

МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ

федеральное государственное автономное
образовательное учреждение высшего образования
«Самарский национальный исследовательский университет
имени академика С.П. Королева»
(Самарский университет)

Институт информатики, математики и электроники
Факультет информатики
Кафедра суперкомпьютеров и общей информатики

Отчет по лабораторной работе №1

Дисциплина: «Развертывание и жизненный цикл программного обеспечения»

Тема: «VM and RAID»

Выполнил: Торжков И.И.

Группа: 6411-100503D

Самара 2022

Steps

1. Create Virtual Machine with Debian/Ubuntu/CentOS or download preinstalled image (<https://www.osboxes.org/>). VM without GUI.
2. Add simple RAID1 to Virtual Machine: *nix OS System on 1-st HDD, 2d and 3d HDDs are in RAID1. 2 (with star). only two HDDs. OS System on RAID1, based on this two HDD.
3. How to test RAID1. Create file on RAID1 file system. Turn off VM and remove one of the HDDs from VM. Turn on VM. File should be accessible.
4. Add new HDD and sync it to RAID1.
5. Add section with Assignment1 description into docx and send by e-mail for checking.

PROCEDURE

Create VM with 3 HDD and install Ubuntu Server 20.04:

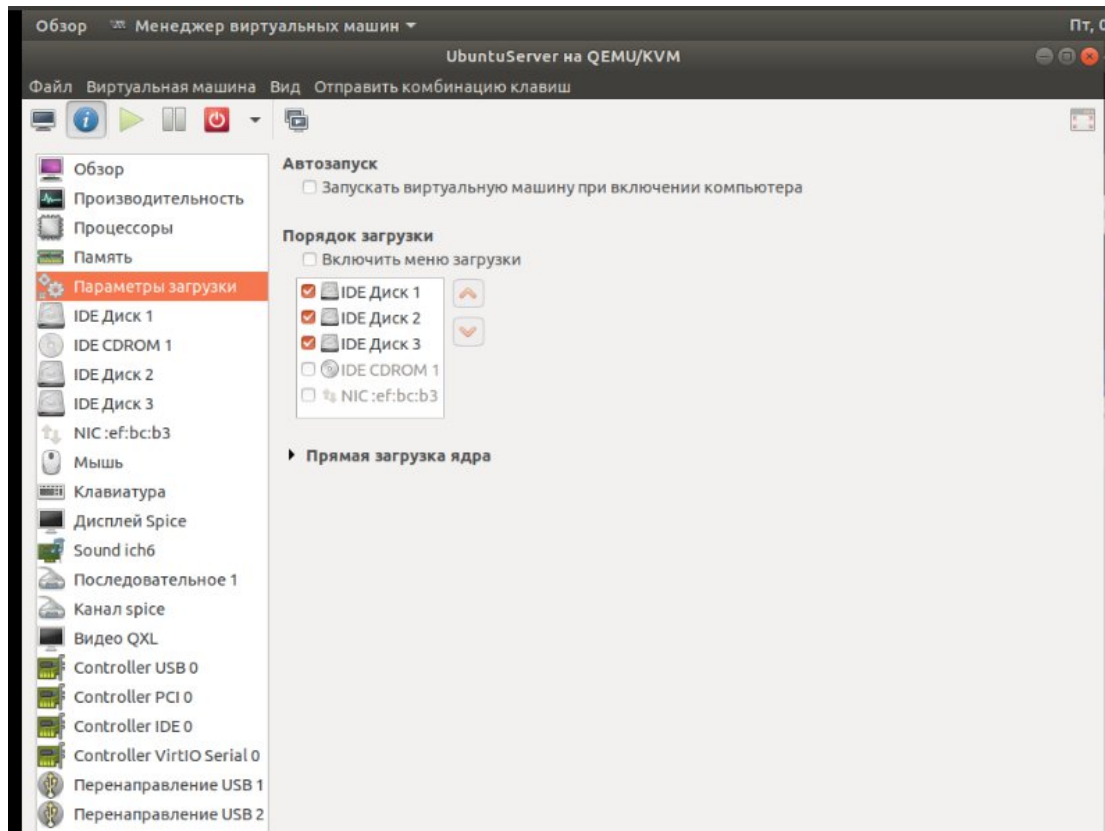


Figure 1

Input lsblk to list all disks:

```
Ubuntu 20.04.4 LTS server tty1

ilya-servern:
Password:
Welcome to Ubuntu 20.04.4 LTS (GNU/Linux 5.4.0-104-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

System information as of Fri 11 Mar 2022 05:14:01 AM UTC

System load:  0.01               Processes:      119
Usage of /:   26.7% of 8.90GB    Users logged in: 0
Memory usage: 5%                IPv4 address for ens3: 192.168.122.236
Swap usage:   0%

 * Super-optimized for small spaces - read how we shrank the memory
   footprint of MicroK8s to make it the smallest full K8s around.

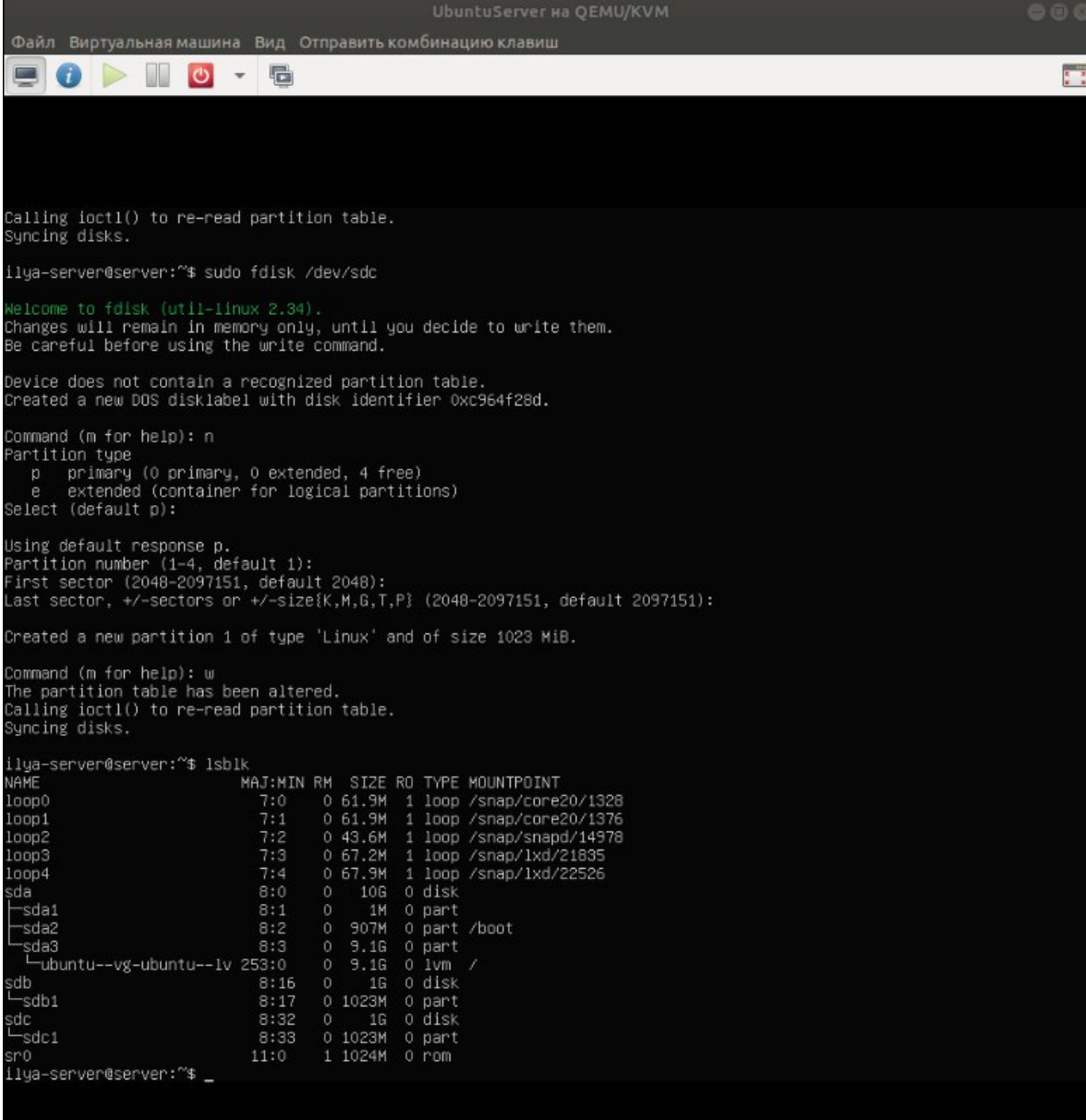
   https://ubuntu.com/blog/microk8s-memory-optimisation

0 updates can be applied immediately.

Last login: Thu Mar 10 06:08:15 UTC 2022 on tty1
ilya-server@server:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
loop0                               7:0      0 61.9M  1 loop /snap/core20/1328
loop1                               7:1      0 61.9M  1 loop /snap/core20/1376
loop2                               7:2      0 43.6M  1 loop /snap/snapd/14978
loop3                               7:3      0 67.2M  1 loop /snap/lxd/21835
