

# Лабораторная работа №10

Основы работы с модулями ядра операционной системы

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## Цель работы

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Получить навыки работы с утилитами управления модулями ядра Linux: их загрузкой, выгрузкой, просмотром параметров и обновлением ядра системы.

## Ход выполнения работы

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```
mlabsi@mlabsi:~$ su
Password:
root@mlabsi:/home/mlabsi# lspci -k
00:00.0 Host bridge: Intel Corporation 440FX - 82441FX PMC [Natoma] (rev 02)
00:01.0 ISA bridge: Intel Corporation 82371SB PIIX3 ISA [Natoma/Triton II]
00:01.1 IDE interface: Intel Corporation 82371AB/EB/MB PIIX4 IDE (rev 01)
        Kernel driver in use: ata_piix
        Kernel modules: ata_piix, ata_generic
00:02.0 VGA compatible controller: VMware SVGA II Adapter
        Subsystem: VMware SVGA II Adapter
        Kernel driver in use: vmwgfx
        Kernel modules: vmwgfx
00:03.0 Ethernet controller: Intel Corporation 82540EM Gigabit Ethernet Controller (rev 02)
        Subsystem: Intel Corporation PRO/1000 MT Desktop Adapter
        Kernel driver in use: e1000
        Kernel modules: e1000
00:04.0 System peripheral: InnoTek Systemberatung GmbH VirtualBox Guest Service
        Kernel driver in use: vboxguest
        Kernel modules: vboxguest
00:05.0 Multimedia audio controller: Intel Corporation 82801AA AC'97 Audio Controller (rev 01)
        Subsystem: Dell Device 0177
        Kernel driver in use: snd_intel8x0
        Kernel modules: snd_intel8x0
00:06.0 USB controller: Apple Inc. KeyLargo/Intrepid USB
        Kernel driver in use: ohci-pci
00:07.0 Bridge: Intel Corporation 82371AB/EB/MB PIIX4 ACPI (rev 08)
        Kernel driver in use: piix4_smbus
        Kernel modules: i2c_piix4
00:0b.0 USB controller: Intel Corporation 82801FB/FBM/FR/FW/FRW (ICH6 Family) USB2 EHCI Controller
        Kernel driver in use: ehci-pci
00:0d.0 SATA controller: Intel Corporation 82801HM/HEM (ICH8M/ICH8M-E) SATA Controller [AHCI mode] (rev 02)
        Kernel driver in use: ahci
        Kernel modules: ahci
root@mlabsi:/home/mlabsi#
```

## Просмотр загруженных модулей

```
root@mlabsi:/home/mlabsi# lsmod | sort
ac97_bus          12288  1 snd_ac97_codec
ahci              57344  3
ata_generic      16384  0
ata_piix         45056  1
cdrom            90112  2 isofs,sr_mod
crc32c_intel     16384  0
crc32_pclmul     12288  0
crc10dif_pclmul  12288  1
dm_log           24576  2 dm_region_hash,dm_mirror
dm_mirror        28672  0
dm_mod           245760  9 dm_multipath,dm_log,dm_mirror
dm_multipath     53248  0
dm_region_hash   28672  1 dm_mirror
drm_ttm_helper   16384  2 vmwgfx
e1000            200704  0
fuse             253952  5
ghash_clmulni_intel 16384  0
i2c_piix4        36864  0
i2c_smbus        20480  1 i2c_piix4
intel_pmc_core   126976  0
intel_rapl_common 53248  1 intel_rapl_msr
intel_rapl_msr   20480  0
intel_uncore_frequency_common 16384  0
intel_vsec       20480  1 intel_pmc_core
ip_set           69632  0
isofs            69632  1
joydev          28672  0
libahci          69632  1 ahci
libata           512000  4 ata_piix,libahci,ahci,ata_generic
loop            45056  0
Module          Size  Used by
```

## Информация о модуле ext4

