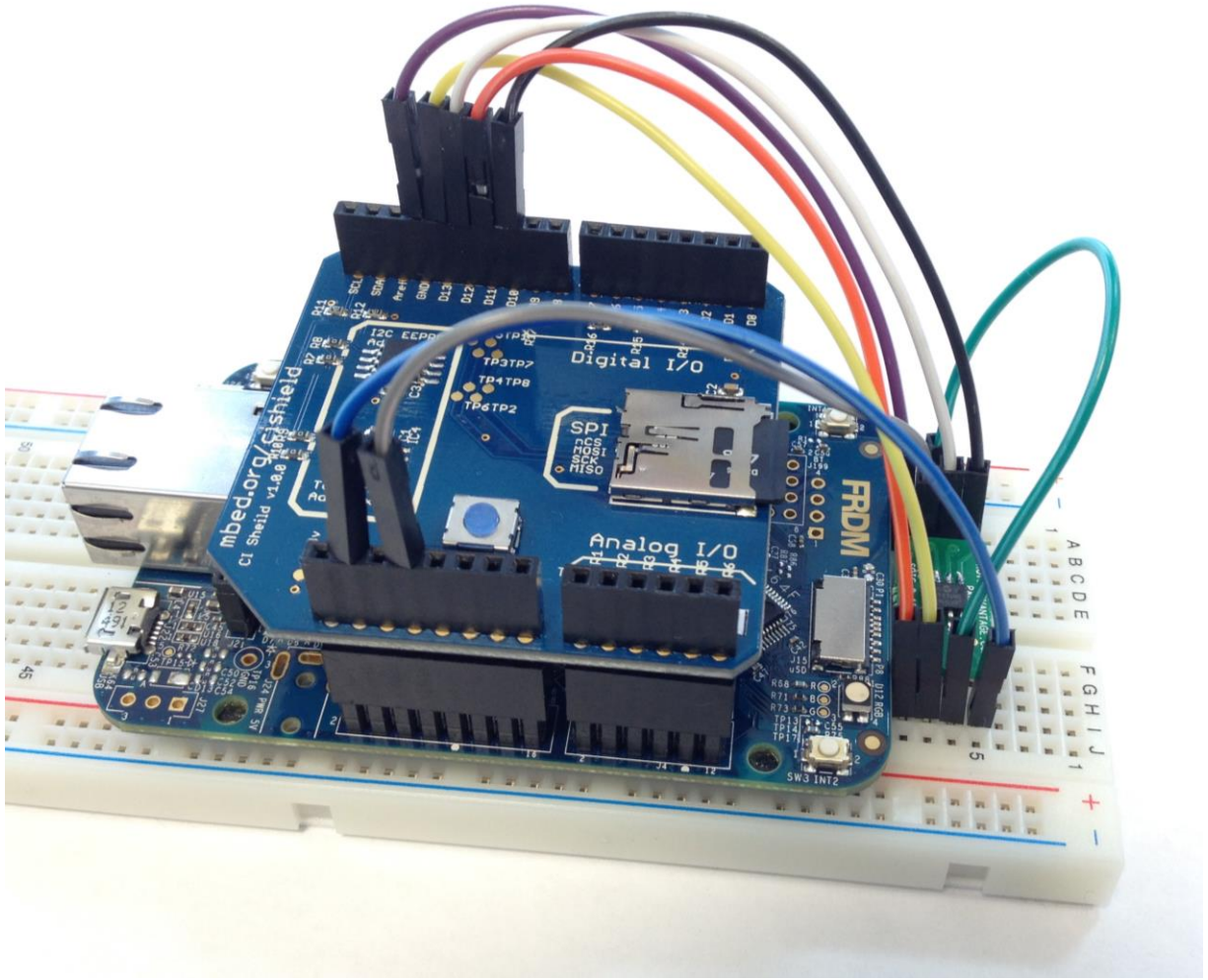
Workshop

Workshop: Overview

- Test Fixtures used as the starting point for examples.
  - Useful Resources.
  - Format of examples.
- Example 1: SDCard Application (class SDBlockDevice) .
- Example 2: SPI NOR Storage (class SPIFBlockDevice).
- Example 3: I2C EEPROM BlockDevice (class I2CEEBlockDevice).

Workshop Test Fixture



We'll use the a test fixture to get the examples up and running, and then replace the devboard with a board of your choice.

Test Fixtures is composed of:

- NXP K64F, or STM F429ZI, or Ublox Odin
- CI Test Shield with SDCard.
- Microchip SST26VF016B 512kB SPI NOR Flash.
- Jumpers from CI Shield Arduino header SPI pins to SPI NOR flash.

