SSE3052: Embedded Systems Practice

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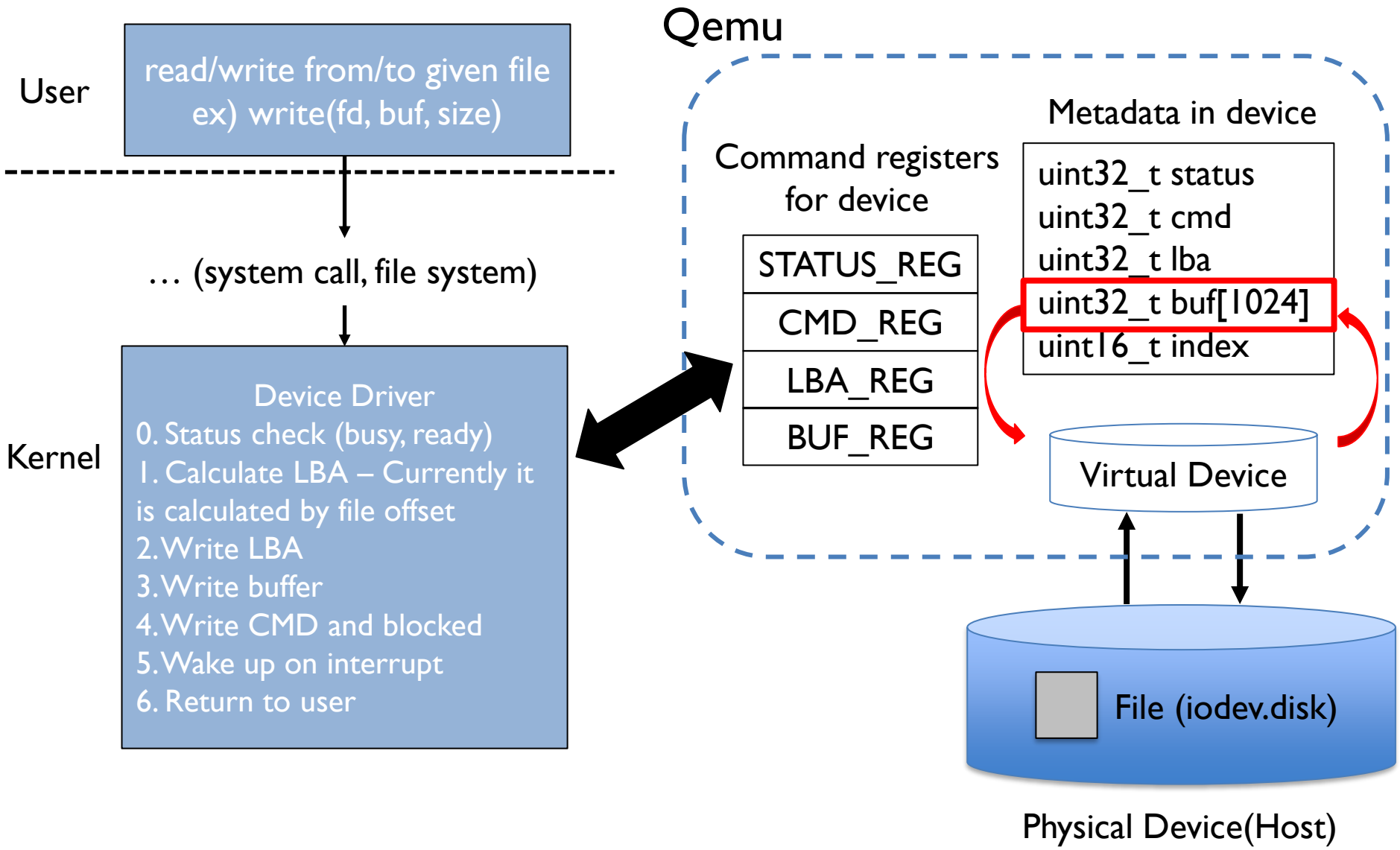
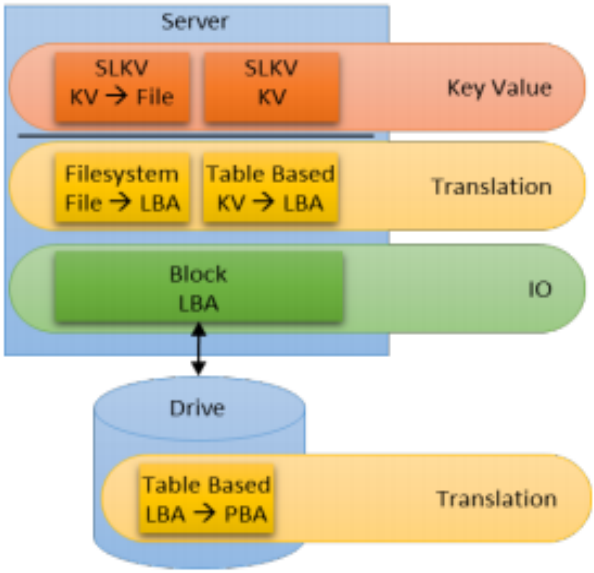
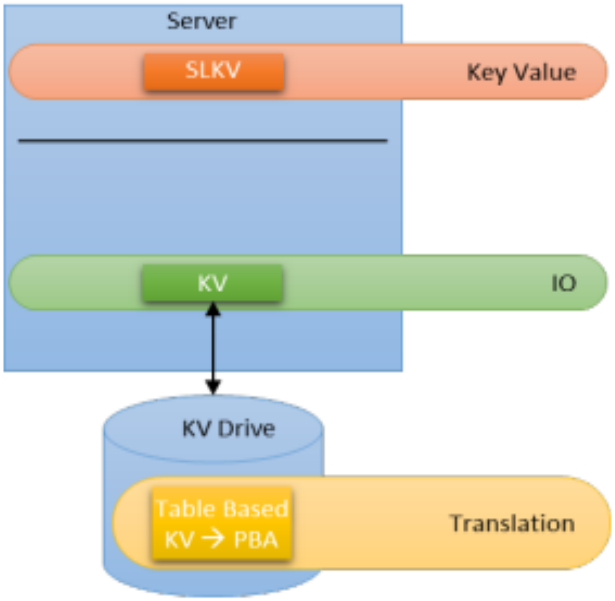
Summary of Today's Lecture



