Introduction to the OpenSSD Jasmine Platform

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About Me

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▪ Device Inspection
▪ Introduction to OpenSSD Jasmine platform
Lab Overview & Notifications
# Lab Overview & Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/15 (Wed)</td>
<td>Lab0: Overview &amp; Intro. to OpenSSD Jasmine</td>
</tr>
<tr>
<td>3/27 (Mon)</td>
<td>Lab1: NAND simulator</td>
</tr>
<tr>
<td>3/29 (Wed)</td>
<td>Lab2: Dummy FTL</td>
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<tr>
<td>4/5 (Wed)</td>
<td>Lab3: Tutorial FTL</td>
</tr>
<tr>
<td>4/12 (Wed)</td>
<td>Lab4: GreedyFTL on NAND simulator</td>
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<tr>
<td>4/19 (Wed)</td>
<td>Lab5: Log-Block FTL on NAND simulator</td>
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<tr>
<td>4/26 (Wed)</td>
<td>Midterm exam week</td>
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<tr>
<td>5/3 (Wed)</td>
<td>National holiday</td>
</tr>
<tr>
<td>5/10 (Wed)</td>
<td>Lab6: Log-Block FTL on Jasmine</td>
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<tr>
<td>5/17 (Wed)</td>
<td>Log-Block FTL Q&amp;A (cont’d)</td>
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<tr>
<td>5/24 (Wed)</td>
<td>Lab7: Intro. to other FTLs</td>
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<tr>
<td>5/31 (Wed)</td>
<td>Lab8: Normal power off (NPO) policy</td>
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<tr>
<td>6/7 (Wed)</td>
<td>Lab9: Sudden power off (SPO) policy</td>
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<tr>
<td>6/14 (Wed)</td>
<td>Lab10: Final presentation</td>
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<tr>
<td>6/21 (Wed)</td>
<td>Final exam week</td>
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</table>
Make Groups!

- OpenSSD Jasmine: **Team projects**
- S/W FTL simulator: **Personal projects**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>김도영</td>
<td>이동규</td>
<td>공정훈</td>
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<td>라종휘</td>
<td>박경린</td>
<td>홍정범</td>
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<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>김종우</td>
<td>김동성</td>
<td>신준혁</td>
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<td>김태형</td>
<td>조철희</td>
<td>박종원</td>
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<td>7</td>
<td>8</td>
<td>9</td>
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<tr>
<td>김다영</td>
<td>성지수</td>
<td>오영호</td>
</tr>
<tr>
<td>심상우</td>
<td>이서석</td>
<td>여상구</td>
</tr>
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</table>
Notifications

- Do not ‘copy’
- Please let me know if (e-mail & hangout)
  - Something goes wrong
  - Stupid questions (Welcome!)
  - Suggestions
  - Someone cheating?
  - “I have better ideas”
  - The course is too easy
Device Inspection
Device Inspection

- You are responsible for your H/W damages after today inspection, except for flash modules.

- The only way to escape from damaged H/W
  - Examine your Jasmine board IN DETAIL before CLASS ENDS.
Indilinx Jasmine Board

Barefoot Controller (ARM7TDMI-S)

SATA 3.0Gbps

Power

Mobile SDRAM

JTAG

UART

Power Switch

NAND Flash Module

Factory Mode Jumper
USB-RS232 Cable
Other 5 Components
For debugging.
Software Prerequisites

- ARM EABI cross compiler for windows
  - To build firmware binary for the ARM controller
  - Install the toolchain ‘Win 7’ compatible mode (Win 10)
  - Download it from the link at icampus (2011.03-42 version exe)

- Serial Driver (Win 7)
  - Download the proper one by yourselves (CD, googling)

- Putty
  - To debug firmware via serial communication
  - [http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html](http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html)
Firmware / Installer Preparation

- Download Jasmine Firmware (Ver. 1.1.0)
  - [http://www.openssd-project.org/mediawiki/download.php?f=OpenSSD-1.1.0.zip&c=OpenSSD.zip](http://www.openssd-project.org/mediawiki/download.php?f=OpenSSD-1.1.0.zip&c=OpenSSD.zip)