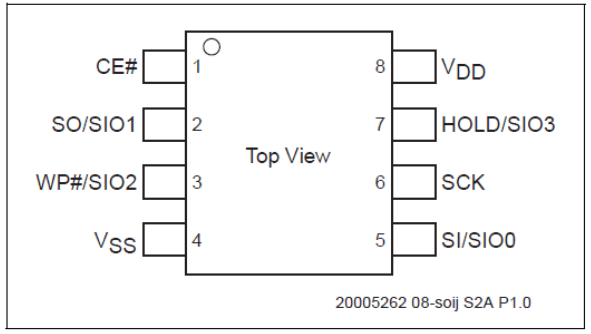
Workshop Test Fixture Resources

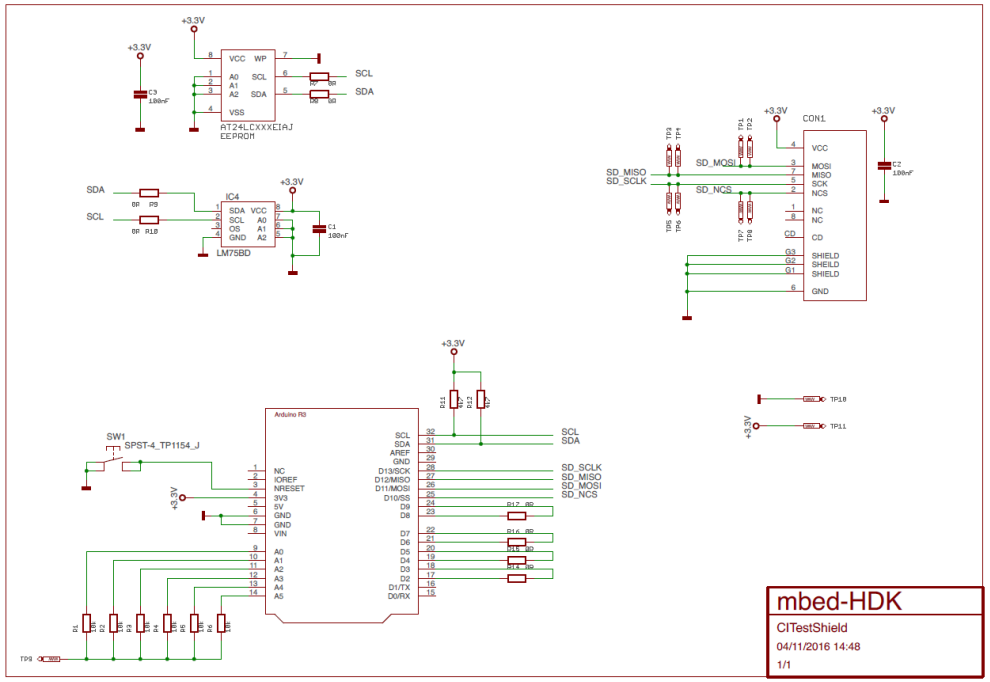
- The CI shield wiring diagram: https://github.com/ARMmbed/mbed-HDK/blob/master/Production%20Design%20Projects/CITestShield/v2.0.0/CITestShield%20V_2_0_0%20SCH.pdf
- The Microchip SST26VF016B SPI NOR datasheet: http://ww1.microchip.com/downloads/en/DeviceDoc/20005262C.pdf

SST26VF016B

2.0 PIN DESCRIPTION

FIGURE 2-1: PIN DESCRIPTION FOR 8-LEAD SOIJ

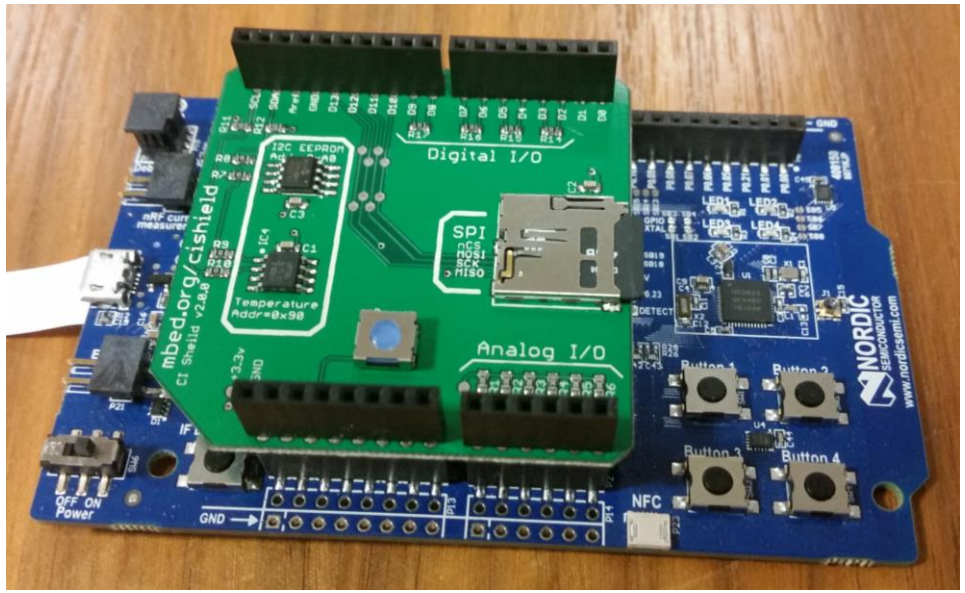




Example Format:

The examples follow a general format:

- Part 1: Simple application demonstrating key feature using Test Fixtures.
- Part 2: mbed Greentea test cases demonstrating greater complexity examples on Test Fixtures.
- Part 3: Demonstrating Parts 1 and 2 on Your Target.
- Part 4: Suggested exercises for further work.