KV-SSD (Key-Value SSD) (1)



Previous drive protocol stack



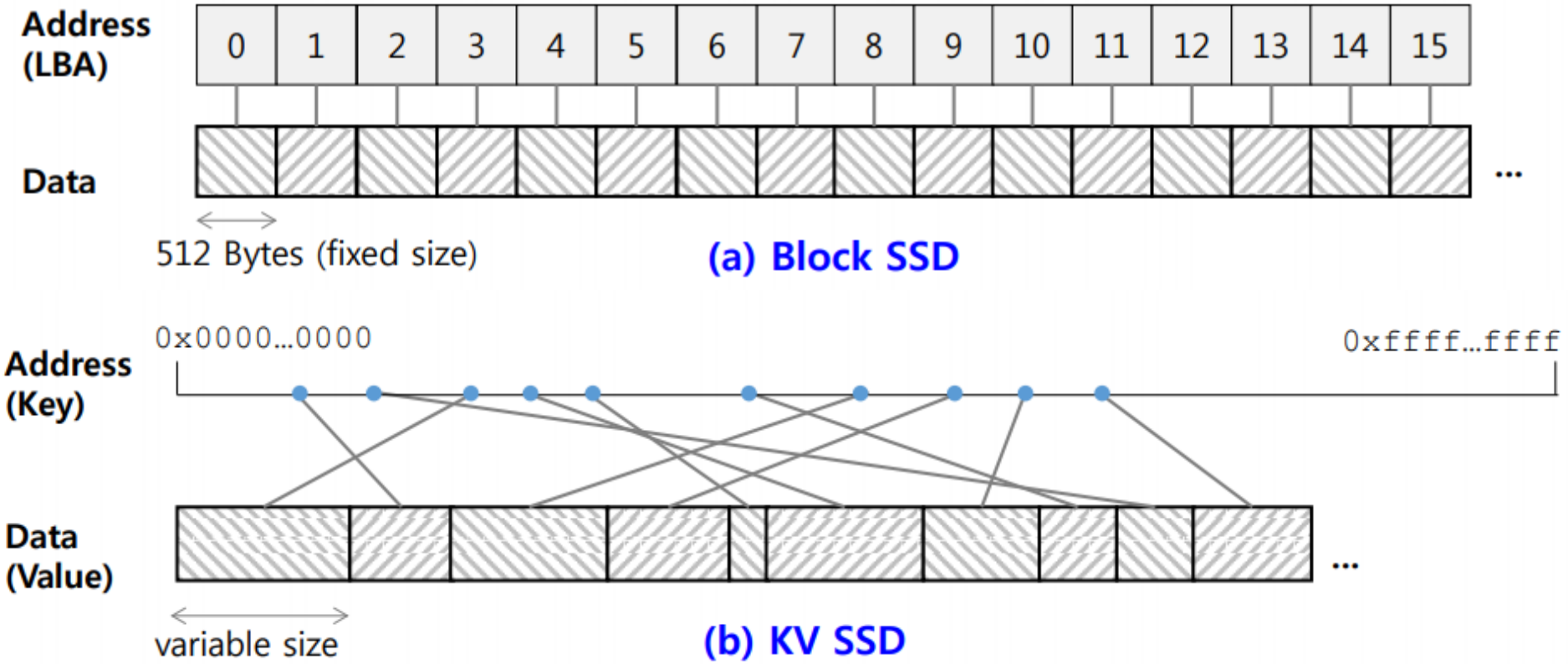
New drive protocal stack

Advantage

- Get rid of complexity translation between KV and Block

KV-SSD (Key-Value SSD) (2)

- KV-SSD supports Key-Value interface composed of,
  - Key (variable address) & Value (variable length)
  - Write: put(key, value), Read: value = get(key)



Simple KV-SSD (1)

