

Администрирование сетевых подсистем

Настройка DHCP-сервера (Лабораторная работа №3)

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Цели и задачи работы

Приобретение практических навыков установки и конфигурирования DHCP-сервера.

1. Установить и запустить службу **Kea DHCP**.
2. Настроить подсеть, параметры выдачи адресов и привязку к интерфейсу.
3. Настроить интеграцию с DNS (прямая и обратная зоны).
4. Реализовать динамическое обновление записей (DDNS).
5. Проверить работу клиента и автоматизацию конфигурации.

Теоретическая часть

- Автоматическая выдача IP-адресов и сетевых параметров.
- Основные параметры: IP, маска, шлюз, DNS, lease time.
- Этапы обмена сообщениями:
 - Discover
 - Offer
 - Request
 - Acknowledge (ACK)

Процесс выполнения лабораторной работы

Конфигурирование DHCP-сервера

```
root@server:~ - sudo -i
Total 15 MB/s | 5.0 MB 00:00
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing      : 1/1
  Installing     : log4cplus-2.1.1-8.el10.x86_64 1/4
  Installing     : libpq-16.8-2.el10_0.x86_64 2/4
  Installing     : kea-libs-2.6.3-1.el10_0.x86_64 3/4
  Running scriptlet: kea-2.6.3-1.el10_0.x86_64 4/4
  Installing     : kea-2.6.3-1.el10_0.x86_64 4/4
  Running scriptlet: kea-2.6.3-1.el10_0.x86_64 4/4

Installed:
  kea-2.6.3-1.el10_0.x86_64      kea-libs-2.6.3-1.el10_0.x86_64
  libpq-16.8-2.el10_0.x86_64    log4cplus-2.1.1-8.el10.x86_64

Complete!
[root@server.smahmudov.net ~]#
[root@server.smahmudov.net ~]#
[root@server.smahmudov.net ~]# cp /etc/kea/kea-dhcp4.conf /etc/kea/kea-dhcp4.conf_$(date -I)
[root@server.smahmudov.net ~]#
```


Настройка конфигурации DHCP

```
// }
// but it's a lot of writing, so it's easier to do this instead:
{
    "name": "domain-name-servers",
    "data": "192.168.1.1"
},

// Typically people prefer to refer to options by their names, so they
// don't need to remember the code names. However, some people like
// to use numerical values. For example, option "domain-name" uses
// option code 15, so you can reference to it either by
// "name": "domain-name" or "code": 15.
{
    "code": 15,
    "data": "smahmudov.net"
},

// Domain search is also a popular option. It tells the client to
// attempt to resolve names within those specified domains. For
// example, name "foo" would be attempted to be resolved as
// foo.mydomain.example.com and if it fails, then as foo.example.com
{
    "name": "domain-search",
    "data": "smahmudov.net"
},

// String options that have a comma in their values need to have
// it escaped (i.e. each comma is preceded by two backslashes).
// That's because commas are reserved for separating fields in
```

Настройка конфигурации DHCP

```
// structures.
"subnet4": [
{
    // This defines the whole subnet. Kea will use this information to
    // determine where the clients are connected. This is the whole
    // subnet in your network.

    // Subnet identifier should be unique for each subnet.
    "id": 1,

    // This is mandatory parameter for each subnet.
    "subnet": "192.168.1.0/24",

    // Pools define the actual part of your subnet that is governed
    // by Kea. Technically this is optional parameter, but it's
    // almost always needed for DHCP to do its job. If you omit it,
    // clients won't be able to get addresses, unless there are
    // host reservations defined for them.
    "pools": [ { "pool": "192.168.1.30 - 192.168.1.199" } ],

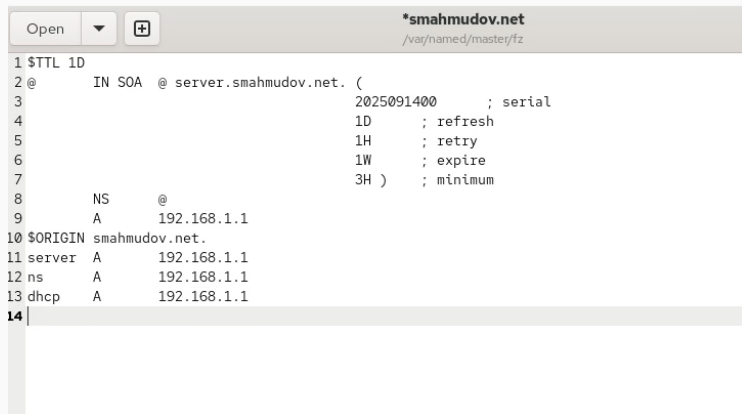
    // These are options that are subnet specific. In most cases,
    // you need to define at least routers option, as without this
    // option your clients will not be able to reach their default
    // gateway and will not have Internet connectivity.
    "option-data": [
        {
            // For each IPv4 subnet you most likely need to specify at
            // least one router.
            "name": "routers",
            "data": "192.168.1.1"
        }
    ],
}
```