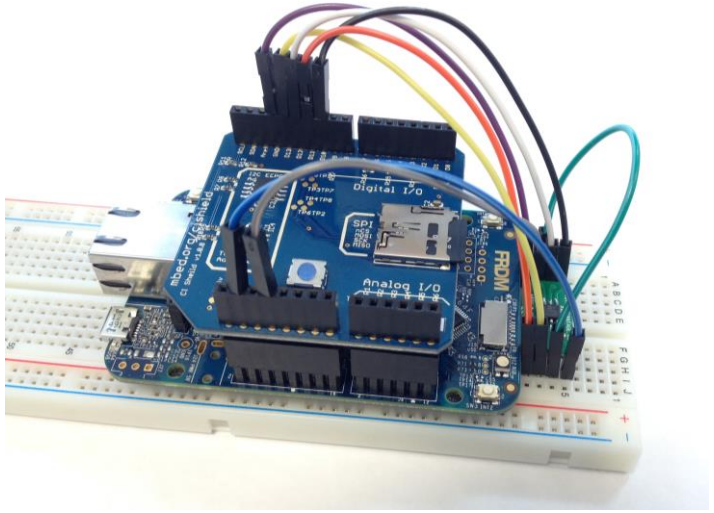
Example 1: SDCard Application (SDBlockDevice)

This example demonstrates:

- How to use the Test Fixture.
- How to use the POSIX File API and FAT32 Filesystem to read/write data to SDCard.
- How to use the mbed_app.json configuration file to build and test on Your Target.

Complete the example using the following steps:

1. Go to the mbed-os-example-sd-driver repository: https://github.com/ARMmbed/mbed-os-example-sd-driver.
2. In the repository README.md, follow the instructions in the section: "**Getting Started With The sd-driver**" as shown. This will explain how to build and run the example application on the test fixture. The application demonstrates how to use the POSIX API to store data on the SDCard.



Getting Started With The sd-driver

This is the mbed-os example for the SDBlockDevice (SDCard) block device driver. See the sd-driver repository for more information.

This guide reviews the steps to get the SDCard with FAT filesystem working on an mbed OS platform.

Please install mbed CLI.

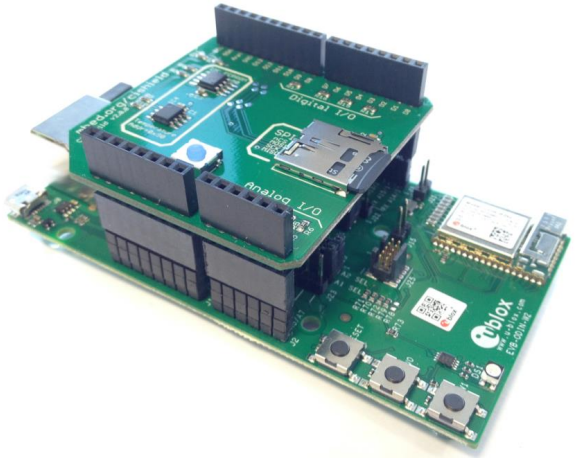
Hardware Requirements

This example can be used on an mbedos platform that:

- Has an on-board SDCard slot or,
- Is fitted with a CI Test Shield.