loop4                               7:4      0 67.9M  1 loop /snap/lxd/22526
sda                                 8:0      0   1G  0 disk
├─sda1                             8:1      0    1M  0 part
├─sda2                             8:2      0 907M  0 part /boot
├─sda3                             8:3      0   9.1G  0 part
└─ubuntu--vg-ubuntu--lv 253:0    0   9.1G  0 lvm  /
sdb                                 8:16     0    1G  0 disk
sdc                                 8:32     0    1G  0 disk
sr0                                11:0     1 1024M  0 rom
```

Figure 2

Create two primary partitions sdb1 and sdc1:



```
UbuntuServer на QEMU/KVM
Файл  Виртуальная машина  Вид  Отправить комбинацию клавиш

Calling ioctl() to re-read partition table.
Syncing disks.

ilya-server@server:~$ sudo fdisk /dev/sdc

Welcome to fdisk (util-linux 2.34).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0xc964f28d.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p):

Using default response p.
Partition number (1-4, default 1):
First sector (2048-2097151, default 2048):
Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-2097151, default 2097151):

Created a new partition 1 of type 'Linux' and of size 1023 MiB.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.

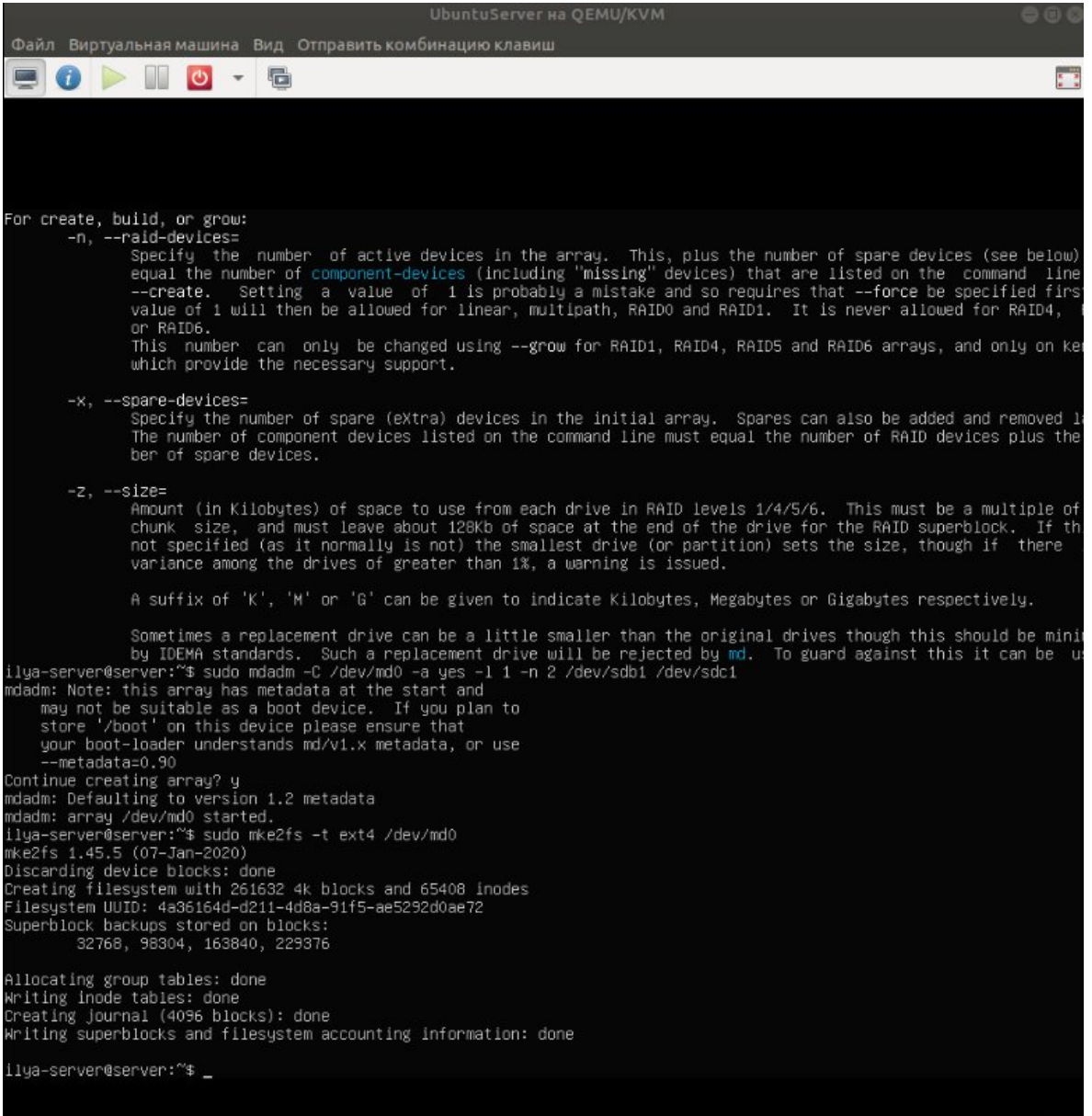
ilya-server@server:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
loop0                               7:0      0  61.9M  1 loop /snap/core20/1328
loop1                               7:1      0  61.9M  1 loop /snap/core20/1376
loop2                               7:2      0  43.6M  1 loop /snap/snapd/14378
loop3                               7:3      0  67.2M  1 loop /snap/lxd/21635
loop4                               7:4      0  67.9M  1 loop /snap/lxd/22526
sda                                 8:0      0   10G  0 disk
├─sda1                             8:1      0    1M  0 part
├─sda2                             8:2      0   907M  0 part /boot
├─sda3                             8:3      0    9.1G  0 part
└─ubuntu--vg-ubuntu--lv          253:0    0    9.1G  0 lvm  /
sdb                                 8:16     0    1G  0 disk
└─sdb1                             8:17     0   1023M  0 part
sdc                                 8:32     0    1G  0 disk
└─sdc1                             8:33     0   1023M  0 part
sr0                                11:0     1   1024M  0 rom

ilya-server@server:~$ _
```

