BLOCK DEVICES

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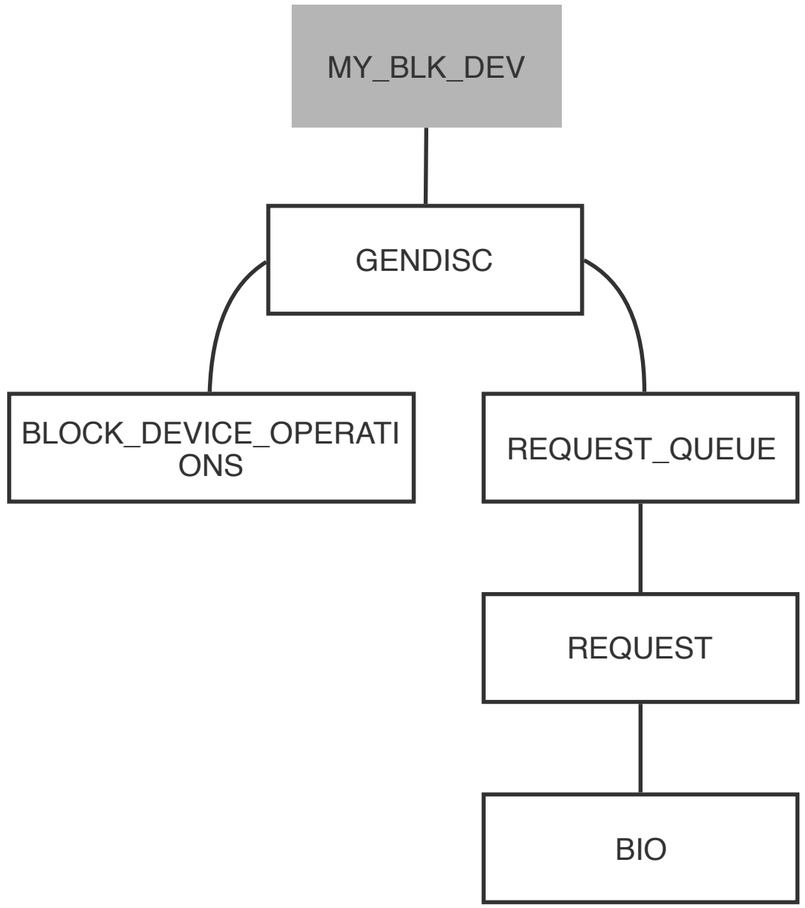
BASICS

„A block driver provides access to devices that transfer **randomly accessible data** in fixed-size **blocks** – disk drives, primarily. The Linux kernel sees block devices a being fundamentally **different from char devices**; as a result, block drivers have a **distinct interface** and their own particular challenges.“