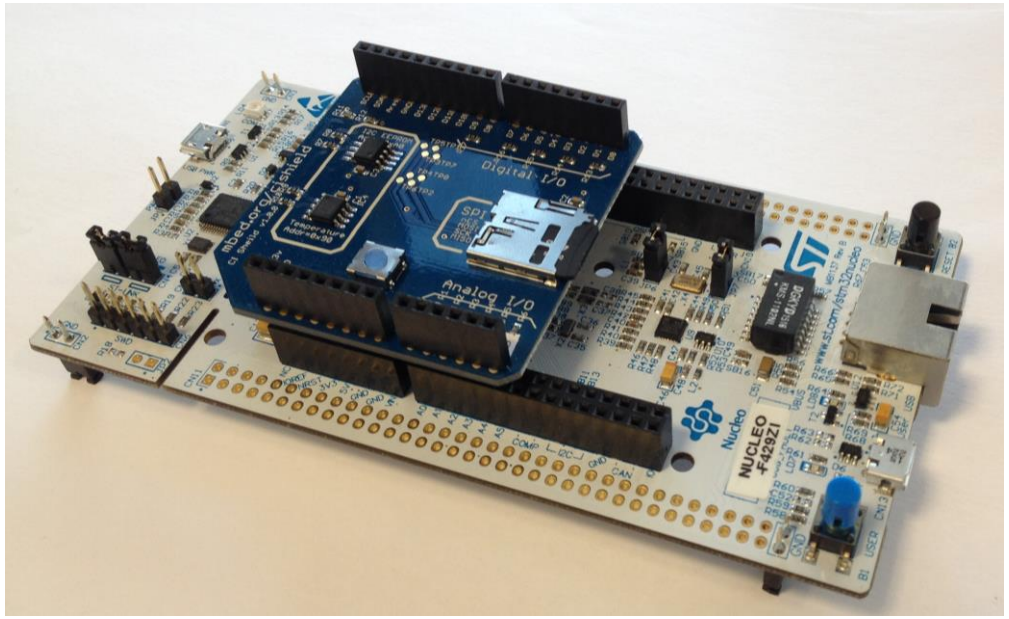
This document uses the K64F as an example. Simply change the relevant options (e.g. -m K64F) to be appropriate for your target.

Example 1: Rebuild for Your Target



Complete the example using the following steps

1. Go to the mbed-os-example-sd-driver repository: https://github.com/ARMmbed/mbed-os-example-sd-driver.
2. In the repository README.md, follow the instructions in the section: "**Testing with an SDCard on Target XYZ**" as shown below. This will explain the mbed_app.json changes required (if any) so the example will work for Your Target.
3. Gently remove the shield from the Test Fixture and insert into the Arduino headers of your target, or use another CI test shield.
4. If it doesn't work…. time to start debugging.



Testing with an SDCard on Target XYZ

The standard way to test is with the mbed CI Test Shield plugged into the target board. This pin mapping for this configuration is parameterised in the `mbed_app.json` file.

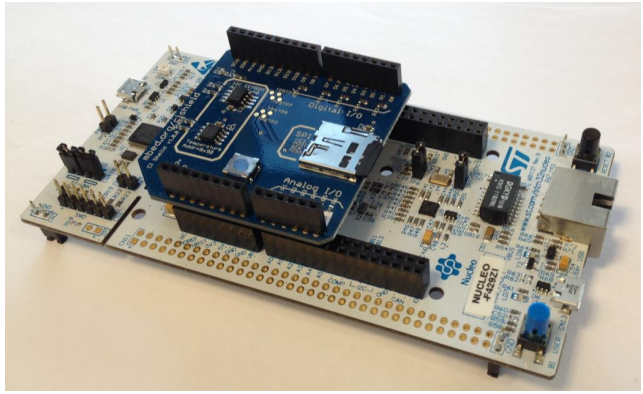
The following is an example of the `mbed_app.json` file available in the repository:

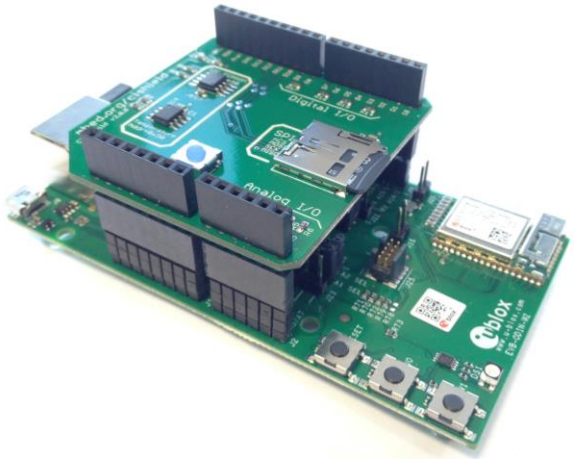
```
{
    "config": {
        "UART_RX": "D0",
        "UART_TX": "D1",
        "DIO_0": "D0",
        "DIO_1": "D1",
        "DIO_2": "D2",
        "DIO_3": "D3",
        "DIO_4": "D4",
        "DIO_5": "D5",
        "DIO_6": "D6",
        "DIO_7": "D7",
        "DIO_8": "D8",
        "DIO_9": "D9",
        "SPI_CS": "D10",
        "SPI_MOSI": "D11",
        "SPI_MISO": "D12",
        "SPI_CLK": "D13",
        "I2C_SDA": "D14",
        "I2C_SCL": "D15",
        "I2C_TEMP_ADDR":"0x90",
```

Example 1: Run Test Cases on Your Target

Run the test cases by completing the following steps:

1. Go to the sd-driver repo: https://github.com/armmbed/sd-driver.
2. In the repository README.md, follow the instructions in the section: "**SDCard POSIX File API mbed Greentea Test Cases**" as shown below. This explains how to build and run the test cases for the K64F, but you should build and run on Your Target.





