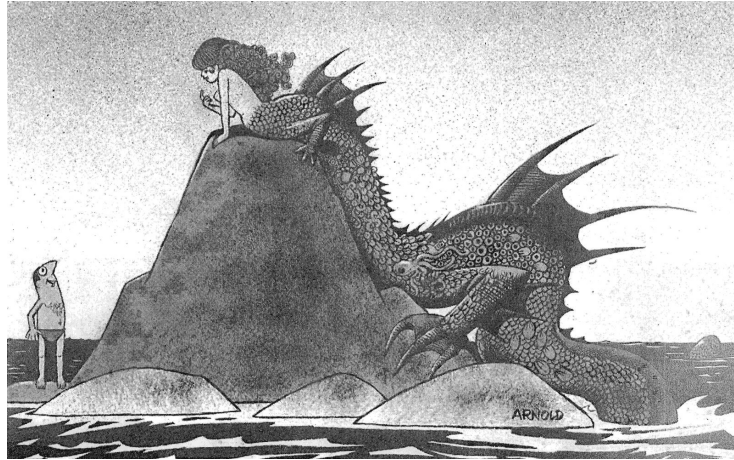


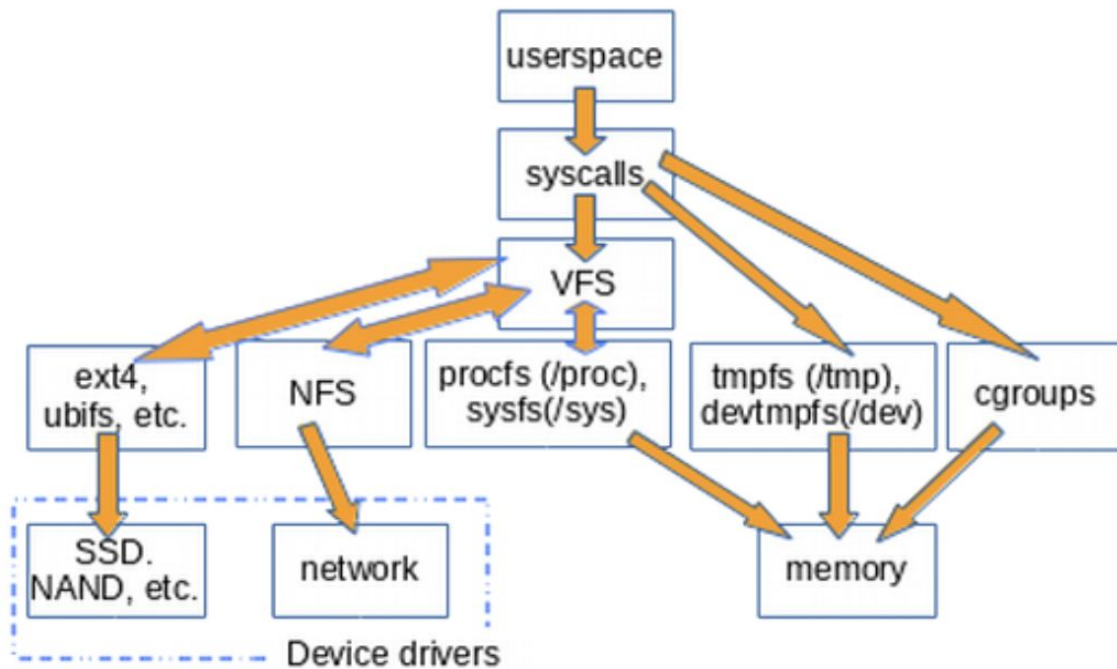
Программирование в Linux



Виртуальные файловые системы

read, write, ioctl... — “виртуальные методы”