Привязка DHCP к интерфейсу

```
// DHCPv4 configuration starts here. This section will be read by DHCPv4 server
// and will be ignored by other components.
"Dhcp4": {
  // Add names of your network interfaces to listen on.
  "interfaces-config": {
    // See section 8.2.4 for more details. You probably want to add just
    // interface name (e.g. "eth0" or specific IPv4 address on that
    // interface name (e.g. "eth0/192.0.2.1").
    "interfaces": [ "eth1" ]

    // Kea DHCPv4 server by default listens using raw sockets. This ensures
    // all packets, including those sent by directly connected clients
    // that don't have IPv4 address yet, are received. However, if your
    // traffic is always relayed, it is often better to use regular
    // UDP sockets. If you want to do that, uncomment this line:
    // "dhcp-socket-type": "udp"
  },
}
```

Рис. 4: Привязка DHCP-сервера к интерфейсу



The image shows a text editor window titled `*smahmudov.net` with a subtitle `/var/named/master/fz`. The editor contains a DNS zone file for `smahmudov.net`. The file is numbered 1 through 14 on the left margin. The content of the file is as follows:

```
1 $TTL 1D
2 @      IN SOA  @ server.smahmudov.net. (
3                               2025091400      ; serial
4                               1D              ; refresh
5                               1H              ; retry
6                               1W              ; expire
7                               3H )            ; minimum
8      NS   @
9      A    192.168.1.1
10 $ORIGIN smahmudov.net.
11 server A    192.168.1.1
12 ns     A    192.168.1.1
13 dhcp   A    192.168.1.1
14
```

Рис. 5: Файл прямой зоны

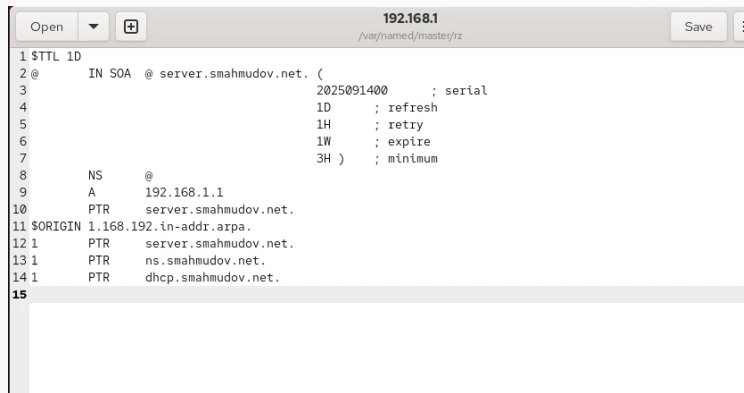


Рис. 6: Файл обратной зоны

```
[root@server.smahmudov.net ~]# systemctl restart named  
[root@server.smahmudov.net ~]#  
[root@server.smahmudov.net ~]# ping dhcp.smahmudov.net  
PING dhcp.smahmudov.net (192.168.1.1) 56(84) bytes of data.  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=1 ttl=64 time=0.030 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=2 ttl=64 time=0.072 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=3 ttl=64 time=0.146 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=4 ttl=64 time=0.029 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=5 ttl=64 time=0.115 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=6 ttl=64 time=0.083 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=7 ttl=64 time=0.068 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=8 ttl=64 time=0.070 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=9 ttl=64 time=0.064 ms  
64 bytes from dhcp.smahmudov.net (192.168.1.1): icmp_seq=10 ttl=64 time=0.095 ms
```