SDCard POSIX File API mbed Greentea Test Cases

This section describes how to build and run the POSIX file API test cases. The following steps are covered:

- Create the FAT/SDCard Application Project. This section describes how to git clone the mbed OS and sd-driver repositories containing the code and test cases of interest.
- Build the mbed OS Test Cases. This section describes how to build the mbed OS test cases.
- Insert a microSD Card Into the K64F for Greentea Testing.This section describes how to format (if required) a microSD card prior to running the tests.
- Run the POSIX File Test Case.This section describes how to run the POSIX file test cases.

Create the FAT/SDCard Application Project

This section describes how to create an application project combining the mbed-os and sd-driver repositories into a single project. In summary the following steps will be covered in this section:

- A top level application project directory is created. The directory name is ex_app1.
- In the ex_app1 directory, the mbed-os repository is cloned.
- In the ex_app1 directory at the same level as the mbed-os directory, the sd-driver repository is cloned.
- The `mbed_app.json` file is copied from the `sd-driver/config/mbed_app.json` to the ex_app1 directory.

First create the top level application directory ex_app1 and move into it:

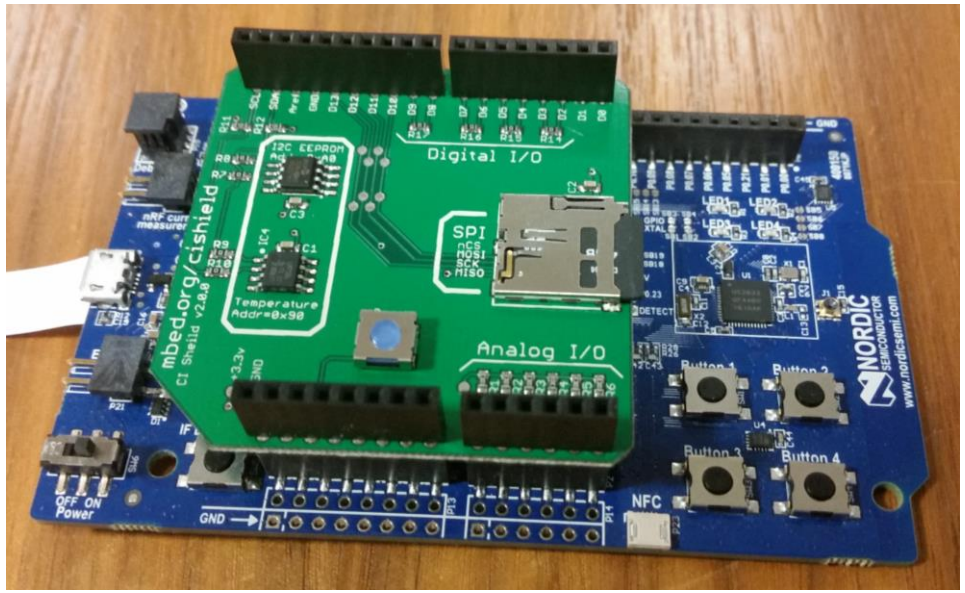
```
simhug01@E107851:/d/demo_area$ mkdir ex_app1
simhug01@E107851:/d/demo_area$ pushd ex_app1
```

Next, get a clone of public mbed OS repository in the following way:

Example 1: Suggested Exercises

The following are possible exercises for further understanding the SDBlockDevice:

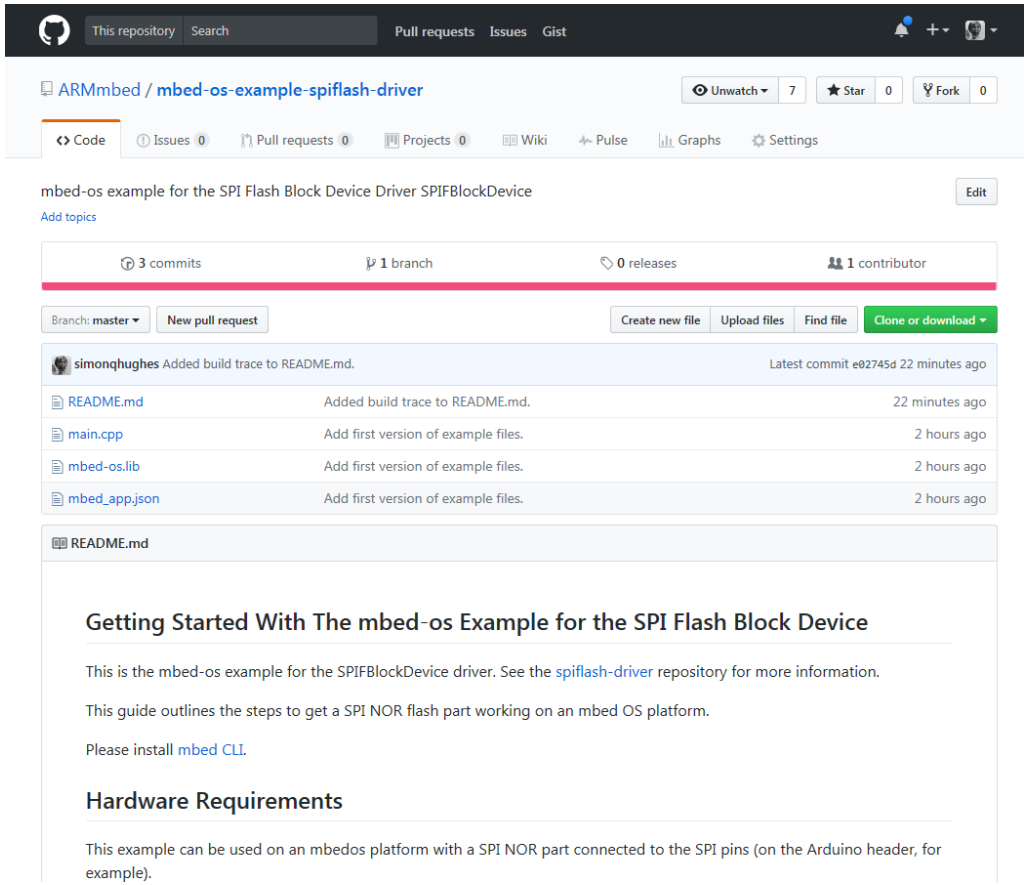
1. If your SoC has an SD IP Block then you could implement a BlockDevice driver to take advantage of the native support.
2. If you have a Quad SPI implementation, you could implement the HAL and wrapper to integrate within mbed OS.
3. Use mbedTLS and the file API to implement file level encryption for files stored on SDCard.



Example 2: SPI NOR Storage Example

This example demonstrates:

- Use of spiflash-driver for reading/writing data using the SPIFBlockDevice.
- Use of SPI NOR Flash (Microchip SST26VF016B).
- How to build and run a simple test application.



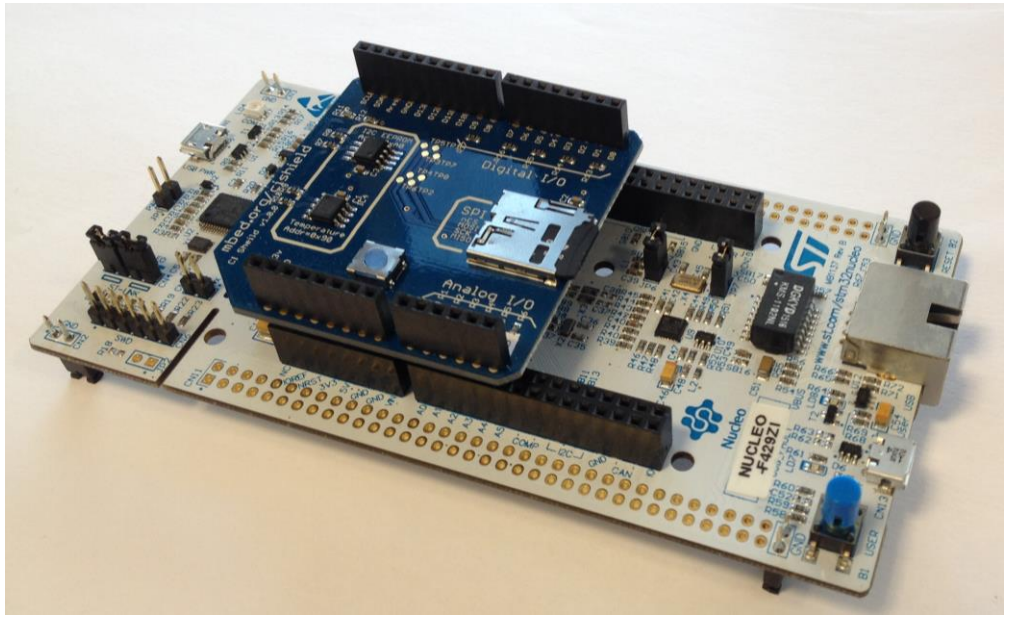
Complete the example using the following steps:

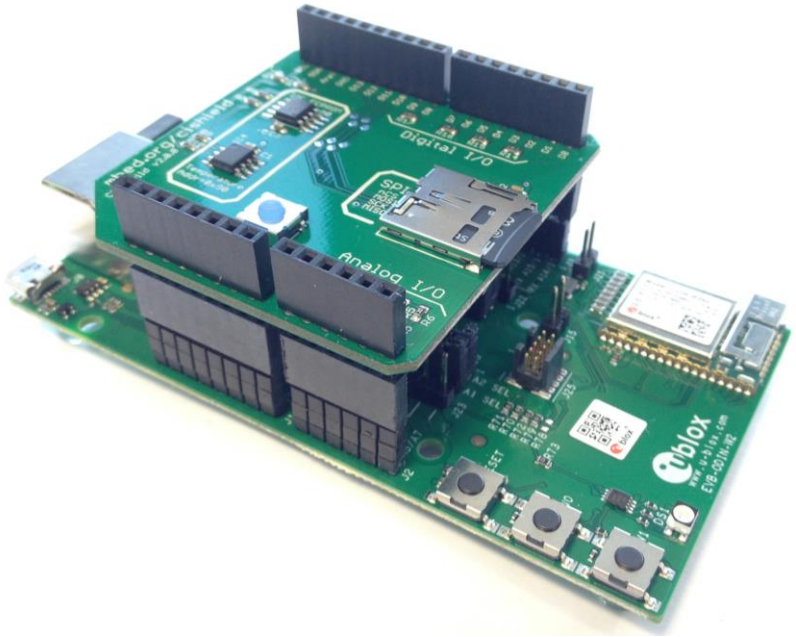
1. Go to the sd-driver repo: https://github.com/armmbed/mbed-os-example-spif-driver.
2. In the repository README.md, follow the instructions in the section: "**Getting Started with the mbed-os Example for the SPI Flash Block Device**" as shown. This will explain how to build and run the example application on the test fixture. The application demonstrates how use the SPIFBlockDevice class to read and write data to the SPI NOR device.

Example 2: Rebuild for Your Target

Complete the example using the following steps

1. Gently remove the shield from the Test Fixture and insert into the Arduino headers of your target. Rewire the SPI NOR flash if the SPI bus is not presented on the D10-D13 header pins.
2. Repeat the steps described in the first part of this example but this time build and test for your target.
3. If it doesn't work…. time to start debugging.





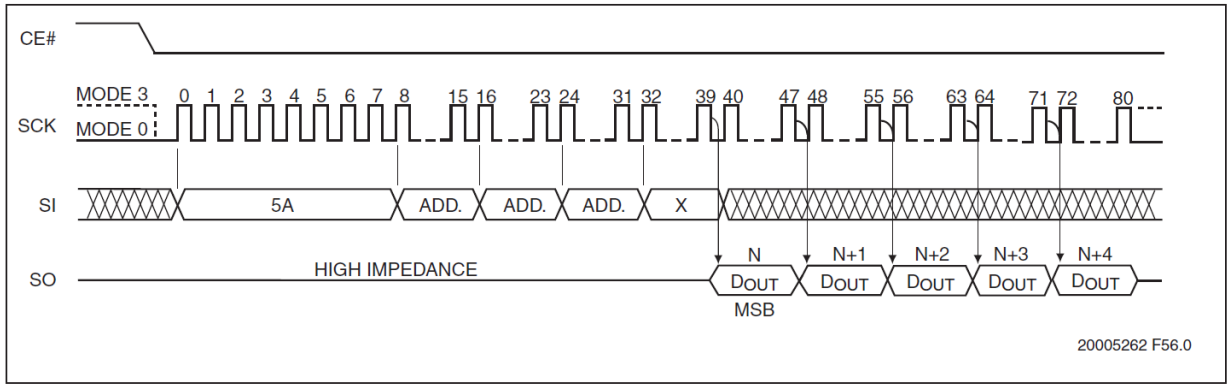
Example 2: Suggested Exercises

The following are possible exercises for further understanding the SPIFBlockDevice:

1. If your target has a native SPI flash part then you could implement a BlockDevice driver to integrated within mbedOS.
2. Build and run the examples for the NXP K82F which has the Macronix MX25U3235FZNI SPI NOR flash on-board (1 development board available).
3. Create a tool or test case to read and print out the Serial Flash Discoverable Parameters (SFDP) header and JEDEC Table parameters from a SPI NOR Flash. Decode one or more of the descriptors of interest. This will be a useful diagnostic tool.

Example2: Serial Flash Discoverable Parameters

FIGURE 5-18: SERIAL FLASH DISCOVERABLE PARAMETERS SEQUENCE



6.1 SFDP Overall Header Structure

	[31:24]	[23:16]	[15:8]	[7:0]	Hex Byte Location
SFDP Header	Serial Flash Discoverable Parameters (SFDP) Signature= 0x50444653				
	Byte 3 = "P"	Byte 2 = "D"	Byte 1 = "F"	Byte 0 = "S"	[3:0]
	Unused (set to 0xFF)	Number of Parameter Headers (NPH)	SFDP Major Revision	SFDP Minor Revision	[7:4]
1st Parameter Header	Parameter Length (in double words)	Parameter Major Revision	Parameter Minor Revision	JEDEC ID (0x00)	[B:8]
	Unused (set to 0xFF)	Parameter Table Pointer (PTP)			[F:C]
2nd Parameter Header (optional)	Parameter Length (in double words)	Parameter Major Revision	Parameter Minor Revision	JEDEC ID (0x00) or Manufacturer ID	[13:10]
	Unused (set to 0xFF)	Parameter Table Pointer (PTP)			[17:14]
...					
Nth Parameter Header (optional)	Parameter Length (in double words)	Parameter Major Revision	Parameter Minor Revision	JEDEC ID (0x00) or Manufacturer ID	
	Unused (set to 0xFF)	Parameter Table Pointer (PTP)			