O’Reilly Linux Device Drivers, 3rd Edition

DATA STRUCTURES



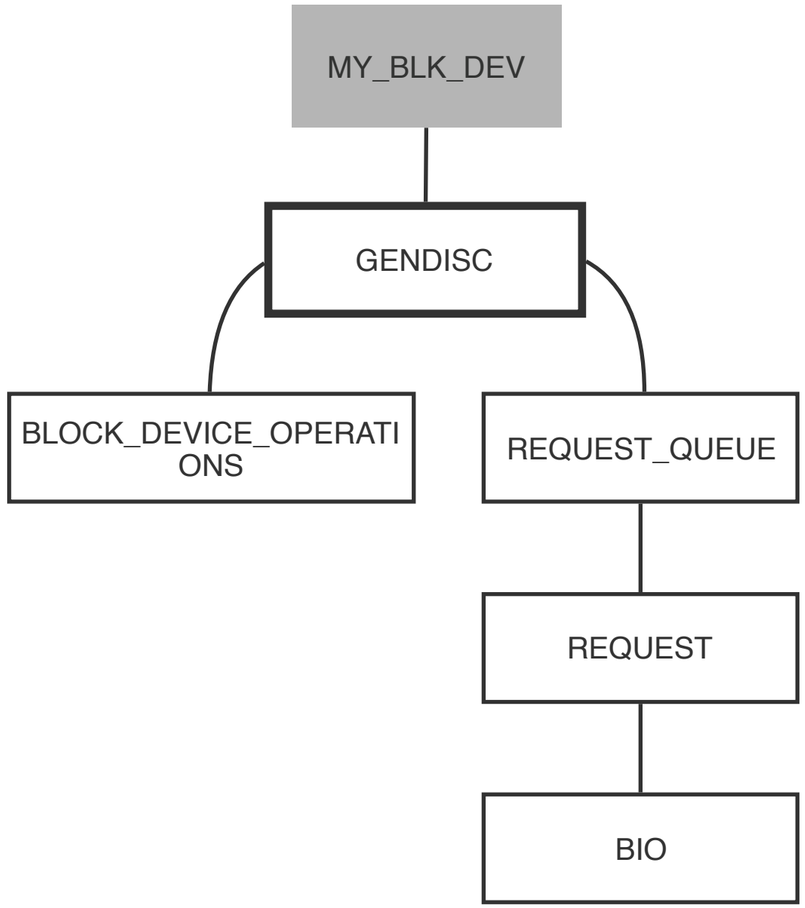
REGISTRATION

BLOCK DRIVER REGISTRATION

```
<linux/fs.h>
/*
 * major: major number of the device, if 0 is passed into register_blkdev
 * new major number will be allocated
 * name: associated device name (e.g. shown in /proc/devices)
 */
int register_blkdev(unsigned int major, const char *name);
void unregister_blkdev(unsigned int major, const char *name);
```

THAT’S IT?

<LINUX/GENHD.BLK>

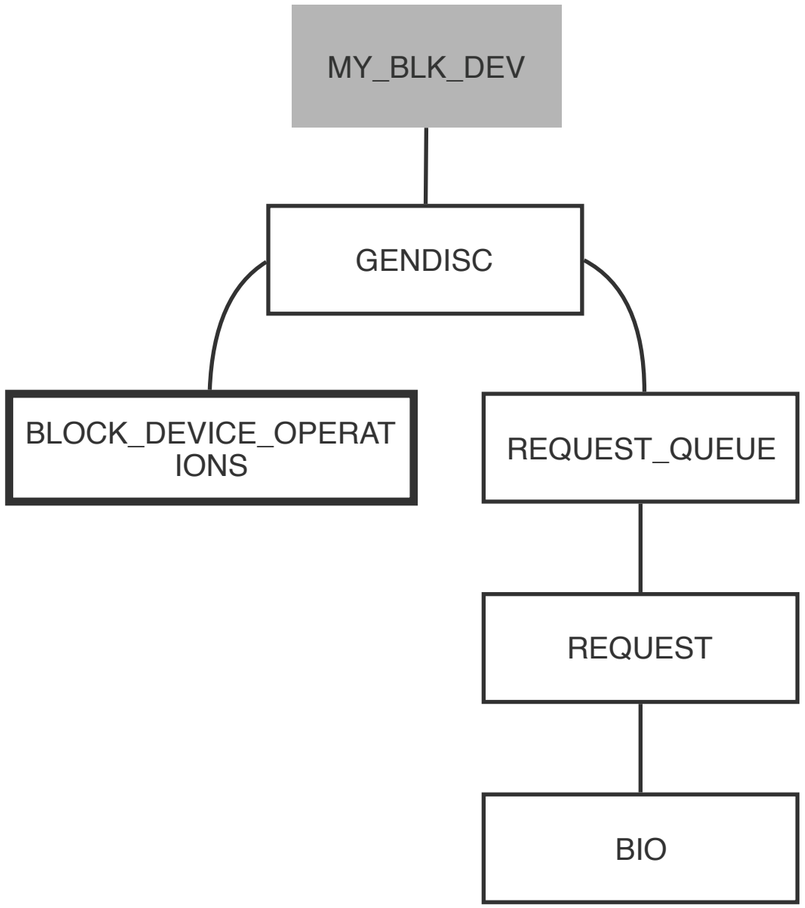


GENDISK

```
my_blk_dev.mbd = alloc_disk(MINOR);
if (! my_blk_dev.mbd) {
  /*
   * error handling goes here
   */
}
my_blk_dev.mbd->major = major;
my_blk_dev.mbd->first_minor = RB_FIRST_MINOR;
my_blk_dev.mbd->fops = &mbd_fops;
my_blk_dev.mbd->private_data = &mbd_dev;
my_blk_dev.mbd->queue = mbd_dev.mbd_queue;
set_capacity(my_blk_dev.mbd, nsectors*(HARD_SECTOR_SIZE/KERNEL_SECTOR_SIZE));
add_disk(my_blk_dev.mbd);
```

OPERATIONS

<LINUX/BLKDEV.H>



BLOCK_DEVICE_OPERATIONS

≈

FILE_OPERATIONS

BLOCK DRIVER OPERATIONS <LINUX/FS.H>

```
struct block_device_operations {
  int (*open) (struct block_device *, fmode_t);
  void (*release) (struct gendisk *, fmode_t);
  //implements ioctl system call
  int (*ioctl) (struct block_device *, fmode_t, unsigned, unsigned long);
  //get geometry of the device
  int (*getgeo)(struct block_device *, struct hd_geometry *);
  struct module *owner;
};
```