Figure 3

Create RAID1 based on sdb and sdc (level 1 and 2 disk in raid):

```
sudo mdadm -C /dev/md0 -a yes -l 1 -n 2 /dev/sdb1 /dev/sdc1
```



```
UbuntuServer на QEMU/KVM
Файл  Виртуальная машина  Вид  Отправить комбинацию клавиш

For create, build, or grow:
  -n, --raid-devices=
      Specify the number of active devices in the array.  This, plus the number of spare devices (see below),
      equal the number of component-devices (including "missing" devices) that are listed on the command line
      --create.  Setting a value of 1 is probably a mistake and so requires that --force be specified first.
      value of 1 will then be allowed for linear, multipath, RAID0 and RAID1.  It is never allowed for RAID4,
      or RAID6.
      This number can only be changed using --grow for RAID1, RAID4, RAID5 and RAID6 arrays, and only on kernels
      which provide the necessary support.

  -x, --spare-devices=
      Specify the number of spare (extra) devices in the initial array.  Spares can also be added and removed later.
      The number of component devices listed on the command line must equal the number of RAID devices plus the
      number of spare devices.

  -z, --size=
      Amount (in Kilobytes) of space to use from each drive in RAID levels 1/4/5/6.  This must be a multiple of
      chunk size, and must leave about 128Kb of space at the end of the drive for the RAID superblock.  If
      not specified (as it normally is not) the smallest drive (or partition) sets the size, though if there
      is a variance among the drives of greater than 1%, a warning is issued.

      A suffix of 'K', 'M' or 'G' can be given to indicate Kilobytes, Megabytes or Gigabytes respectively.

      Sometimes a replacement drive can be a little smaller than the original drives though this should be minimized
      by IDEMA standards.  Such a replacement drive will be rejected by md.  To guard against this it can be used
      with the --replace option.

ilya-server@server:~$ sudo mdadm -C /dev/md0 -a yes -l 1 -n 2 /dev/sdb1 /dev/sdc1
mdadm: Note: this array has metadata at the start and
      may not be suitable as a boot device.  If you plan to
      store '/boot' on this device please ensure that
      your boot-loader understands md/v1.x metadata, or use
      --metadata=0.90
Continue creating array? y
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md0 started.
ilya-server@server:~$ sudo mke2fs -t ext4 /dev/md0
mke2fs 1.45.5 (07-Jan-2020)
Discarding device blocks: done
Creating filesystem with 261632 4k blocks and 65408 inodes
Filesystem UUID: 4a36164d-d211-4d8a-91f5-ae5292d0ae72
Superblock backups stored on blocks:
      32768, 98304, 163840, 229376

Allocating group tables: done
Writing inode tables: done
Creating journal (4096 blocks): done
Writing superblocks and filesystem accounting information: done

ilya-server@server:~$ _
```