подсистема VFS определяет интерфейс file_operations



/proc — подробная информация обо всех процессах

```
dmis@dmis-MS-7A15:~$ ls /proc
1      1138    140815  141369  143586  194    222    2528    2698    3        3294    39      469      68615   92575   buddyinfo  kpagecgroup  sysrq-trigger
10     114076  140929  141374  143608  195    223    2578    2699    30       3296    4       470      71882   92814   bus         kpagecount   sysvipc
1000   114466  141034  141431  143653  196    2237   2596    27      3019     3299    40      471      76866   94       cgroups    kpageflags   thread-self
1002   114514  141079  141432  143677  197    23      2598    2725    3042     33      40080    472     76872   95       cmdline    loadavg      timer_list
1004   1149    141099  141472  143678  198    234    26      2738    3143     332     41      473      76888   96       consoles   locks        tty
1005   115934  141154  141482  143689  2      235    2604    2750    3165     334     42      474      76894   97       cpuinfo     mdstat       uptime
1006   1189    141157  141512  143695  20     23653  2613    2771    3171     335     42613    475     76898   97135    crypto     meminfo      version
1007   119     141159  141618  143708  2025   23654  2620    2775    3191     3350    42621    476     76903   972     devices    misc         version_signature
1008   12      141181  141629  143876  2030   23661  2625    2777    32      336     42622    477     76907   97203    diskstats  modules      vmallocinfo
1011   122     141183  141641  143914  2031   23662  2639    2785    3206     3383    427     478     76911   973     dma         mounts       vmstat
1016   1238    141218  141652  143996  2035   23663  26404   28      3213     34      43      495     76937   97322    driver      mtrr         zoneinfo
102    124144  141220  141798  144111  2052   23664  26410   2833    3231     3407    434     498     76966   977     execdomains net
103    125627  141241  141830  144114  2056   23665  26413   2834    3250     3416    437     510     79013   978     fb          pagetypeinfo
1040   125629  141257  141841  144162  2098   23666  26416   2836    3251     3429    440     512     813     98      filesystems partitions
105    125630  141259  142919  15      21     24     2651    2844    3252     3490    443     513     814     980     fs          pressure
106    13      141285  143146  16      2103   2403   2654    2849    3253     35      445     51317   828     981     interrupts sched_debug
106110 137     141287  143154  17      2104   24846  2661    2865    3259     3543    44801    514     829     99      iomem       schedstat
107    1397    141298  143166  18      2105   2489   2664    2876    3267     36      449     515     84143   990     ioports     scsi
11     1398    141310  143182  1801    2134   2503   2667     29     3268     3617    458     517     880     992     irq         self
110    1399    141315  143196  1802    2135   2507   2669    2925    3272     3690    461     5394    883     99519    kallsyms    slabinfo
1126   14      141319  143321  187     2153   2516   2671    2931    3273     3771    465     546     9      997     kcore       softirqs
1127   140212  141330  143466  191     219    2520   2673    2946    3278     38      466     6       90      999     keys        stat
1135   140365  141347  143469  192     22     2525   2682    2970    3285     3802    467     67726   91      acpi        key-users    swaps
1136   140636  141348  143516  193     220    2527   2687    2974    3286     387     468     67842   92      asound      kmsg         sys
```

```
dmis@dmis-MS-7A15:~$ ls /proc/self
arch_status  clear_refs  cwd         gid_map     maps        net         oom_score_adj  root      smaps        status      uid_map
attr         cmdline     environ     io          mem         ns          pagemap       sched     smaps_rollback  syscall     wchan
autogroup    comm        exe         limits      mountinfo   numa_maps   patch_state    schedstat  stack         task
auxv         coredump_filter  fd         loginuid    mounts      oom_adj     personality     sessionid  stat          timers
cgroup       cpuset      fdinfo      map_files   mountstats  oom_score   projid_map     setgroups  statm         timerslack_ns
```

control groups (cgroupsfs)

```
dmis@dmis-MS-7A15:~$ ls /sys/fs/cgroup/  
blkio      cpuset     memory     perf_event unified  
cpu        devices    net_cls    pids  
cpuacct    freezer    net_cls,net_prio rdma  
cpu,cpuacct hugetlb     net_prio    systemd
```

```
$ sudo cgcreate -a dmis -t dmis -g memory:test_group  
$ echo 1000000 >  
/sys/fs/cgroup/memory/test_group/memory.limit_in_bytes  
$ cat /sys/fs/cgroup/memory/test_group/memory.limit_in_bytes  
999424  
$ echo $proc_id > /sys/fs/cgroup/memory/test_group/tasks
```

linux/fs.h file_operations

```
1888 struct file_operations {
1889     struct module *owner;
1890     loff_t (*llseek) (struct file *, loff_t, int);
1891     ssize_t (*read) (struct file *, char __user *, size_t, loff_t *);
1892     ssize_t (*write) (struct file *, const char __user *, size_t, loff_t *);
1893     ssize_t (*read_iter) (struct kiocb *, struct iov_iter *);
1894     ssize_t (*write_iter) (struct kiocb *, struct iov_iter *);
1895     int (*iopoll)(struct kiocb *kiocb, bool spin);
1896     int (*iterate) (struct file *, struct dir_context *);
1897     int (*iterate_shared) (struct file *, struct dir_context *);
1898     __poll_t (*poll) (struct file *, struct poll_table_struct *);
1899     long (*unlocked_ioctl) (struct file *, unsigned int, unsigned long);
1900     long (*compat_ioctl) (struct file *, unsigned int, unsigned long);
1901     int (*mmap) (struct file *, struct vm_area_struct *);
1902     unsigned long mmap_supported_flags;
1903     int (*open) (struct inode *, struct file *);
1904     int (*flush) (struct file *, fl_owner_t id);
1905     int (*release) (struct inode *, struct file *);
1906     int (*fsync) (struct file *, loff_t, loff_t, int datasync);
1907     int (*fasync) (int, struct file *, int);
1908     int (*lock) (struct file *, int, struct file_lock *);
1909     ssize_t (*sendpage) (struct file *, struct page *, int, size_t, loff_t *, int);
1910     unsigned long (*get_unmapped_area)(struct file *, unsigned long, unsigned long, unsigned long);
1911     int (*check_flags)(int);
1912     int (*flock) (struct file *, int, struct file_lock *);
1913     ssize_t (*splice_write)(struct pipe_inode_info *, struct file *, loff_t *, size_t, unsigned int);
1914     ssize_t (*splice_read)(struct file *, loff_t *, struct pipe_inode_info *, size_t, unsigned int);
1915     int (*setlease)(struct file *, long, struct file_lock **, void **);
1916     long (*fallocate)(struct file *file, int mode, loff_t offset,
1917                       loff_t len);
1918     void (*show_fdinfo)(struct seq_file *m, struct file *f);
1919 #ifndef CONFIG_MMU
1920     unsigned (*mmap_capabilities)(struct file *);
1921 #endif
1922     ssize_t (*copy_file_range)(struct file *, loff_t, struct file *,
1923                               loff_t, size_t, unsigned int);
1924     loff_t (*remap_file_range)(struct file *file_in, loff_t pos_in,
1925                               struct file *file_out, loff_t pos_out,
1926                               loff_t len, unsigned int remap_flags);
1927     int (*fadvise)(struct file *, loff_t, loff_t, int);
```

*Filesystem in **Userspace** (FUSE)*