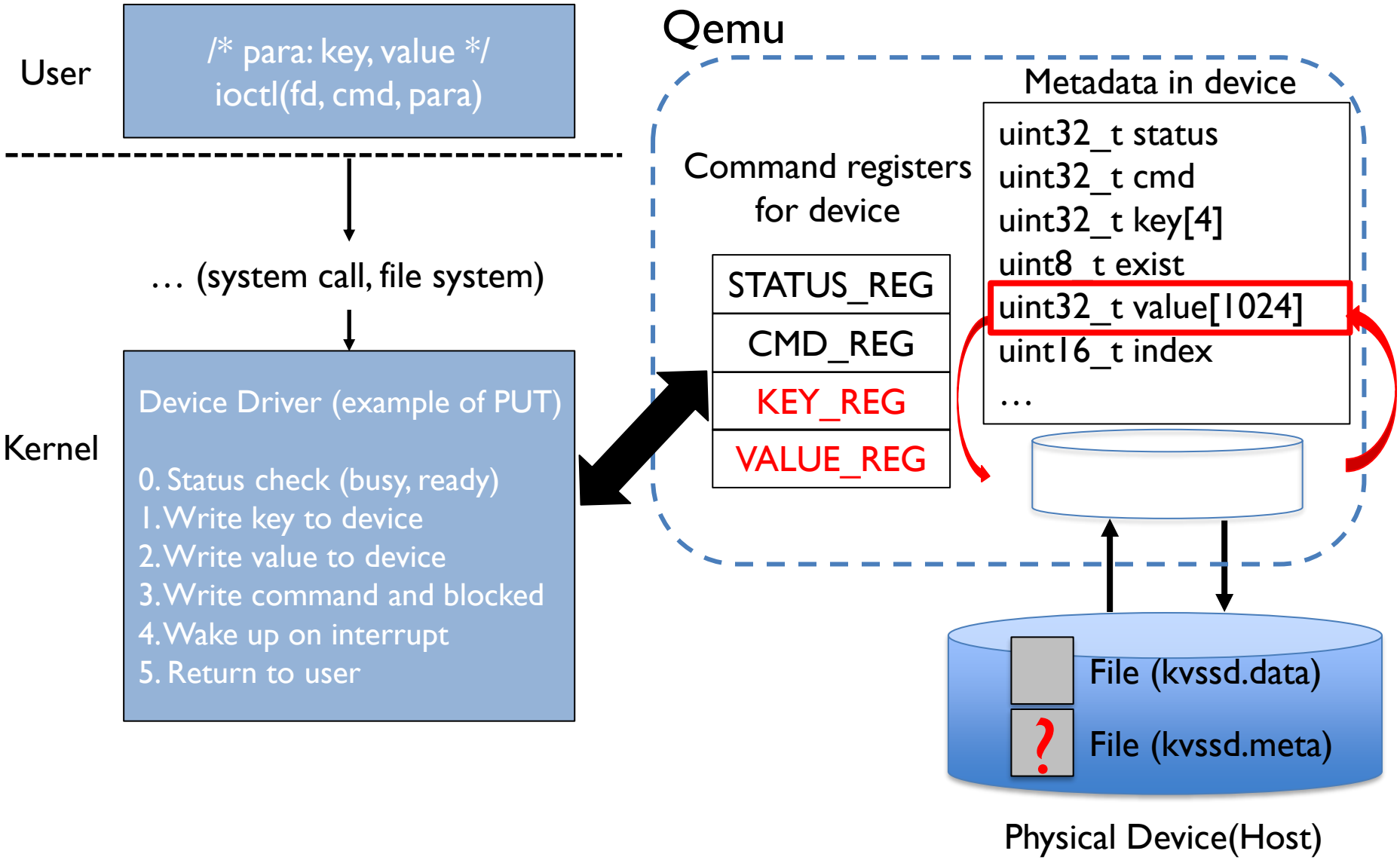
Simple KV-SSD features

ITEM	DESCRIPTION
Key Size	16 bytes (static size)
Value Size	4KB
Block Size	4KB
KV Command	get, put, erase, exist

- Simple KV-SSD gets commands from user by *ioctl*
- ioctl (int fd, int cmd, unsigned long para) {

```
switch(cmd) {
        case CMD_PUT:
                …
        case CMD_GET:
                …
        case CMD_EXIST:
                …
        case CMD_ERASE:
                …
};
```

Simple KV-SSD (2)

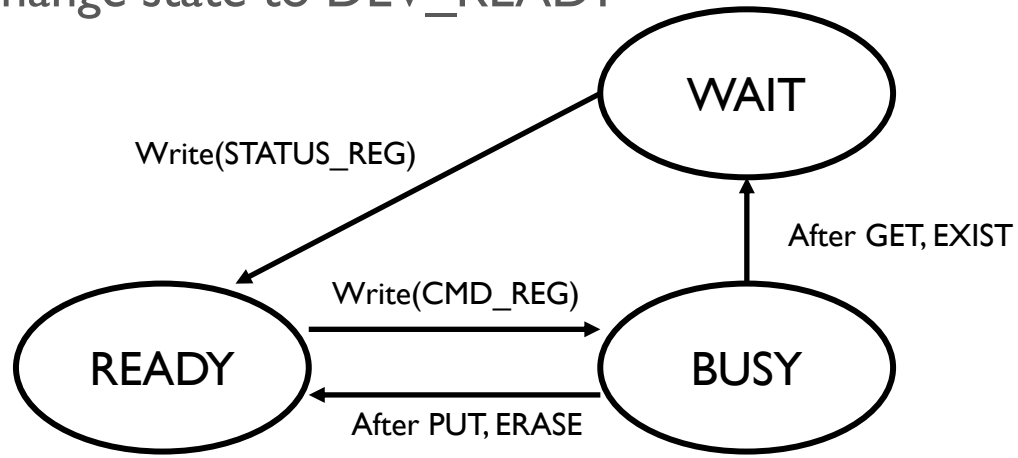


File kvssd.meta

- Abstraction of metadata blocks
- Contents of the file
  - Number of keys
  - Key and PBN pairs
  - etc.
- Read *kvssd.meta* to memory at *device_init*
- Write updated information of key to *kvssd.meta*
  - Ex1) Add new key by PUT operation
  - Ex2) PBA of the key is updated by PUT operation
  - etc.

QEMU Internals: Device States

- DEV_READY
  - Device is ready for get command from host
- DEV_BUSY
  - Device is busy and blocks command from host
- DEV_WAIT
  - Device is waiting for host to read results of the command
  - If written value from host to STATUS_REG is identical with current processing key, change state to DEV_READY



Protocols

- Description of interface btw. goldfish and device
- Following slides are protocols of each operation
  - PUT, GET, EXIST, ERASE
- Device driver code is opened on iCampus
  - Read carefully with following protocols

QEMU Protocols: Registers

- STATUS_REG
  - Read: return current status
  - Write: if current state is DEV_WAIT, and written value is same with key, switch st ate to DEV_READY
- CMD_REG
  - Write: executes actions of written command (CMD_PUT, CMD_GET, CMD_ERA SE, CMD_EXIST)
- KEY_REG
  - Read: return existance of the key
  - Write: Store written value to the key
- VALUE_REG
  - Read: return value of the key
  - Write: store written value to the value of the key

QEMU Protocol: CMD_REG (1)

- Write on CMD_REG

```
switch (cmd) {
    …
    case CMD_PUT:
        1. check existance of the key
            - if key exists, invalidate original physical block
        2. Allocate new physical block for PUT
            - validate new physical block
            - update kvssd.meta
        3. Write value to kvssd.data
        4. Raise an interrupt
        5. Change state of the device (DEV_READY)
    …
};
```

QEMU Protocol: CMD_REG (2)