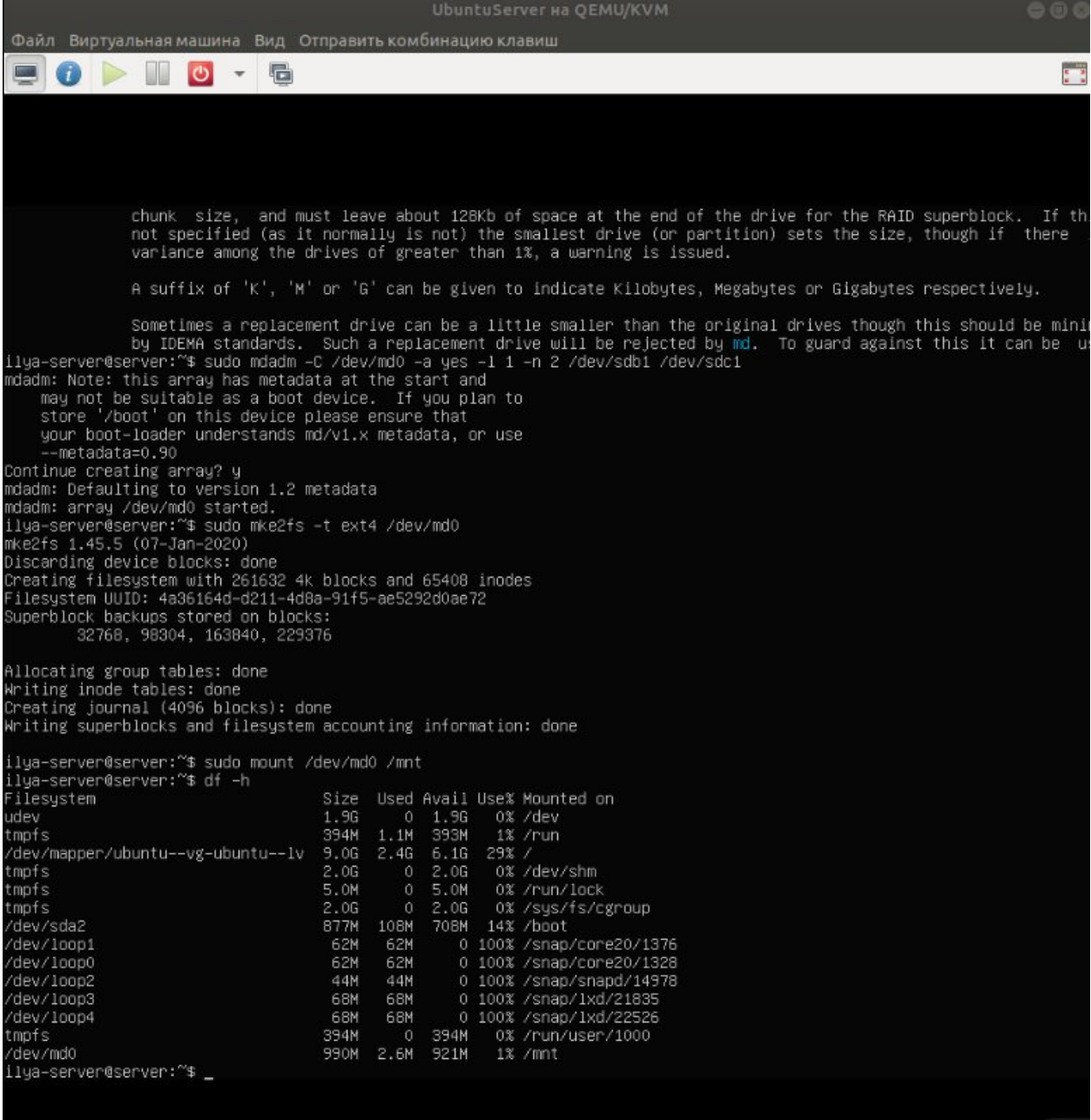
Figure 4

Create a file system based on RAID1, mount it and check:

```
sudo mke2fs -t ext4 /dev/md0
```

```
sudo mount /dev/md0 /mnt
```

```
df -h
```



```
chunk size, and must leave about 128Kb of space at the end of the drive for the RAID superblock. If th
not specified (as it normally is not) the smallest drive (or partition) sets the size, though if there
variance among the drives of greater than 1%, a warning is issued.

A suffix of 'K', 'M' or 'G' can be given to indicate Kilobytes, Megabytes or Gigabytes respectively.

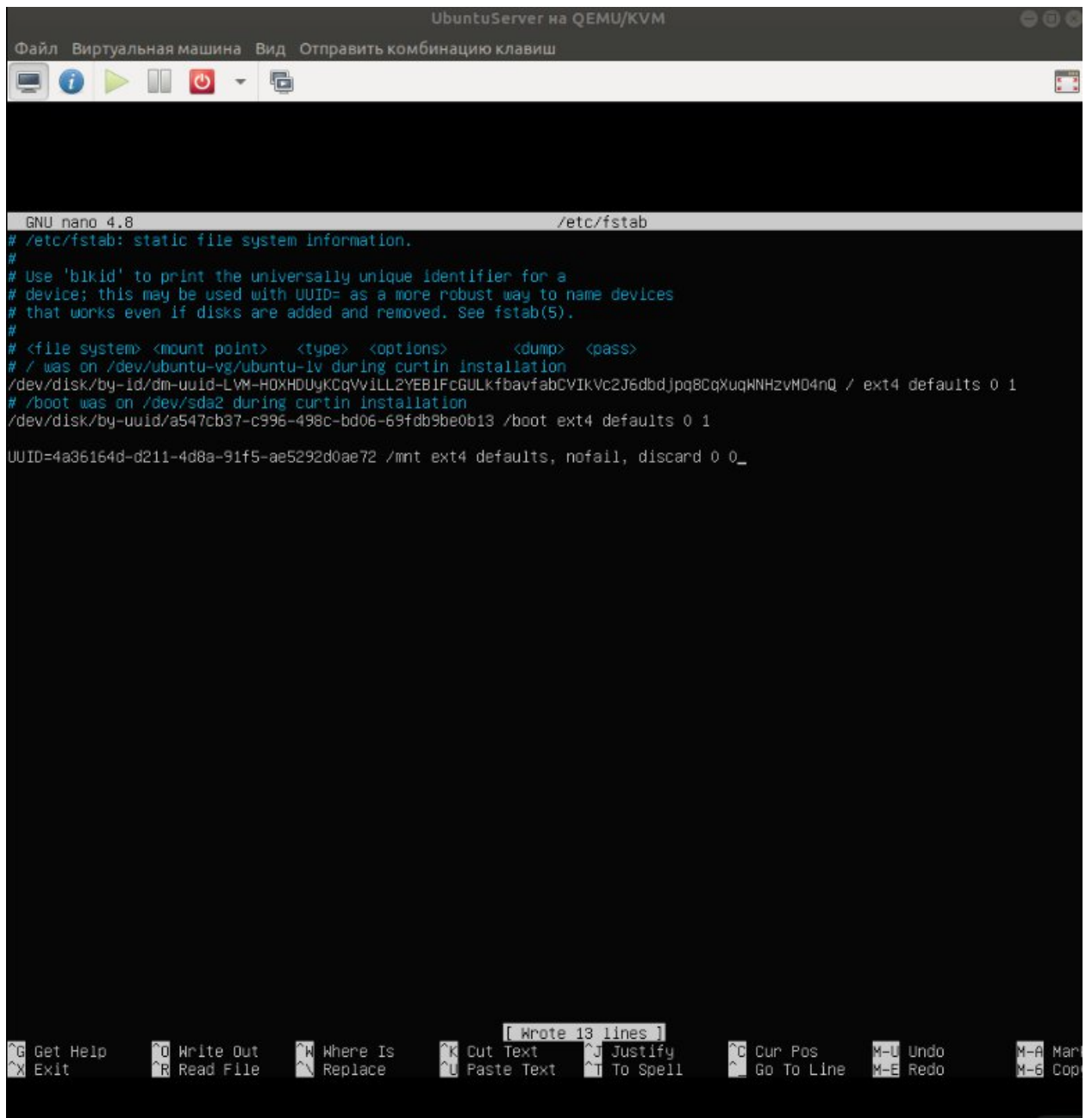
Sometimes a replacement drive can be a little smaller than the original drives though this should be mini
by IDEMA standards. Such a replacement drive will be rejected by md. To guard against this it can be u
ilya-server@server:~$ sudo mdadm -C /dev/md0 -a yes -l 1 -n 2 /dev/sdb1 /dev/sdc1
mdadm: Note: this array has metadata at the start and
may not be suitable as a boot device. If you plan to
store '/boot' on this device please ensure that
your boot-loader understands md/v1.x metadata, or use
--metadata=0.90
Continue creating array? y
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md0 started.
ilya-server@server:~$ sudo mke2fs -t ext4 /dev/md0
mke2fs 1.45.5 (07-Jan-2020)
Discarding device blocks: done
Creating filesystem with 261632 4k blocks and 65408 inodes
Filesystem UUID: 4a36164d-d211-4d8a-91f5-ae5292d0ae72
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376

Allocating group tables: done
Writing inode tables: done
Creating journal (4096 blocks): done
Writing superblocks and filesystem accounting information: done

ilya-server@server:~$ sudo mount /dev/md0 /mnt
ilya-server@server:~$ df -h
Filesystem                                Size  Used Avail Use% Mounted on
udev                                     1.9G   0   1.9G   0% /dev
tmpfs                                   394M  1.1M  393M   1% /run
/dev/mapper/ubuntu--vg-ubuntu--lv      9.0G  2.4G  6.1G  29% /
tmpfs                                   2.0G   0   2.0G   0% /dev/shm
tmpfs                                   5.0M   0   5.0M   0% /run/lock
tmpfs                                   2.0G   0   2.0G   0% /sys/fs/cgroup
/dev/sda2                               877M  108M  708M  14% /boot
/dev/loop1                             62M   62M   0 100% /snap/core20/1376
/dev/loop0                             62M   62M   0 100% /snap/core20/1328
/dev/loop2                             44M   44M   0 100% /snap/snapd/14978
/dev/loop3                             68M   68M   0 100% /snap/lxd/21835
/dev/loop4                             68M   68M   0 100% /snap/lxd/22526
tmpfs                                   394M   0  394M   0% /run/user/1000
/dev/md0                               990M  2.6M  921M   1% /mnt
ilya-server@server:~$
```