- Edit OpenSSD-1.1.0/target_spw/uart.c

```c
void uart_printf(const char * msg, ...) {
    char out[256];
    va_list ap;
    int len = 0;
    va_start(ap, msg);
    len = vsnprintf(out, sizeof(out) - 1, msg, ap);
    va_end(ap);
    if ( len> = 0 ) {
        out[len] = '\0';
        uart_print(out);
    }
}
```

- Build firmware(OpenSSD-1.1.0/build_gnu/build.bat)
  - **Without** Admin Permission
  - Edit Makefile to change current FTL with another

- Firmware installer
  - Put the installer into OpenSSD-1.1.0/build_gnu folder
Install Firmware: Factory Mode

- Factory Mode
  - Firmware uploading mode
- Power-down Jasmine board
- Power-up Jasmine board as ‘Factory Mode’

- Run installer (OpenSSD-1.1.0/build_gnu/install.exe)
  - With Admin Permission
Install Firmware: Factory Mode

Scan (bad) list will be saved in block 0 for each flash.

If 2\textsuperscript{nd} process fails, even you’ve done the 4\textsuperscript{th} process. Ignore the error message, try 3\textsuperscript{rd} one, and redo the whole process(1-2-3).
Run Firmware: Normal Mode

- Power-down Jasmine board
- Power-up Jasmine board as ‘Normal Mode’
Diskpart

```plaintext
Copyright (C) 1999-2013 Microsoft Corporation.

DISKPART> list disk

<table>
<thead>
<tr>
<th>Disk #</th>
<th>Status</th>
<th>Size</th>
<th>Available</th>
<th>Dyn</th>
<th>Gpt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk 0</td>
<td>Online</td>
<td>238 GB</td>
<td>0 B</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Disk 1</td>
<td>Online</td>
<td>1863 GB</td>
<td>1742 GB</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Disk 2</td>
<td>Online</td>
<td>59 GB</td>
<td>59 GB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DISKPART> select disk 2

2 디스크가 선택한 디스크입니다.

DISKPART> clean

DiskPart에서 디스크를 정리했습니다.

DISKPART> create partition primary

DiskPart에서 지정한 파티션을 만들었습니다.
```
Format & Mount
uart_printf() for Debugging

- Set OPTION_UART_DEBUG in include/jasmine.h
- Clean(OpenSSD-1.1.0/clean.bat)
- Re-build the firmware
- Debugging log will be sent to host in ‘Normal Mode’

- Example
  - `uart_printf("Total FTL DRAM %d Kb", dram_size);`
Putty Configuration
Introduction to OpenSSD
Jasmine Platform
Storage Device
HDD vs SSD
HDD vs SSD

- **HDD**
  - Slow Read/Write speed
  - Different Sequential/Random I/O speed
  - In-Place update

- **SSD**
  - Fast Read/Write speed
  - Similar Sequential/Random I/O speed
  - In-Place update is impossible.
    - Page unit write/ Block unit erase.
  - Wearing.
The OpenSSD Project

- It is an initiative to promote research and education on the recent SSD technology

- Providing OpenSSD platforms on which open source SSD firmware can be developed
Hardware Architecture

![Hardware Architecture Diagram]

- **Micro processor**
  - ARM7TDMI-S Core
- **Code, variable**
  - SRAM (96KB)
  - ROM
  - NAND Controller
  - Buffer Manager
  - SATA Device
  - DRAM Controller
  - Memory Utility
- **Read/write to flash**
  - NAND Flash
  - SATA Host interface
- **For debug**
  - Clock Generator
  - UART
  - GPIO
  - Timer
  - WDT
  - PMU
  - ICU
  - JTAG
- **Buffer**
  - DRAM

For more details, see the document by Jin-Soo Kim.
Technical Resource

- Download resources from OpenSSD Wiki
  - [http://www.openssd-project.org](http://www.openssd-project.org)
  - FTL Developer’s Guide
  - Jasmine Firmware
To End up Today...

- Put some uart_printf()s in OpenSSD-1.1.0/sata_main to print out the number of read/written sectors
  - Hint: Main()
- Set up Putty to receive debugging log from OpenSSD
- Proceed the diskpart process in page 13
- Save a copy of putty results into “YourStudentID.txt” and e-mail me attaching the txt file
Any Questions?