- Write on CMD_REG

```
switch (cmd) {
        …
        case CMD_GET:
                1. check existance of the key
                2. Read value from kvssd.data (if key exists)
                3. Raise an interrupt
                4. Change state of the device to DEV_WAIT
        …
}
```

QEMU Protocol: CMD_REG (3)

- Write on CMD_REG

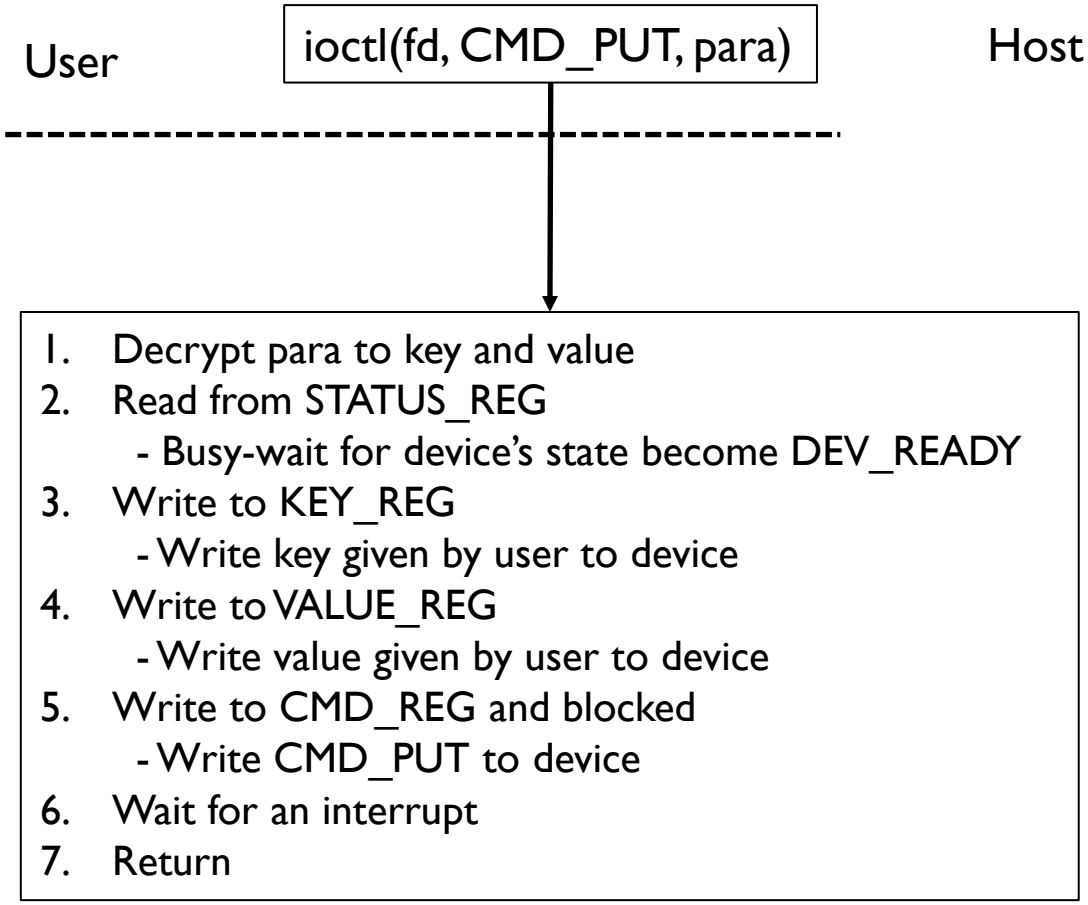
```
switch (cmd) {
        …
        case CMD_EXIST:
                1. check existance of the key
                2. raise an interrupt
                3. Change state of the device to DEV_WAIT
        …
}
```

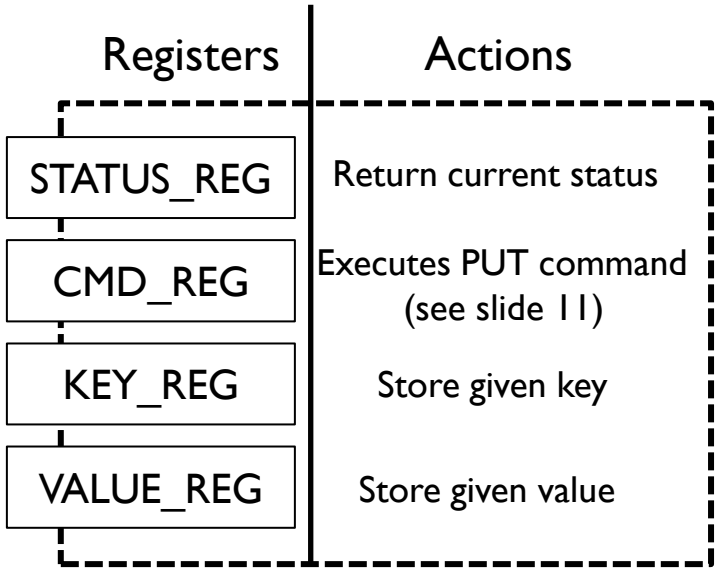
QEMU Protocol: CMD_REG (4)