Figure 5

Edit the `/etc/fstab` file containing the boot information to mount created partitions automatically each time the system boots.



```
GNU nano 4.8 /etc/fstab
# /etc/fstab: static file system information.
#
# Use 'bikid' to print the universally unique identifier for a
# device; this may be used with UUID= as a more robust way to name devices
# that works even if disks are added and removed. See fstab(5).
#
# <file system> <mount point> <type> <options> <dump> <pass>
# / was on /dev/ubuntu-vg/ubutu-lv during curtin installation
/dev/disk/by-id/dm-uuid-LVM-H0XH0UyKCqVvILL2YEB1FcGULkfbavfabCVIkVc2J6dbdJpq8CqXuqMNHZvM04nq / ext4 defaults 0 1
# /boot was on /dev/sda2 during curtin installation
/dev/disk/by-uuid/a547cb37-c996-498c-bd06-69fdb9be0b13 /boot ext4 defaults 0 1
UUID=4a36164d-d211-4d8a-91f5-ae5292d0ae72 /mnt ext4 defaults, nofail, discard 0 0_

[Wrote 13 lines]
^G Get Help  ^O Write Out  ^W Where Is   ^K Cut Text   ^J Justify    ^C Cur Pos    M-U Undo     M-A Man
^X Exit      ^R Read File  ^_ Replace    ^U Paste Text ^T To Spell   ^_ Go To Line M-E Redo     M-6 Cop
```

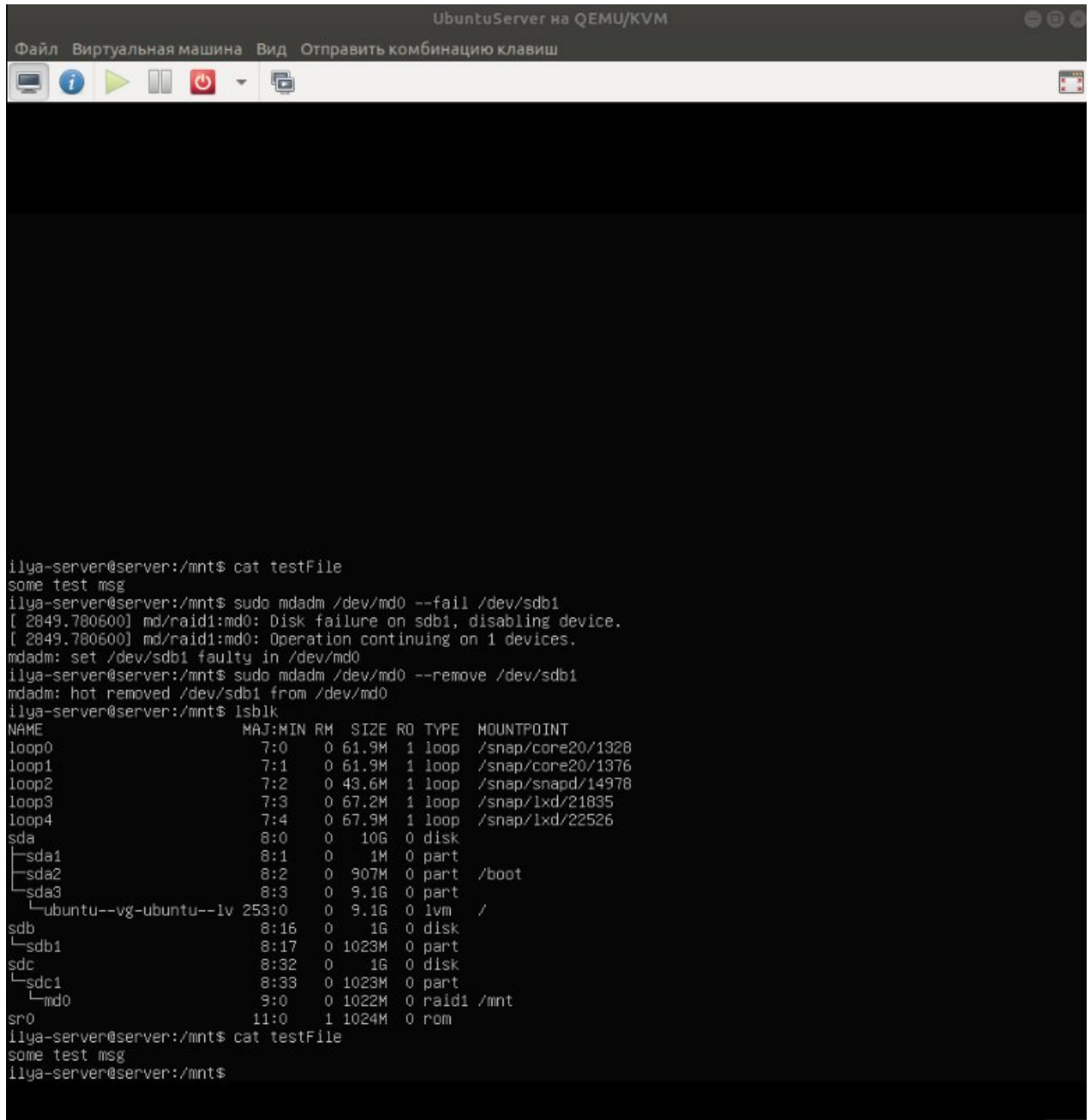
Figure 6

Add a test file in the /mnt directory:

```
ilya-server@server:/mnt$ cat testFile
some test msg
ilya-server@server:/mnt$
```

Figure 7

Remove sdb1 from RAID1 and check file.