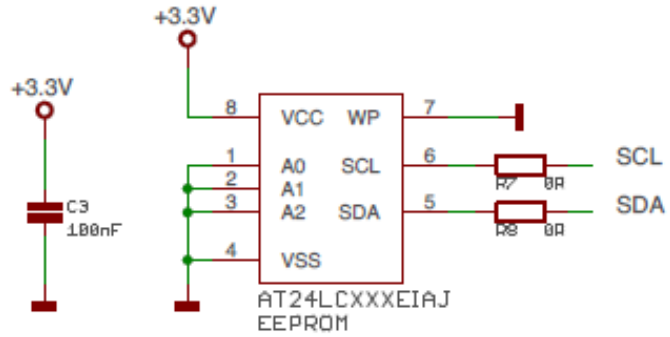
Figure 4 — Overall Header Structure

JEDEC Standard JESD216: Serial Discoverable Parameters (SFDP) for SPI NOR Flash (JESD216.pdf download from http://www.jedec.org/)

Example 3: I2CEEPROM BlockDevice Example

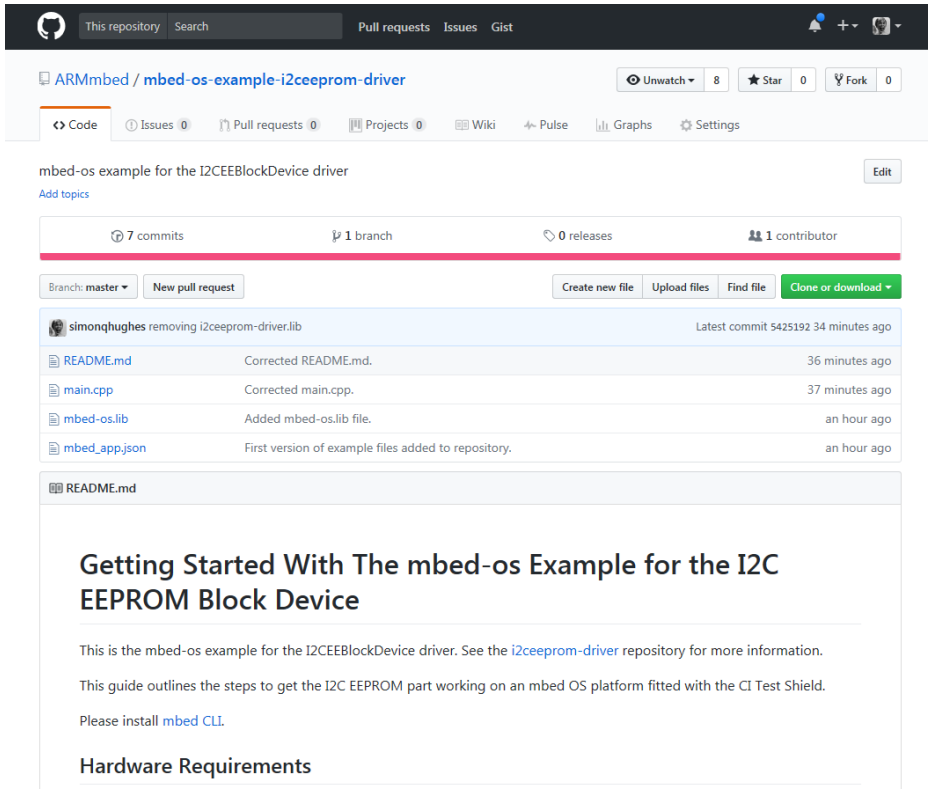
This example demonstrates:

- Use of i2ceeprom-driver for reading/writing data using the I2CEEBlockDevice.
- CI Test Shield I2C EEPROM (AT24LC).
- How to build and run a simple test application.



Complete the example using the following steps:

1. Go to the sd-driver repo: [https://github.com/armmbed/**mbed-os-example-i2ceeprom-driver**](https://github.com/armmbed/mbed-os-example-i2ceeprom-driver) .
2. In the repository README.md, follow the instructions in the section: "**Getting Started With The mbed-os Example for the I2C EEPROM Block Device**" as shown. This will explain how to build and run the example application on the test fixture. The application demonstrates how use the I2CEEBlockDevice class to read and write data to the EEPROM.
3. Gently remove the CI test shield from the Test Fixture and insert into the Arduino headers of your target, or use another shield. Build and run the example on your target.
4. If it doesn't work…. time to start debugging.



Stretch Goal:

- Apply an “over the air update” firmware image to become the new bootable image.

Workshop:Conclusion

- Well Done, have a drink.

Thank you!

ARM