- Write on CMD_REG

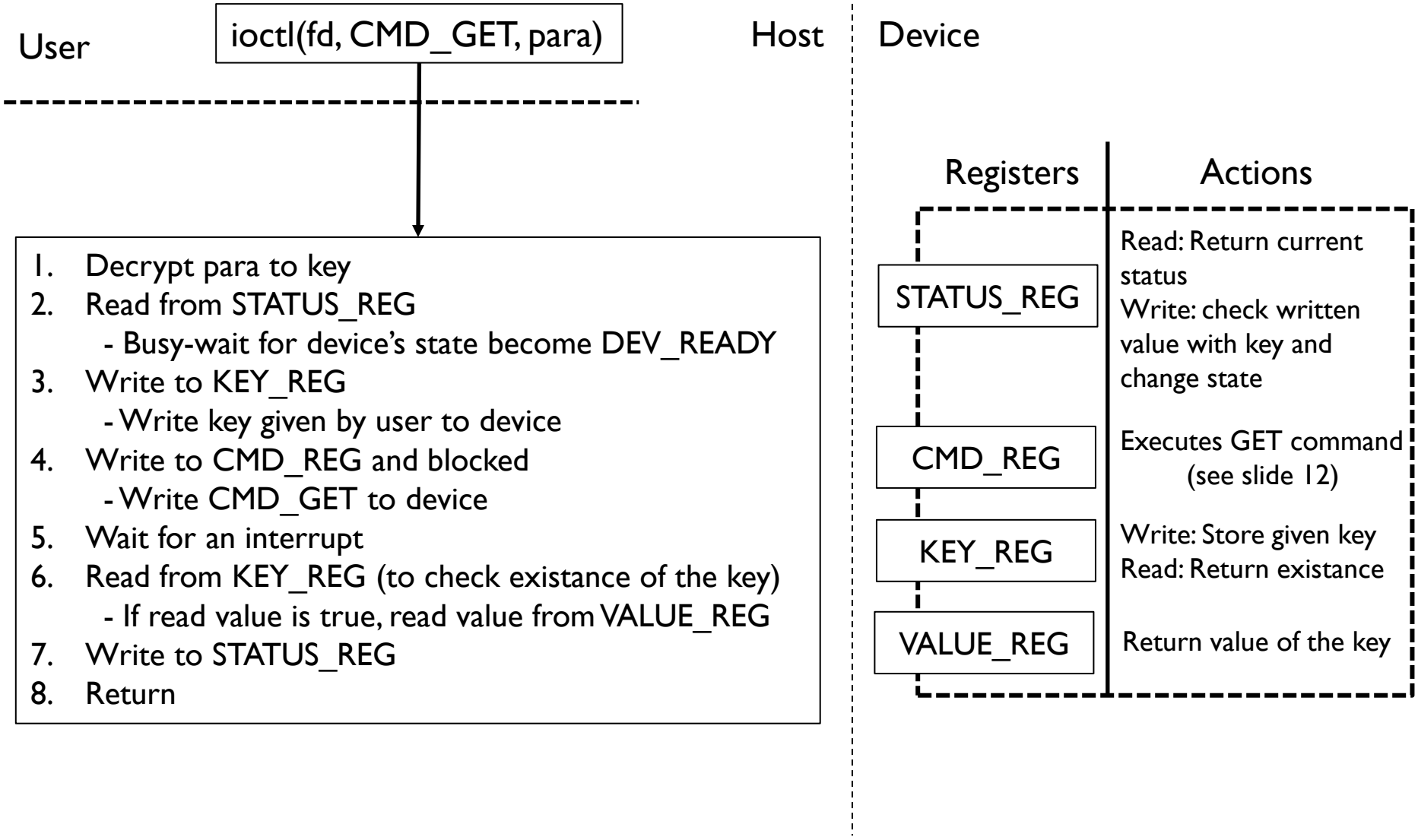
```
switch (cmd) {
        …
        case CMD_ERASE:
                1. invalid physical block of the key
                2. update kvssd.meta
                3. raise an interrupt
                4. change state of the device to DEV_READY
        …
}
```