The screenshot shows a terminal window titled "UbuntuServer на QEMU/KVM". The terminal output is as follows:

```
ilya-server@server:/mnt$ cat testFile
some test msg
ilya-server@server:/mnt$ sudo mdadm /dev/md0 --fail /dev/sdb1
[ 2849.780600] md/raid1:md0: Disk failure on sdb1, disabling device.
[ 2849.780600] md/raid1:md0: Operation continuing on 1 devices.
mdadm: set /dev/sdb1 faulty in /dev/md0
ilya-server@server:/mnt$ sudo mdadm /dev/md0 --remove /dev/sdb1
mdadm: hot removed /dev/sdb1 from /dev/md0
ilya-server@server:/mnt$ lsblk
```

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
loop0	7:0	0	61.9M	1	loop	/snap/core20/1328
loop1	7:1	0	61.9M	1	loop	/snap/core20/1376
loop2	7:2	0	43.6M	1	loop	/snap/snapd/14978
loop3	7:3	0	67.2M	1	loop	/snap/lxd/21835
loop4	7:4	0	67.9M	1	loop	/snap/lxd/22526
sda	8:0	0	10G	0	disk	
├─sda1	8:1	0	1M	0	part	
├─sda2	8:2	0	907M	0	part	/boot
├─sda3	8:3	0	9.1G	0	part	
└─ubuntu--vg-ubuntu--lv	253:0	0	9.1G	0	lvm	/
sdb	8:16	0	1G	0	disk	
└─sdb1	8:17	0	1023M	0	part	
sdc	8:32	0	1G	0	disk	
└─sdc1	8:33	0	1023M	0	part	
└─md0	9:0	0	1022M	0	raid1	/mnt
sr0	11:0	1	1024M	0	rom	

```
ilya-server@server:/mnt$ cat testFile
some test msg
ilya-server@server:/mnt$
```

Figure 8

The file is still here.

Turn off the VM and remove one of the disks:

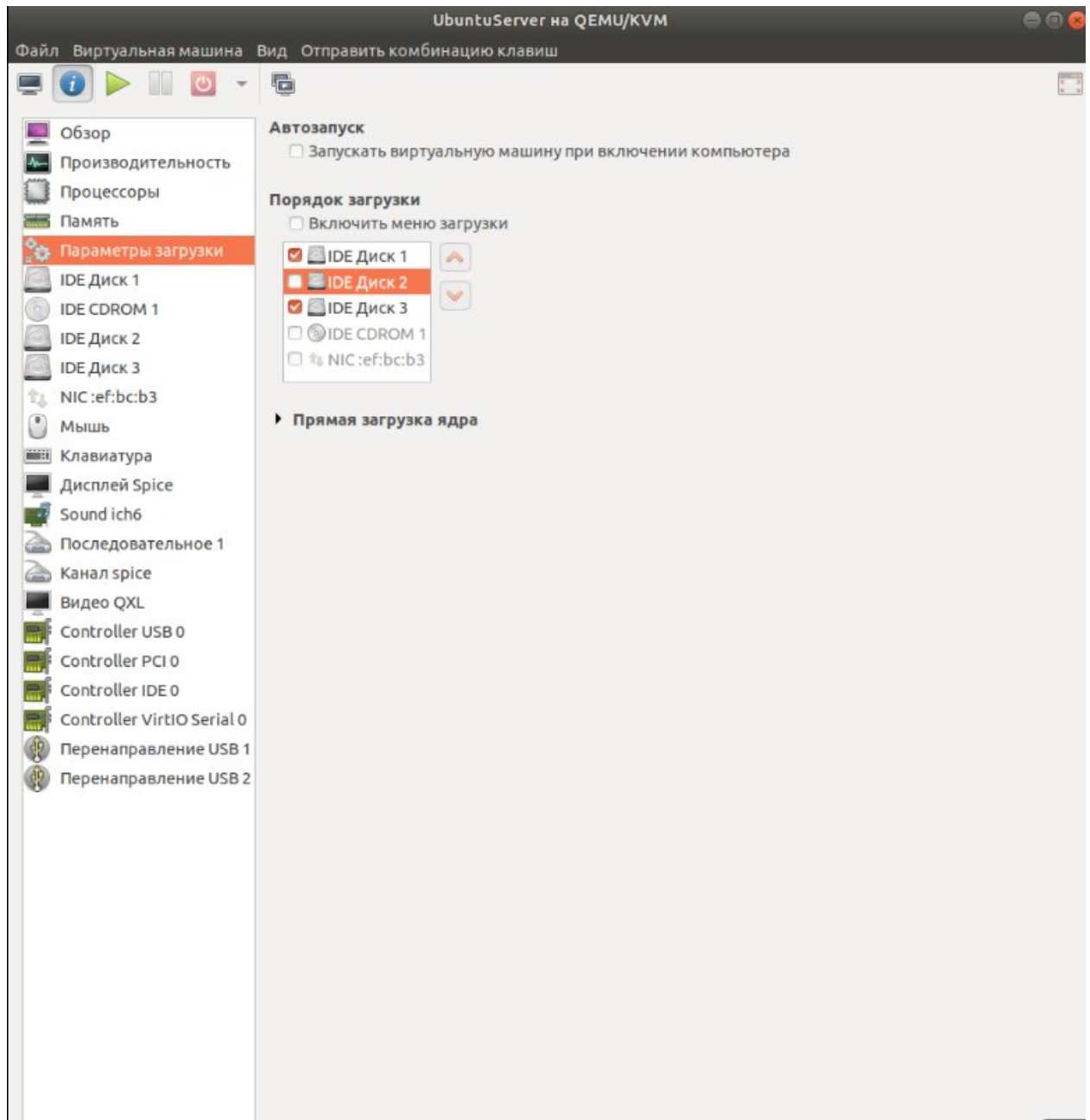
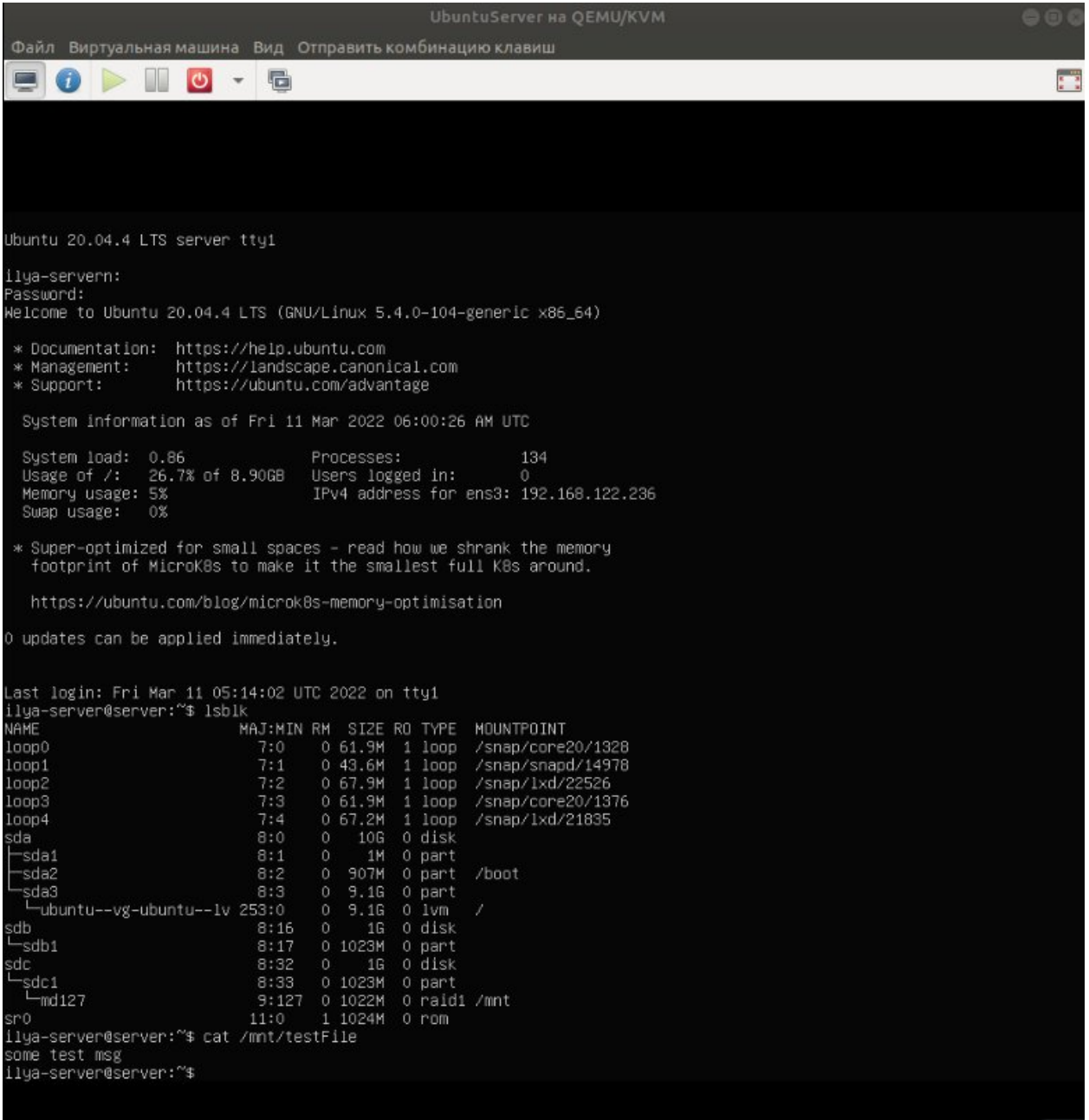


