Linux Kernel Hacking Free Course, 3rd edition

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Drivers for block devices

March 22, 2006

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Class of devices

From previous lectures:

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char device Data can be read as byte streams and random accesses are uncommon

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block device slow, disk-like devices in which data can be accessed in blocks; random accesses are common

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- The kernel uses complex data structure (*disk cache*) and different scheduling algorithms to reduce the disk latency

All of these items must be considered when writing a block device driver.

Data unit

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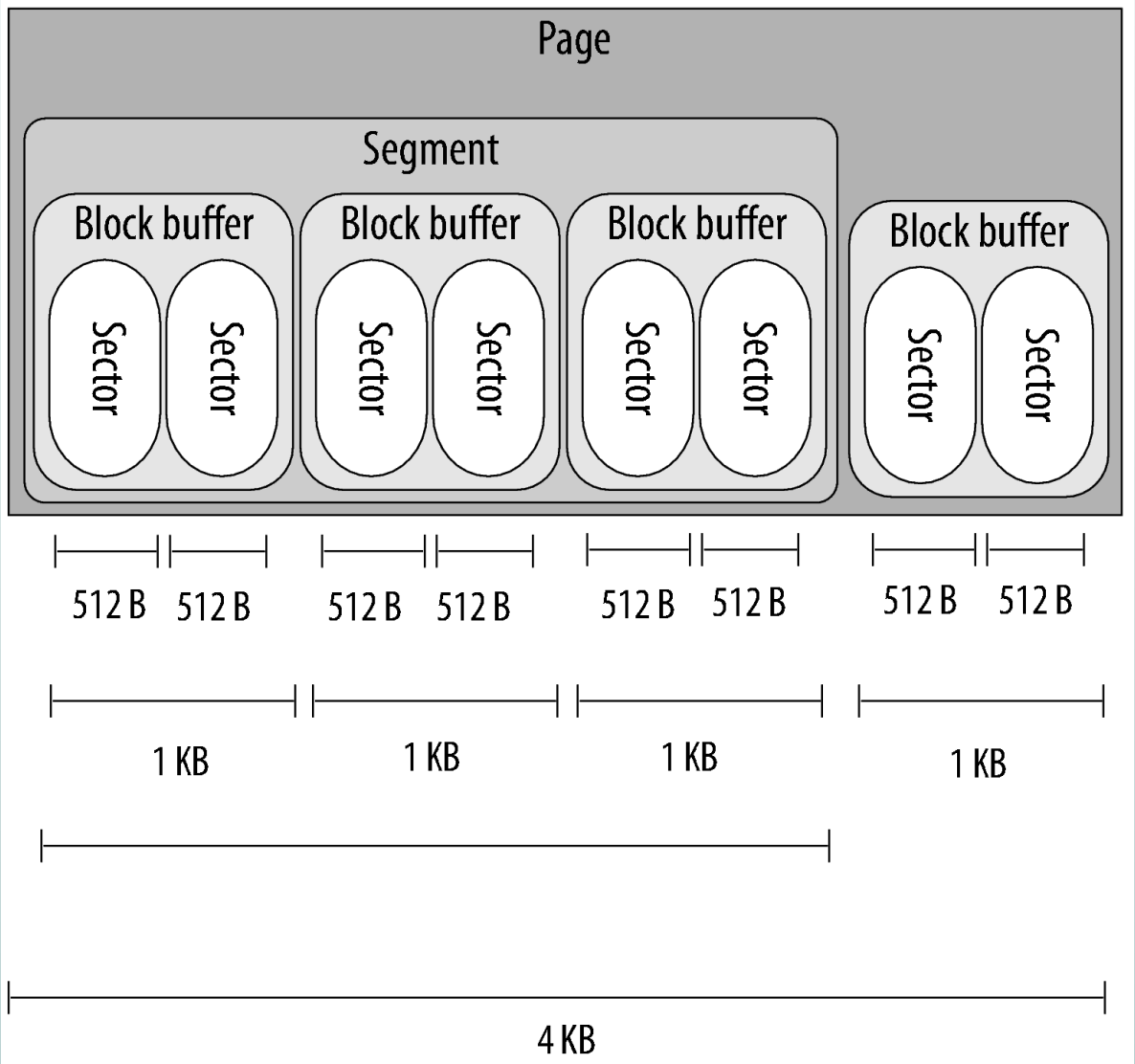
page Data into the page cache are stored in pages (4096 bytes)


Page
Segment
Block buffer
Block buffer
Block buffer
Block buffer
Sector
Sector
Sector
Sector
Sector
Sector
Sector
Sector
512 B
512 B
512 B
512 B
512 B
512 B
512 B
512 B
1 KB
1 KB
1 KB
1 KB
4 KB