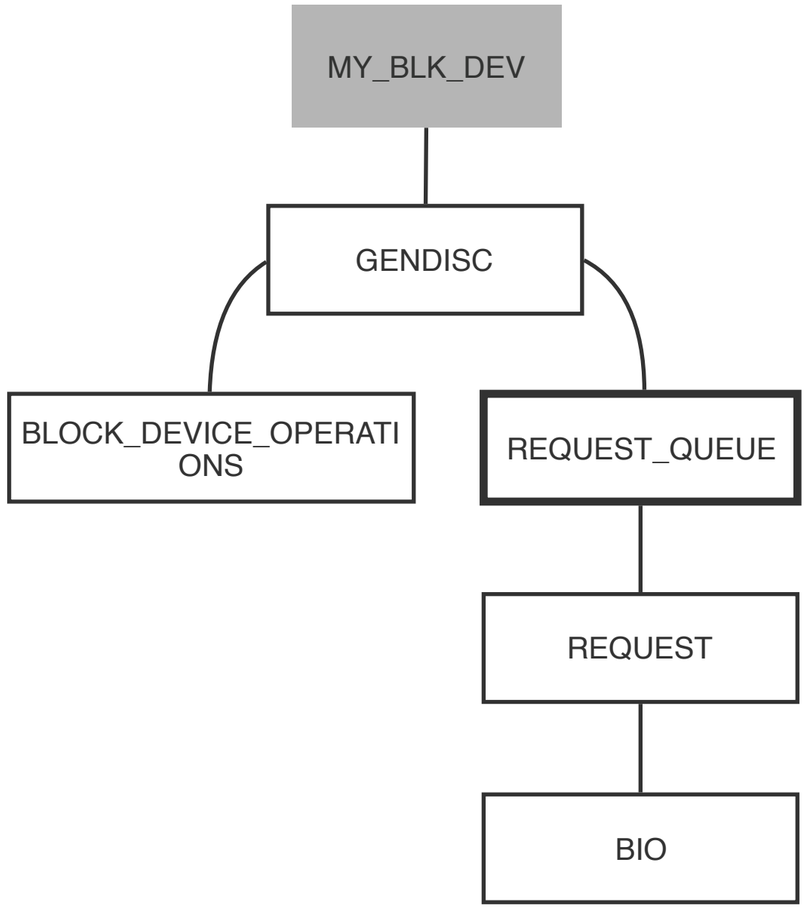
IOCTL
<DRIVERS/BLOCK/IOCTL.C>

- Today mainly provides the devices geometry
- Amount of heads, cylinders, sectors, starting point
- Necessary for e.g. fdisk to work properly

REQUEST PROCESSING

READ/WRITE
REQUEST

<LINUX/BLKDEV.H>



REQUEST QUEUE
SET IT UP

```
<linux/blkdev.h>
/*
 * request: request function
 * lock: spinlock
*/
//request_queue_t is used to manage request queues
request_queue_t *blk_init_queue(request_fn_proc *request,
        spinlock_t *lock);
void blk_cleanup_queue(request_queue_t *);
struct request *blk_fetch_request(request_queue_t *queue);
/*
 * blk_dequeue_request and blk_requeue_request allow you to remove and add
 * back requests from/to the queue
*/
void blk_dequeue_request(struct request *req);
void blk_requeue_request(request_queue_t *queue, struct request *req);
void blk_stop_queue(request_queue_t *queue);
void blk_start_queue(request_queue_t *queue);
```

REQUEST QUEUE
SKY ISN'T THE LIMIT

```
<linux/blkdev.h>
/*
 * DMA: Direct Memory Access bypassing the CPU
 * dma_addr: highest physical address to which a device can perform DMA
 * This information is needed by the kernel to be able to create a
 * bounce buffer if necessary
 * Those operations are way more expensive in terms of performance
 */
void blk_queue_bounce_limit(request_queue_t *queue, u64 dma_addr);
```