Figure 9

Turn the VM back on and display its disks and check that the file is still here:



```
UbuntuServer на QEMU/KVM
Файл  Виртуальная машина  Вид  Отправить комбинацию клавиш

Ubuntu 20.04.4 LTS server tty1

ilya-servern:
Password:
Welcome to Ubuntu 20.04.4 LTS (GNU/Linux 5.4.0-104-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

System information as of Fri 11 Mar 2022 06:00:26 AM UTC

System load: 0.86          Processes:            134
Usage of /:  26.7% of 8.90GB Users logged in:          0
Memory usage: 5%          IPv4 address for ens3: 192.168.122.236
Swap usage:  0%

 * Super-optimized for small spaces - read how we shrank the memory
   footprint of MicroK8s to make it the smallest full K8s around.

   https://ubuntu.com/blog/microk8s-memory-optimisation

0 updates can be applied immediately.

Last login: Fri Mar 11 05:14:02 UTC 2022 on tty1
ilya-server@server:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINT
loop0                               7:0      0 61.9M  1 loop  /snap/core20/1328
loop1                               7:1      0 43.6M  1 loop  /snap/snapd/14978
loop2                               7:2      0 67.9M  1 loop  /snap/lxd/22526
loop3                               7:3      0 61.9M  1 loop  /snap/core20/1376
loop4                               7:4      0 67.2M  1 loop  /snap/lxd/21835
sda                                 8:0      0   1G  0 disk
├─sda1                             8:1      0    1M  0 part
├─sda2                             8:2      0 907M  0 part  /boot
├─sda3                             8:3      0   9.1G  0 part
│   └─ubuntu--vg-ubuntu--lv 253:0  0   9.1G  0 lvm   /
sdb                                 8:16     0    1G  0 disk
├─sdb1                             8:17     0 1023M  0 part
sdc                                 8:32     0    1G  0 disk
├─sdc1                             8:33     0 1023M  0 part
│   └─md127                        9:127    0 1022M  0 raid1 /mnt
sr0                                 11:0     1 1024M  0 rom

ilya-server@server:~$ cat /mnt/testFile
some test msg
ilya-server@server:~$
```

Figure 10

Turn the VM off and add a new HDD to it:

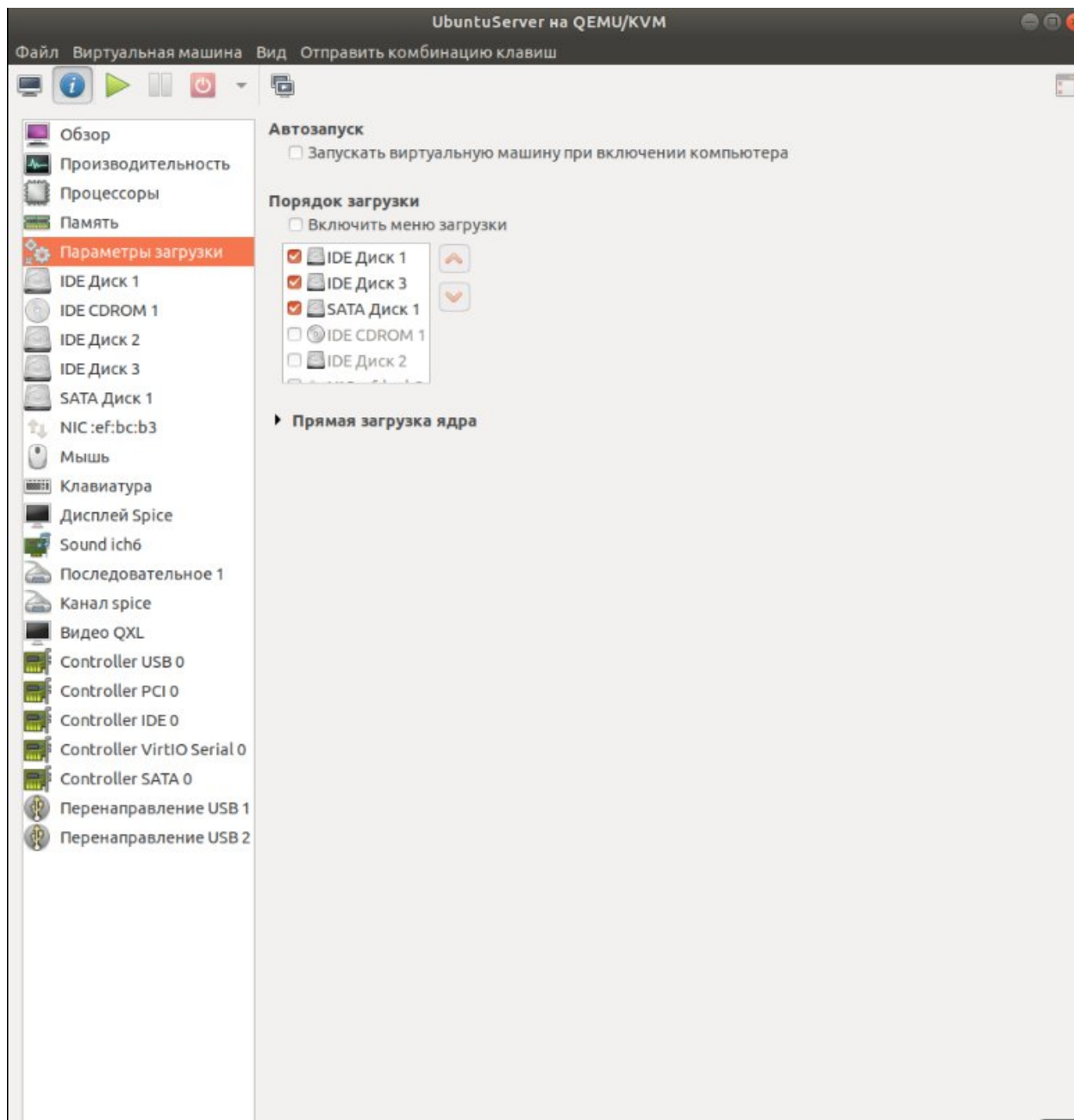
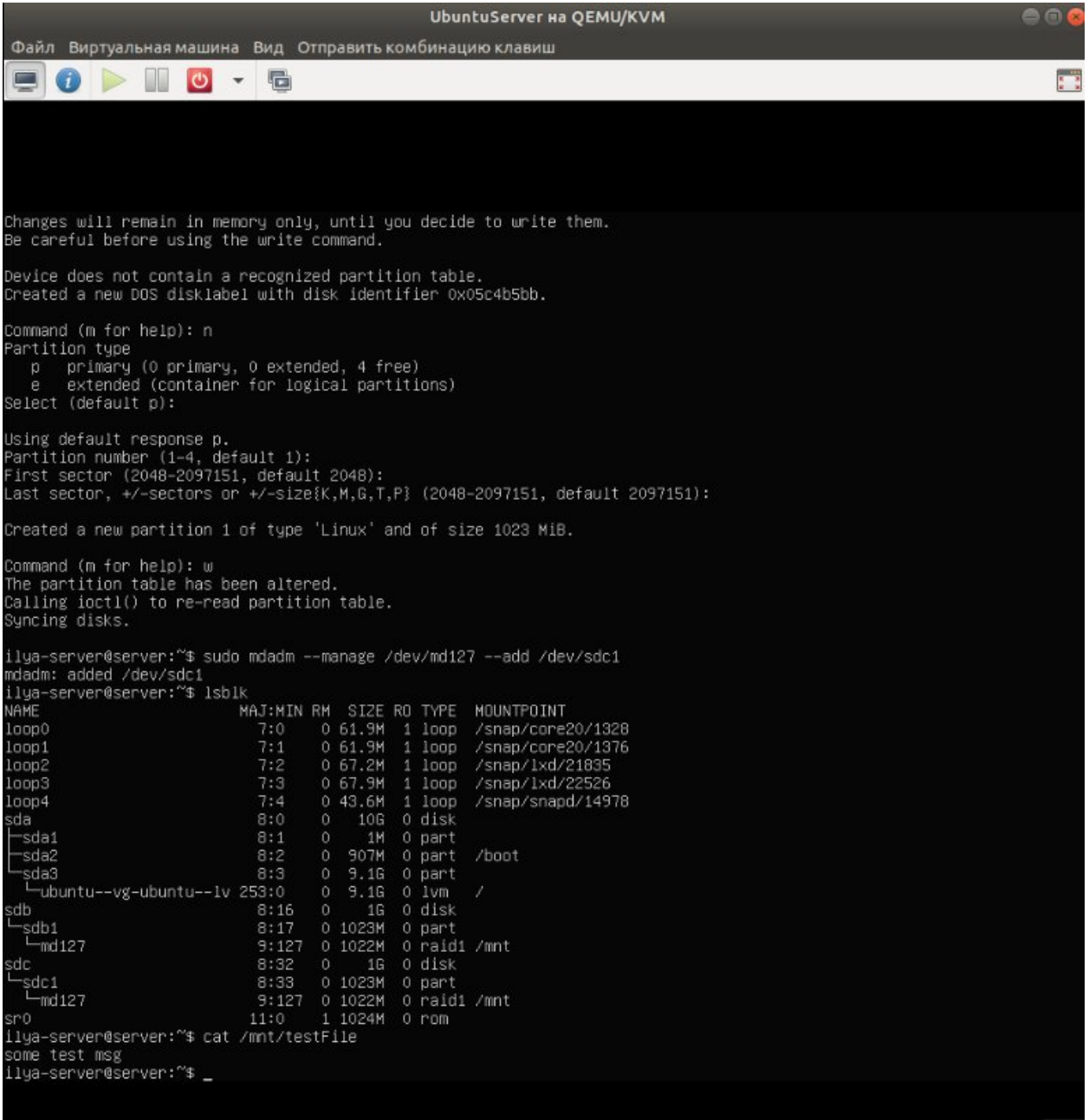


Figure 11

Add new HDD to RAID and check test file.



```
UbuntuServer на QEMU/KVM
Файл  Виртуальная машина  Вид  Отправить комбинацию клавиш

Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0x05c4b5bb.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p):

Using default response p.
Partition number (1-4, default 1):
First sector (2048-2097151, default 2048):
Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-2097151, default 2097151):

Created a new partition 1 of type 'Linux' and of size 1023 MiB.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.

ilya-server@server:~$ sudo mdadm --manage /dev/md127 --add /dev/sdc1
mdadm: added /dev/sdc1
ilya-server@server:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE  MOUNTPOINT
loop0                              7:0      0 61.9M  1 loop  /snap/core20/1328
loop1                              7:1      0 61.9M  1 loop  /snap/core20/1376
loop2                              7:2      0 67.2M  1 loop  /snap/lxd/21835
loop3                              7:3      0 67.9M  1 loop  /snap/lxd/22526
loop4                              7:4      0 43.6M  1 loop  /snap/snapd/14978
sda                                 8:0      0   1G  0 disk
├─sda1                             8:1      0    1M  0 part
├─sda2                             8:2      0  907M  0 part  /boot
├─sda3                             8:3      0   9.1G  0 part
└─ubuntu--vg-ubuntu--lv           253:0    0   9.1G  0 lvm   /
sdb                                 8:16     0    1G  0 disk
├─sdb1                             8:17     0 1023M  0 part
└─md127                           9:127    0 1022M  0 raid1 /mnt
sdc                                 8:32     0    1G  0 disk
├─sdc1                             8:33     0 1023M  0 part
└─md127                           9:127    0 1022M  0 raid1 /mnt
sr0                                11:0     1 1024M  0 rom

ilya-server@server:~$ cat /mnt/testFile
some test msg
ilya-server@server:~$ _
```

Figure 12

CONCLUSION

During the execution of the work, a raid array was created and the commands for its configuration and testing were studied.