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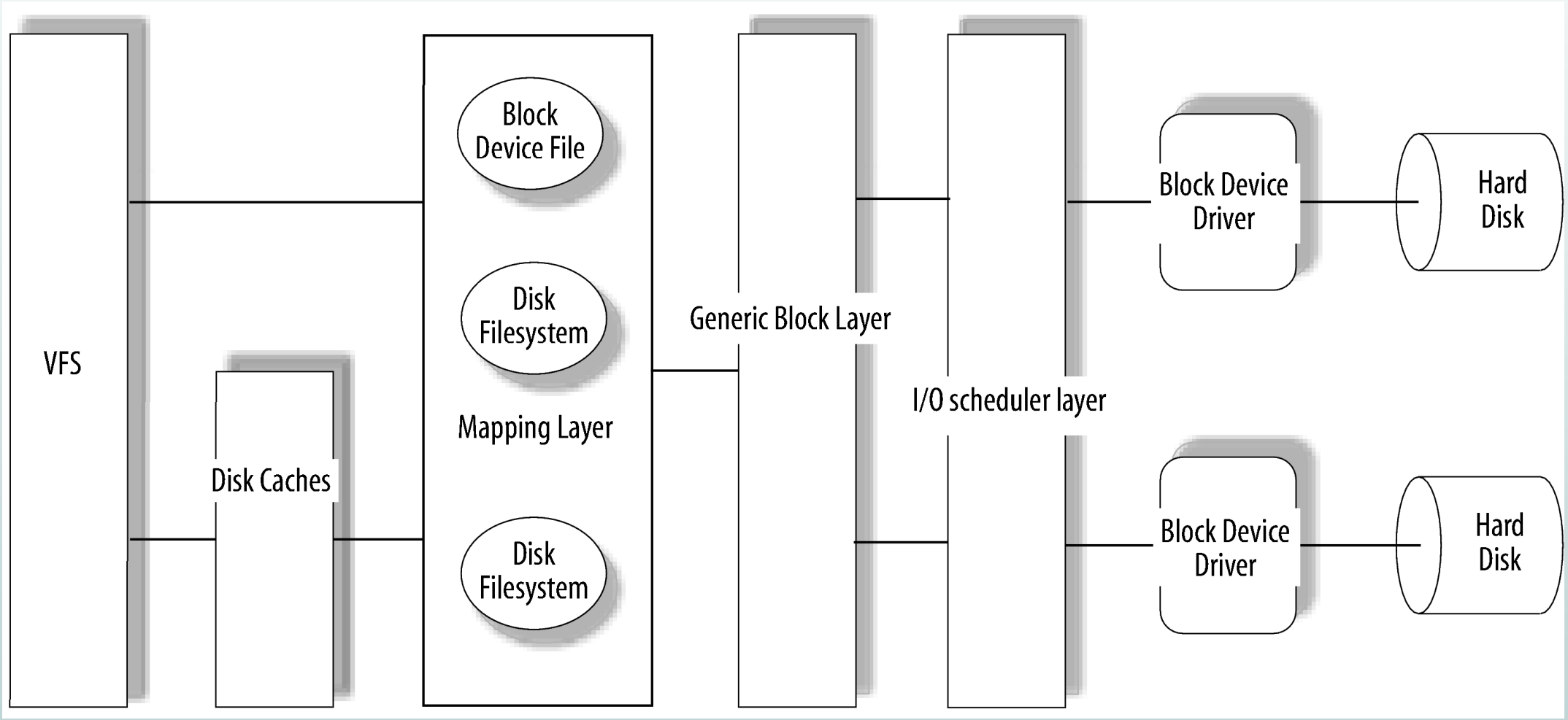
The higher part interfaces with the VFS and with the Generic Block Layer; the lower part interfaces with the kernel I/O Scheduler and with the hardware.


VFS
Disk Caches
Block Device File
Disk Filesystem
Mapping Layer
Disk Filesystem
Generic Block Layer
I/O scheduler layer
Block Device Driver
Hard Disk
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Bldex: a simple RAMDISK based block device

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5. Handle the request queue

Bldex: step 1, data definition

Bldex has a private data structure where all the information related to the device are stored.

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```
struct bldex_desc_t {
        int major;
        int size_in_sectors;
        u8 *data;
        int users;
        spinlock_t lock;
        struct request_queue *queue;
        struct gendisk *gd;
};
```

Bldex: step 2, registration

A block device driver must register itself by specifying a `major number` and a `name` for the disk.

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```
unregister_blkdev()
```

unregisters the device driver.

Gendisk

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From the developer's point of view, a single `gendisk` object is required, which represents the whole disk.

Bldex: step 3, obtaining the gendisk object

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At this point the driver must be ready to handle I/O requests for the disk because `add_disk()` issues read requests while accessing the partition table.

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- `open()`, `release()`
- `ioctl()` in order to implement all the operations that cannot be implemented as `read`/`write`
- `media_changed()`, `revalidate_disk()` if the device can be removed

Bldex: step 4, methods (2)

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All these methods are stored into a `block_device_operations` table that can be accessed by the `fops` field into the `gendisk` object.

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A request must be refer to contiguous disk sectors however it may encompass scattered data buffers in memory.

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- the transfer direction (to/from the disk)

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The function `blk_cleanup_queue()` removes the request queue.