REQUEST QUEUE
THE END

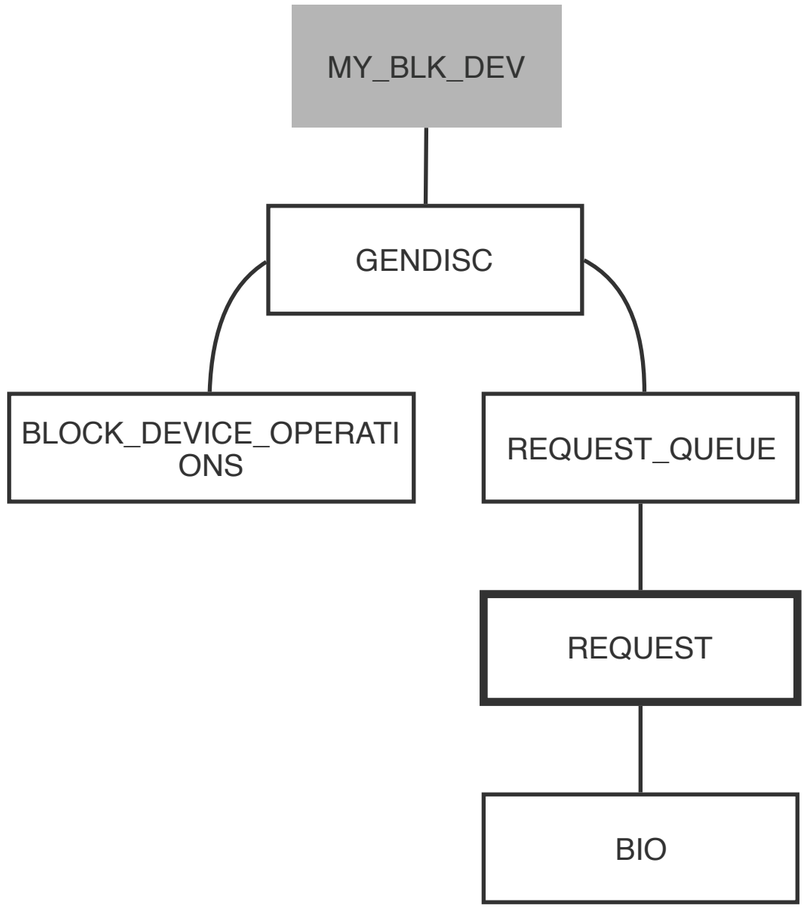
```
<linux/blkdev.h>
/*
 * return:  -true   all sectors have been transferred and request is completed
 *          -false  still pending
 */
bool __blk_end_request_cur(struct request *req, int error);
```

REQUEST METHOD
DO IT

```
<linux/blkdev.h>

void request(request_queue_t *queue);
```

<LINUX/BLKDEV.H>

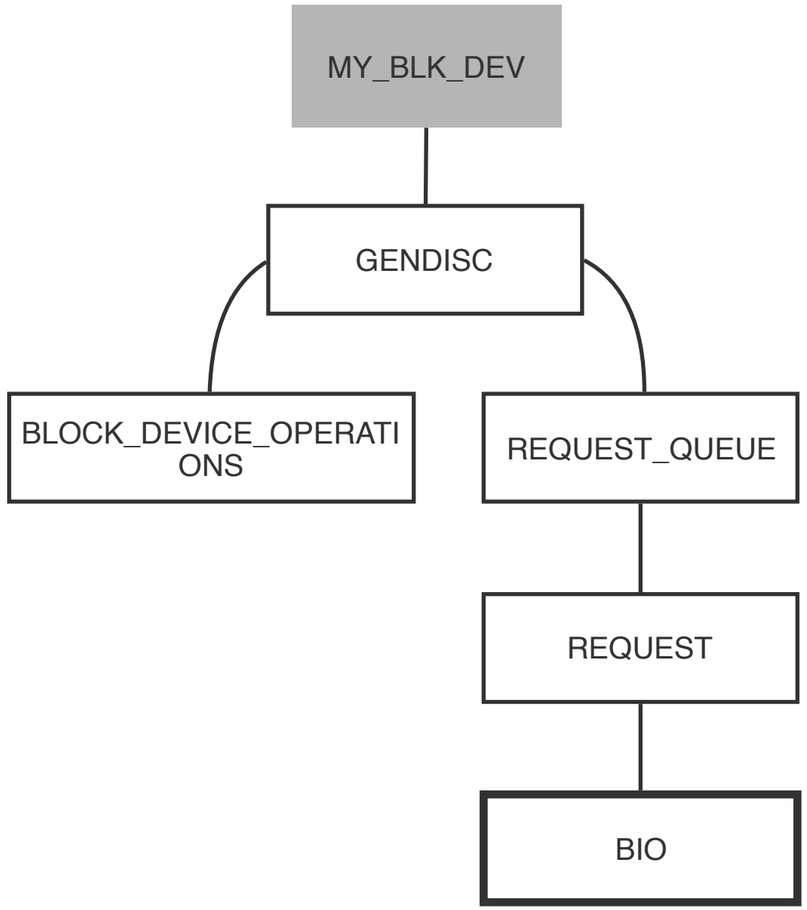


REQUEST
SET IT UP

```
<linux/blkdev.h>
/*
 * sector: index of the sector which represents the starting point of our
 * requests operation
 * nr_sectors: number of sectors to be transferred
 * *buffer: pointer to the buffer representing the data source or target
 * rq_data_dir: determines between read and write operations, returns
 *   - zero for read
 *   - non zero for for write
*/

sector_t sector;
unsigned long nr_sectors;
char *buffer;
rq_data_dir(struct request *req);
```