```
root@mlabsi:/home/mlabsi# lsmod | grep ext4
root@mlabsi:/home/mlabsi# modprobe ext4
root@mlabsi:/home/mlabsi# lsmod | grep ext4
ext4                1187840  0
mbcache              16384  1 ext4
jbd2                 217088  1 ext4
root@mlabsi:/home/mlabsi# modinfo ext4
filename:            /lib/modules/6.12.0-55.12.1.el10_0.x86_64/kernel/fs/ext4/ext4.ko.xz
softdep:             pre: crc32c
license:             GPL
description:         Fourth Extended Filesystem
author:              Remy Card, Stephen Tweedie, Andrew Morton, Andreas Dilger, Theodore Ts'o and others
alias:               fs-ext4
alias:               ext3
alias:               fs-ext3
alias:               ext2
alias:               fs-ext2
rhelversion:         10.0
srcversion:          CBA9BD0FC931061AEC0A8F4
depends:              jbd2,mbcache
intree:              Y
name:                ext4
retpoline:           Y
vermagic:            6.12.0-55.12.1.el10_0.x86_64 SMP preempt mod_unload modversions
sig_id:              PKCS#7
signer:              Rocky kernel signing key
sig_key:             57:BC:A1:34:94:0D:57:12:99:67:28:D8:C0:8B:1C:4B:8C:8A:13:06
sig_hashalgo:        sha256
signature:           05:D7:3D:A0:55:EA:4A:16:70:78:23:1F:C7:9A:17:C6:A9:9C:B5:71:
                    55:55:25:20:01:5A:10:25:27:10:25:27:27:25:20:01:5A:10:25:27:
```

Рис. 3: Просмотр информации о модуле ext4

```
01:0F:DB:E7:F9:0D:AF:80:8F:02:55:15:7D:01:5E:78:16:AE:ED:F0:
FA:7A:C2:3E:9E:63:B4:57:50:92:28:E8:95:2D:D3:44:C5:8B:F5:C8:
0A:BE:F5:96:B5:D8:DE:8F:91:DA:85:E5:BF:A2:7D:9B:2A:4C:AD:4E:
07:54:52:A9:F2:62:B6:D7:58:9F:2E:8D:6A:C2:F4:8E:98:32:EB:14:
E6:BE:EE:3B:C5:98:36:95:53:D8:61:BD:41:8A:FF:4B:AC:49:70:B2:
19:94:AF:2A
root@mlabsi:/home/mlabsi#
root@mlabsi:/home/mlabsi# modprobe -r ext4
root@mlabsi:/home/mlabsi# modprobe -r ext4
root@mlabsi:/home/mlabsi# modprobe -r xfs
modprobe: FATAL: Module xfs is in use.
root@mlabsi:/home/mlabsi# █
```

Рис. 4: Попытка выгрузки модулей ext4 и xfs



## Проверка и загрузка bluetooth

```
root@mlabsi: /home/mlabsi#  
root@mlabsi:/home/mlabsi# lsmod | grep bluetooth  
root@mlabsi:/home/mlabsi# modprobe bluetooth  
root@mlabsi:/home/mlabsi# lsmod | grep bluetooth  
bluetooth                1114112  0  
rfkill                    40960  4 bluetooth  
root@mlabsi:/home/mlabsi# modinfo bluetooth  
filename:                /lib/modules/6.12.0-55.12.1.el10_0.x86_64/kernel/net/bluetooth/bluetooth.ko.xz  
alias:                   net-pf-31  
license:                 GPL  
version:                 2.22  
description:             Bluetooth Core ver 2.22  
author:                 Marcel Holtmann <marcel@holtmann.org>  
rhelversion:             10.0  
srcversion:              5F9AA895ADC3BA3840211D1  
depends:                  rfkill  
intree:                  Y  
name:                    bluetooth  
retpoline:               Y  
vermagic:                6.12.0-55.12.1.el10_0.x86_64 SMP preempt mod_unload modversions  
sig_id:                  PKCS#7  
signer:                  Rocky kernel signing key  
sig_key:                 57:BC:A1:34:94:0D:57:12:99:67:28:D8:C0:8B:1C:4B:8C:8A:13:06  
sig_hashalgo:            sha256  
signature:               2E:24:0B:EE:9E:E6:A3:58:91:2A:D3:87:25:A3:1B:46:06:89:06:BC:  
                        4A:99:10:8D:7A:0F:1F:FF:92:59:FD:59:74:DB:7F:42:40:14:03:C9:
```

Рис. 5: Информация о модуле bluetooth

```
2B:8A:CF:8F:23:38:B4:7A:A9:92:49:86:D7:9F:08:7D:8A:92:7D:DD:
41:D6:4B:31:F6:45:31:D4:7E:6E:E1:D6:94:BA:D0:6A:12:CC:76:A2:
12:55:EF:6B:91:C8:45:F0:F5:75:0B:DD:7D:6B:D7:E1:B0:13:51:40:
29:D2:1D:3B:DD:E2:BF:AC:4B:77:67:BA:C8:95:16:41:00:9A:8F:96:
21:DC:9A:C2:B2:20:31:5C:EC:90:EA:B0:24:C3:5D:B9:72:31:B8:98:
DB:A9:4D:FE
parm:      disable_esco:Disable eSCO connection creation (bool)
parm:      disable_ertm:Disable enhanced retransmission mode (bool)
parm:      enable_ecred:Enable enhanced credit flow control mode (bool)
root@mlabsi:/home/mlabsi# modprobe -r bluetooth
root@mlabsi:/home/mlabsi# █
```

Рис. 6: Выгрузка модуля bluetooth

# Просмотр версии ядра и списка пакетов