Рис. 7: Проверка доступности DHCP-сервера по имени

```
sn geto getonly; success service success stopper success net success exit 0 exitcode
[root@server.smahmudov.net ~]#
[root@server.smahmudov.net ~]# firewall-cmd --add-service=dhcp
success
[root@server.smahmudov.net ~]# firewall-cmd --add-service=dhcp --permanent
success
[root@server.smahmudov.net ~]# restorecon -vR /etc
Relabeled /etc/NetworkManager/system-connections/eth1.nmconnection from unconfined_u:object_r:user_tmp_t:s0 to unconfined_u:object_r:NetworkManager_etc_rw_t:s0
[root@server.smahmudov.net ~]# restorecon -vR /var/named/
[root@server.smahmudov.net ~]# restorecon -vR /var/lib/kea/
[root@server.smahmudov.net ~]#
```

Рис. 8: Разрешение DHCP в firewall

```
[root@server.smahmudov.net ~]#  
[root@server.smahmudov.net ~]# systemctl start kea-dhcp4.service  
[root@server.smahmudov.net ~]#  
[root@server.smahmudov.net ~]# cat /var/lib/kea/kea-leases4.csv  
address,hwaddr,client_id,valid_lifetime,expire,subnet_id,fqdn_fwd,fqdn_rev,hostname,state,user_context,pool_id  
192.168.1.30,08:00:27:d2:8d:de,01:08:00:27:d2:8d:de,3600,1757837446,1,0,0,client,0,,0  
192.168.1.30,08:00:27:d2:8d:de,01:08:00:27:d2:8d:de,3600,1757837446,1,0,0,client,0,,0  
192.168.1.30,08:00:27:d2:8d:de,01:08:00:27:d2:8d:de,3600,1757837452,1,0,0,client,0,,0  
[root@server.smahmudov.net ~]#
```

Рис. 9: Список аренд DHCP


```
smahmudov@client:~  
  
RX packets 1899  bytes 228114 (222.7 KiB)  
RX errors 0  dropped 0  overruns 0  frame 0  
TX packets 1636  bytes 266277 (260.0 KiB)  
TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
  
eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500  
    inet 192.168.1.30  netmask 255.255.255.0  broadcast 192.168.1.255  
    inet6 fe80::8e12:12d:a6e0:9d5a  prefixlen 64  scopeid 0x20<link>  
    ether 08:00:27:d2:8d:de  txqueuelen 1000  (Ethernet)  
    RX packets 83  bytes 8960 (8.7 KiB)  
    RX errors 0  dropped 0  overruns 0  frame 0  
    TX packets 227  bytes 21649 (21.1 KiB)  
    TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
  
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536  
    inet 127.0.0.1  netmask 255.0.0.0  
    inet6 ::1  prefixlen 128  scopeid 0x10<host>  
    loop  txqueuelen 1000  (Local Loopback)  
    RX packets 18  bytes 2135 (2.0 KiB)  
    RX errors 0  dropped 0  overruns 0  frame 0  
    TX packets 18  bytes 2135 (2.0 KiB)  
    TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
  
[smahmudov@client.smahmudov.net ~]$
```

```
16
17 zone "smahmudov.net" IN {
18     type master;
19     file "master/fz/smahmudov.net";
20     update-policy {
21         grant DHCP_UPDATER wildcard *.smahmudov.net A DHCID;
22     };
23
24 };
25
26 zone "1.168.192.in-addr.arpa" IN {
27     type master;
28     file "master/rz/192.168.1";
29     update-policy {
30         grant DHCP_UPDATER wildcard *.1.168.192.in-addr.arpa PTR DHCID;
31     };
32 };
```

Рис. 11: Создание ключа TSIG


Настройка обновления DNS-зоны

```
1 {
2   "ip-address": "127.0.0.1",
3   "port": 53001,
4   "control-socket": {
5     "socket-type": "unix",
6     "socket-name": "/run/kea/kea-ddns-ctrl-socket"
7   },
8   <?include "/etc/kea/tsig-keys.json"?>
9 }
10
11 "forward-ddns" : {
12   "ddns-domains" : [
13     {
14       "name": "smahmudov.net.",
15       "key-name": "DHCP_UPDATER",
16       "dns-servers": [
17         { "ip-address": "192.168.1.1" }
18       ]
19     }
20   ]
21 },
22
23 "reverse-ddns" : {
24   "ddns-domains" : [
25     {
26       "name": "1.168.192.in-addr.arpa.",
27       "key-name": "DHCP_UPDATER",
28       "dns-servers": [
29         { "ip-address": "192.168.1.1" }
30       ]
31     }
32   ]
33 },
34 }
```