<LINUX/BIO.H>

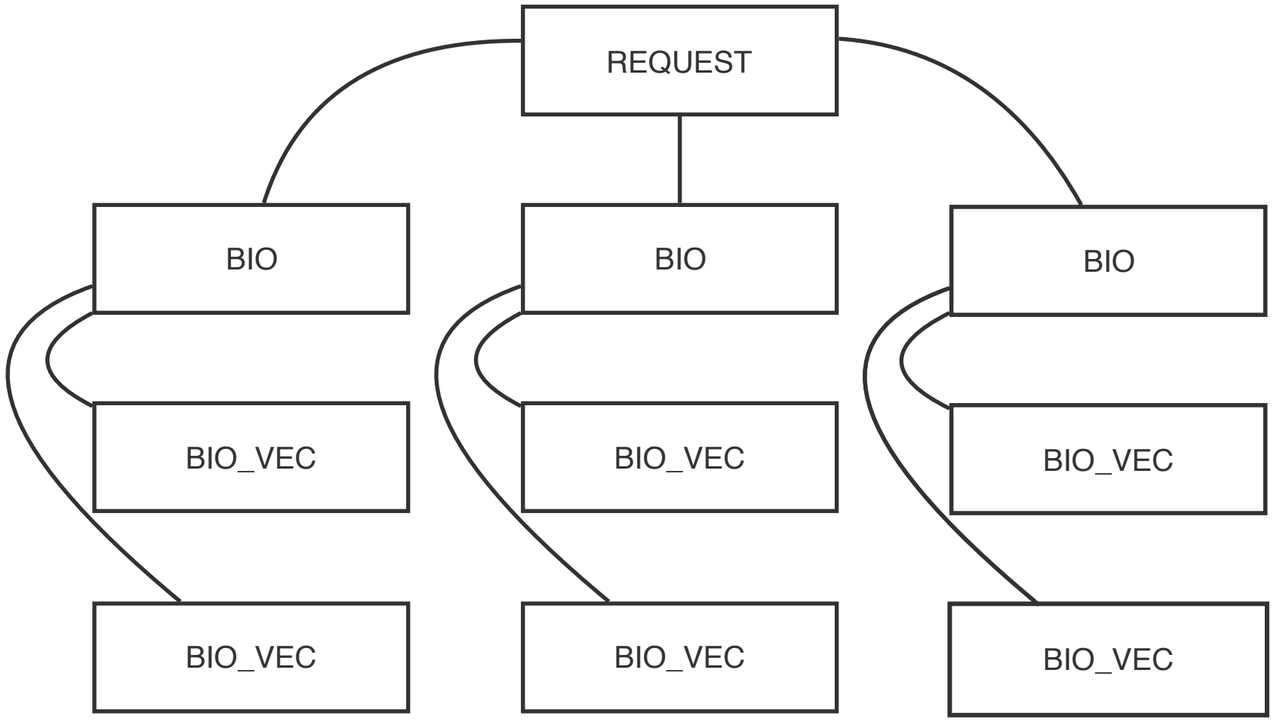

MY_BLK_DEV
GENDISC
BLOCK_DEVICE_OPERATIONS
REQUEST_QUEUE
REQUEST
BIO

BIO = BLOCKING I/O

<LINUX/BIO.H>

- describes an blocking I/O request
- several bios are merged into a request
- contains (multiple) page(s) of data; each represented as bio_vec which contains the length in bytes and the offset of the buffer in the page

<LINUX/BIO.H>


REQUEST
BIO
BIO
BIO
BIO_VEC
BIO_VEC
BIO_VEC
BIO_VEC
BIO_VEC
BIO_VEC

SOURCES

- O'Reilly Linux Device Drivers, 3rd Edition Jonathan Corbet, Alessandro Rubini, Greg Kroah-Hartman
  http://www.oreilly.com/openbook/linuxdrive3/book/
- tldp.org
  http://www.tldp.org/LDP/tlk/dd/drivers.html
- sysplay.in (Demo)
  https://sysplay.in/blog/linux-device-drivers/2014/04/disk-on-ram-playing-destructively/