```
root@mlabsi:/home/mlabsi#  
root@mlabsi:/home/mlabsi# uname -r  
6.12.0-55.12.1.el10_0.x86_64  
root@mlabsi:/home/mlabsi# dnf list kernel  
Rocky Linux 10 - BaseOS                    5.9 kB/s | 4.3 kB    00:00  
Rocky Linux 10 - BaseOS                    1.6 MB/s | 21 MB     00:12  
Rocky Linux 10 - AppStream                 13 kB/s | 4.3 kB     00:00  
Rocky Linux 10 - AppStream                105 kB/s | 2.2 MB     00:21  
Rocky Linux 10 - Extras                   8.5 kB/s | 3.1 kB     00:00  
Rocky Linux 10 - Extras                   8.1 kB/s | 5.4 kB     00:00  
Installed Packages  
kernel.x86_64                             6.12.0-55.12.1.el10_0 @anaconda  
Available Packages  
kernel.x86_64                             6.12.0-55.39.1.el10_0 baseos  
root@mlabsi:/home/mlabsi#
```

Рис. 7: Просмотр версии и списка пакетов ядра

```

yum install xorg-x11-server-Xwayland-24.1.5-4.el10_0.x86_64
xxd-2:9.1.083-5.el10_0.1.x86_64
yum-4.20.0-14.el10_0.rocky.0.1.noarch
zlib-ng-compat-2.2.3-1.el10.rocky.0.1.x86_64
zlib-ng-compat-devel-2.2.3-1.el10.rocky.0.1.x86_64
Installed:
kernel-6.12.0-55.39.1.el10_0.x86_64
kernel-devel-6.12.0-55.39.1.el10_0.x86_64
kernel-modules-core-6.12.0-55.39.1.el10_0.x86_64
libatomic-14.2.1-7.el10.x86_64
kernel-core-6.12.0-55.39.1.el10_0.x86_64
kernel-modules-6.12.0-55.39.1.el10_0.x86_64
kernel-modules-extra-6.12.0-55.39.1.el10_0.x86_64
libdex-0.8.1-1.el10.x86_64

Complete!
root@mlabsi:/home/mlabsi# dnf update kernel
Last metadata expiration check: 0:00:57 ago on Sat 18 Oct 2025 01:24:24 PM MSK.
Dependencies resolved.
Nothing to do.
Complete!
root@mlabsi:/home/mlabsi# dnf update
Last metadata expiration check: 0:01:04 ago on Sat 18 Oct 2025 01:24:24 PM MSK.
Dependencies resolved.
Nothing to do.
Complete!
root@mlabsi:/home/mlabsi# dnf upgrade --refresh
Rocky Linux 10 - BaseOS                    5.2 kB/s | 4.3 kB    00:00
Rocky Linux 10 - AppStream                  14 kB/s | 4.3 kB    00:00
Rocky Linux 10 - Extras                     11 kB/s | 3.1 kB    00:00
Dependencies resolved.
Nothing to do.
Complete!
root@mlabsi:/home/mlabsi#

```

Рис. 8: Обновление ядра и системы

## Проверка новой версии ядра

```
mlabsi@mlabsi:~$ uname -r
6.12.0-55.39.1.el10_0.x86_64
mlabsi@mlabsi:~$ hostnamectl
  Static hostname: mlabsi.localdomain
        Icon name: computer-vm
        Chassis: vm 🖥️
        Machine ID: c371d82aeddd4c358d0da59eb13ae51b
        Boot ID: 9fddb632c4d24b5f81acec460437d10e
  Virtualization: oracle
  Operating System: Rocky Linux 10.0 (Red Quartz)
        CPE OS Name: cpe:/o:rocky:rocky:10::baseos
        OS Support End: Thu 2035-05-31
  OS Support Remaining: 9y 7month 1w 4d
        Kernel: Linux 6.12.0-55.39.1.el10_0.x86_64
        Architecture: x86-64
        Hardware Vendor: innotek GmbH
        Hardware Model: VirtualBox
        Firmware Version: VirtualBox
        Firmware Date: Fri 2006-12-01
        Firmware Age: 18y 10month 2w 3d
mlabsi@mlabsi:~$
```

## Заключение

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В ходе лабораторной работы освоены основные команды работы с модулями ядра Linux, их загрузка, выгрузка, просмотр параметров и обновление ядра системы.