PUT Protocol

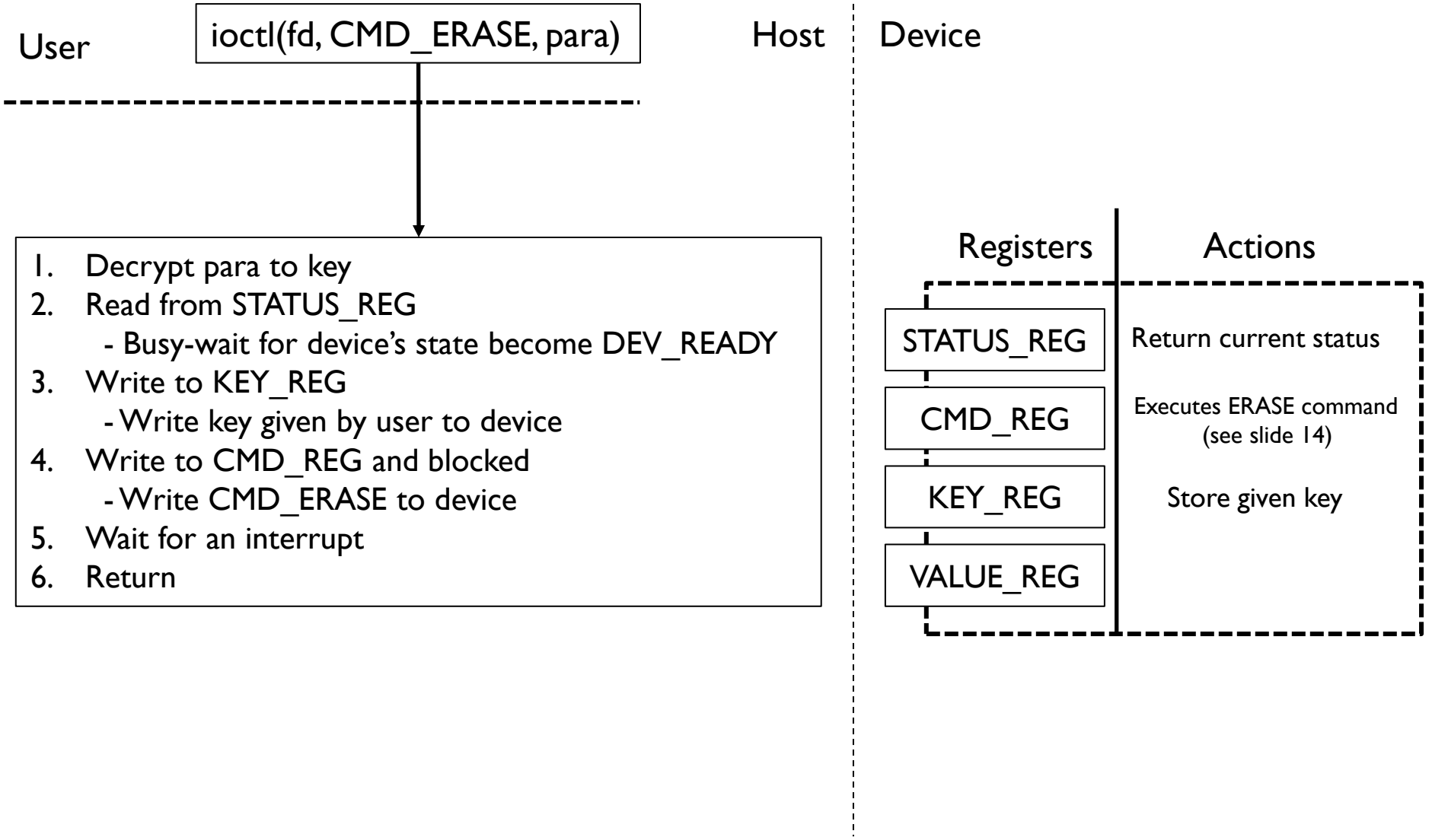




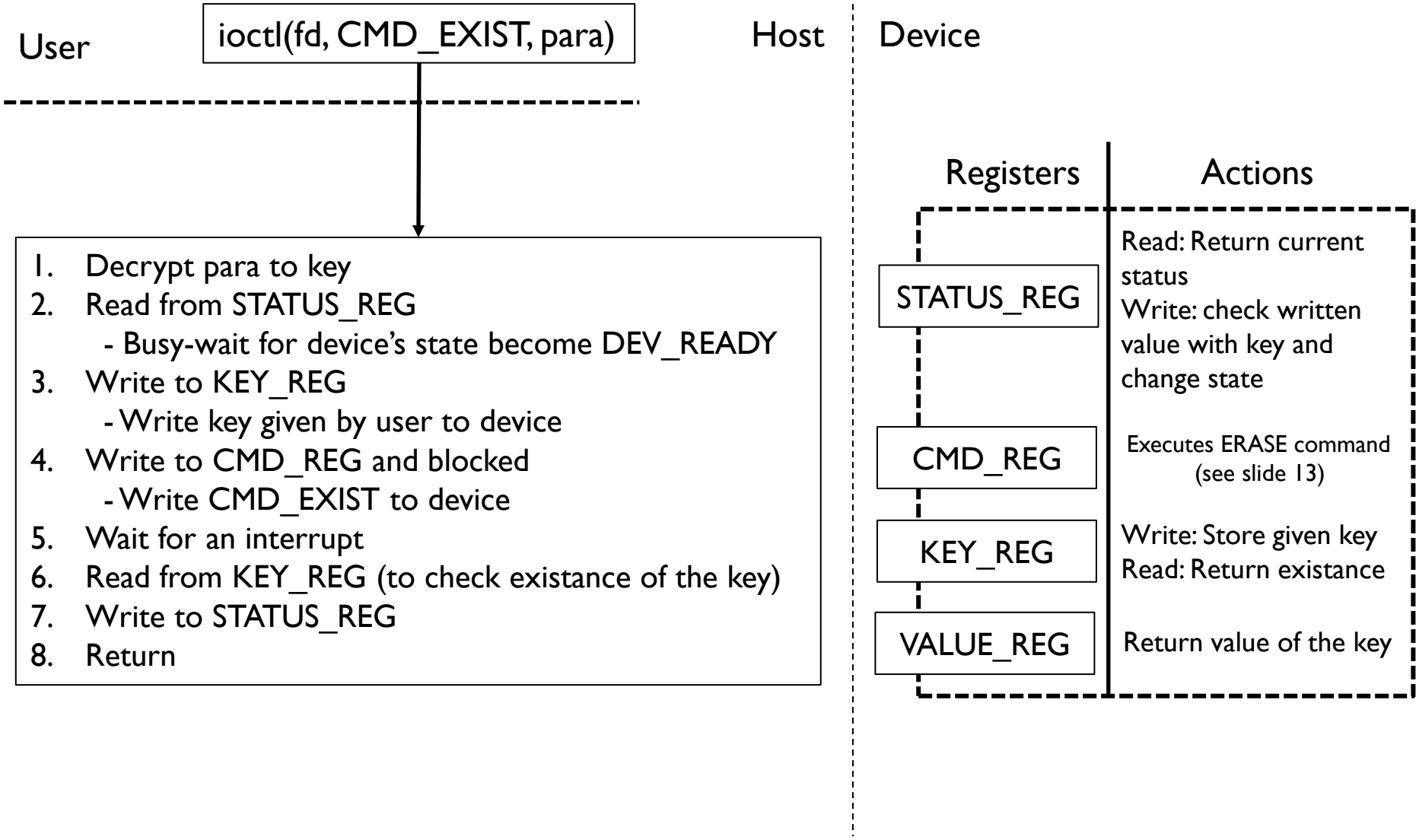
GET Protocol



ERASE Protocol



EXIST Protocol



Project 1

- Write QEMU code for KV-SSD
  - Do not use block which used by other key
    - You should manage metadata about *used* and *valid* of the data block (*kvssd.data*)
    - New block allocation should selected from unused block
  - Allocate new block for PUT operation on existing key
    - Invalidate original block
- Write brief report about project
  - Report should include,
    - Metadata management (*kvssd.meta*)
    - Data management (*kvssd.data*)
    - Explanation of your code
    - etc.

Submission

- Compress your files as YourStudentID-1.zip
  - Codes to submit
    - QEMU device file only
  - Report
    - Write brief report of project
  - Upload to iCampus

- PLEASE DO NOT COPY
  - YOU WILL GET F GRADE IF YOU COPIED

- Due date: 4/5 (Mon.) 23:59:00
  - -20% per day for delayed submission

Questions

- If you have any questions, please use piazza