Настройка обновления DNS-зоны

```
root@server.smahmudov.net ~]# gedit /etc/named/smahmudov.net
[root@server.smahmudov.net ~]#
[root@server.smahmudov.net ~]# named-checkconf
[root@server.smahmudov.net ~]#
[root@server.smahmudov.net ~]# systemctl restart named
[root@server.smahmudov.net ~]# touch /etc/kea/tsign-keys.json
[root@server.smahmudov.net ~]# cat /etc/named/keys/dhcp_updater.key
key "DHCP_UPDATER" {
    algorithm hmac-sha512;
    secret "9RDtHBpFC3JU7NmpqS2NUVvPBkJgRA7jKLfIk03MgrEngLH7wLugm4X+PxVPt62kb6KzpCTdvoVWbvsgmZn9Rg==";
};
[root@server.smahmudov.net ~]# gedit /etc/kea/tsign-keys.json
[root@server.smahmudov.net ~]#
[root@server.smahmudov.net ~]# mv /etc/kea/tsign-keys.json /etc/kea/tsig-keys.json
[root@server.smahmudov.net ~]# chown kea:kea /etc/kea/tsig-keys.json
[root@server.smahmudov.net ~]# chmod 640 /etc/kea/tsig-keys.json
[root@server.smahmudov.net ~]#
[root@server.smahmudov.net ~]# gedit /etc/kea/kea-dhcp-ddns.conf
[root@server.smahmudov.net ~]# chown kea:kea /etc/kea/kea-dhcp-ddns.conf
[root@server.smahmudov.net ~]# systemctl enable --now kea-dhcp-ddns.service
Created symlink '/etc/systemd/system/multi-user.target.wants/kea-dhcp-ddns.service' -> '/usr/lib/systemd/system/kea-dhcp-ddns.service'.
[root@server.smahmudov.net ~]# systemctl start kea-dhcp-ddns.service
```

Рис. 13: Файл tsig-keys.json



```
1 "tsig-keys" [
2 {
3     "name": "DHCP_UPDATER",
4     "algorithm": "hmac-sha512",
5     "secret": "9RDtHBpFC3HU7NmpqS2NUVvPBkJgRA7jKLf1k03MgrEnglH7wLugm4X+PxVPi62kb6KzpCTdvoVWbvsgmZn9Rg=="
6 }
7 ]
```

Рис. 14: Файл kea-dhcp-ddns.conf

Настройка обновления DNS-зоны

```
[root@server.smahmudov.net ~]#  
[root@server.smahmudov.net ~]# systemctl enable --now kea-dhcp-ddns.service  
[root@server.smahmudov.net ~]# systemctl status kea-dhcp-ddns.service  
● kea-dhcp-ddns.service - Kea DHCP-DDNS Server  
   Loaded: loaded (/usr/lib/systemd/system/kea-dhcp-ddns.service; enabled; preset: disabled)  
   Active: active (running) since Sun 2025-09-14 07:33:49 UTC; 2s ago  
     Invocation: 280576a8afd341cda3634a4672adc4fb  
       Docs: man:kea-dhcp-ddns(8)  
    Main PID: 18928 (kea-dhcp-ddns)  
      Tasks: 5 (limit: 10381)  
     Memory: 1.7M (peak: 6.1M)  
        CPU: 11ms  
     OGroup: /system.slice/kea-dhcp-ddns.service  
             └─18928 /usr/sbin/kea-dhcp-ddns -c /etc/kea/kea-dhcp-ddns.conf  
  
Sep 14 07:33:49 server.smahmudov.net systemd[1]: Started kea-dhcp-ddns.service - Kea DHCP-DDNS Server.  
Sep 14 07:33:49 server.smahmudov.net kea-dhcp-ddns[18928]: 2025-09-14 07:33:49.223 INFO [kea-dhcp-ddns.dctl/18928.140471451685184] DCTL_STARTING DhcpDdns s  
Sep 14 07:33:49 server.smahmudov.net kea-dhcp-ddns[18928]: INFO COMMAND_ACCEPTOR_START Starting to accept connections via unix domain socket bound to /run/  
Sep 14 07:33:49 server.smahmudov.net kea-dhcp-ddns[18928]: INFO DCTL_CONFIG_COMPLETE server has completed configuration: listening on 127.0.0.1, port 53001  
Sep 14 07:33:49 server.smahmudov.net kea-dhcp-ddns[18928]: INFO DHCP_DDNS_STARTED Kea DHCP-DDNS server version 2.6.3 started  
front@server.smahmudov.net ~1#
```

Рис. 15: Запуск kea-dhcp-ddns.service

```
// and will be ignored by other components.  
"Dhcp4": {  
  "interfaces-config": {  
  
    "interfaces": [ "eth1" ]  
  
  },  
  
  "control-socket": {  
    "socket-type": "unix",  
    "socket-name": "kea4-ctrl-socket"  
  },  
  
  "dhcp-ddns": {  
    "enable-updates": true  
  },  
  
  "ddns-qualifying-suffix": "smahmudov.net",  
  "ddns-override-client-update": true,  
}
```

Настройка обновления DNS-зоны

```
socket type raw
[root@server.snahmudov.net ~]# systemctl restart kea-dhcp4.service
[root@server.snahmudov.net ~]# systemctl status kea-dhcp4.service
● kea-dhcp4.service - Kea DHCPv4 Server
   Loaded: loaded (/usr/lib/systemd/system/kea-dhcp4.service; enabled; preset: disabled)
   Active: active (running) since Sun 2025-09-14 07:39:58 UTC; 6s ago
 Invocation: 23fc28d443fc4687b2a6ee95c6226d14
    Docs: man:kea-dhcp4(8)
   Main PID: 19626 (kea-dhcp4)
      Tasks: 7 (limit: 10381)
     Memory: 2.5M (peak: 6.1M)
        CPU: 14ms
   CGroup: /system.slice/kea-dhcp4.service
           └─19626 /usr/sbin/kea-dhcp4 -c /etc/kea/kea-dhcp4.conf

Sep 14 07:39:58 server.snahmudov.net systemd[1]: Started kea-dhcp4.service - Kea DHCPv4 Server.
Sep 14 07:39:58 server.snahmudov.net kea-dhcp4[19626]: 2025-09-14 07:39:58.056 INFO [kea-dhcp4.dhcp4/19626.140186563156160] DHCP4_STARTING Kea DHCPv4 server
Sep 14 07:39:58 server.snahmudov.net kea-dhcp4[19626]: 2025-09-14 07:39:58.056 INFO [kea-dhcp4.commands/19626.140186563156160] COMMAND_RECEIVED Received command
lines 1-15/15 (END)
```

Рис. 17: Перезапуск kea-dhcp4

Настройка обновления DNS-зоны

```
[root@client.smahmudov.net ~]# dig @192.168.1.1 client.smahmudov.net

; <<>> DiG 9.18.33 <<>> @192.168.1.1 client.smahmudov.net
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 5923
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: f3d40819e380cd900100000068c671b15bc3d0ca72a8c284 (good)
;; QUESTION SECTION:
;client.smahmudov.net.          IN      A

;; ANSWER SECTION:
client.smahmudov.net.  1200    IN      A      192.168.1.30

;; Query time: 0 msec
;; SERVER: 192.168.1.1#53(192.168.1.1) (UDP)
;; WHEN: Sun Sep 14 07:41:37 UTC 2025
;; MSG SIZE rcvd: 93

[root@client.smahmudov.net ~]#
```

Рис. 18: Проверка DNS-записи клиента

Выводы по проделанной работе

В ходе лабораторной работы был развернут и настроен DHCP-сервер **Kea**.

Были реализованы:

- * назначение IP-адресов клиентам;
- * настройка прямой и обратной зон в DNS;
- * динамическое обновление записей DDNS.

Работоспособность подтверждена через **ifconfig**, **ping**, **dig**.