

Отчёт по лабораторной работе №3

Настройка DHCP-сервера Kea и DDNS-интеграции с Bind

Элсаиед Адел

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Российский университет дружбы народов, Москва, Россия

Цели и задачи работы

Приобретение практических навыков установки и конфигурирования DHCP-сервера.

Выполнение работы

- переход в режим суперпользователя (`sudo -i`)
- установка пакета `kea` через `dnf`
- зависимости установлены автоматически, ошибок не выявлено

```
-----
Total                                                    86 kB/s | 5.3 MB    01:02
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing      :                                1/1
  Installing     : mariadb-connector-c-config-3.4.4-1.el10.noarch 1/6
  Installing     : mariadb-connector-c-3.4.4-1.el10.x86_64      2/6
  Installing     : log4cplus-2.1.1-8.el10.x86_64                3/6
  Installing     : libpq-16.8-2.el10_0.x86_64                  4/6
  Installing     : kea-libs-3.0.1-2.el10_1.x86_64              5/6
  Running scriptlet: kea-3.0.1-2.el10_1.x86_64                  6/6
  Installing     : kea-3.0.1-2.el10_1.x86_64                  6/6
  Running scriptlet: kea-3.0.1-2.el10_1.x86_64                  6/6

Installed:
  kea-3.0.1-2.el10_1.x86_64      kea-libs-3.0.1-2.el10_1.x86_64      libpq-16.8-2.el10_0.x86_64
  log4cplus-2.1.1-8.el10.x86_64 mariadb-connector-c-3.4.4-1.el10.x86_64 mariadb-connector-c-config-3.4.4-1.el10.noarch

Complete!
[root@server.elsaiedadel.net server]#
```

Рис. 1: Установка DHCP-сервера Kea

Настройка DHCP: параметры DNS

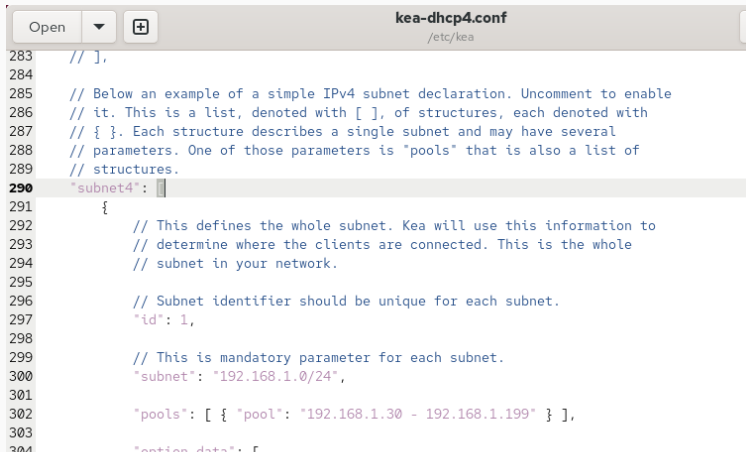
- DNS-сервер для клиентов: 192.168.1.1
- доменное имя: elsaiedadel.net
- домен поиска: elsaiedadel.net



```
142 // {
143 //     "name": "domain-name-servers",
144 //     "code": 6,
145 //     "csv-format": "true",
146 //     "space": "dhcp4",
147 //     "data": "192.0.2.1, 192.0.2.2"
148 // }
149 // but it's a lot of writing, so it's easier to do this instead:
150 {
151     "name": "domain-name-servers",
152     "data": "192.168.1.1"
153 },
154
155 // Typically people prefer to refer to options by their names, so they
156 // don't need to remember the code names. However, some people like
157 // to use numerical values. For example, option "domain-name" uses
158 // option code 15, so you can reference to it either by
159 // "name": "domain-name" or "code": 15.
160 {
161     "code": 15,
162     "data": "elsaiedadel.net"
163 },
164
165 // Domain search is also a popular option. It tells the client to
```

Настройка DHCP: подсеть и пул адресов

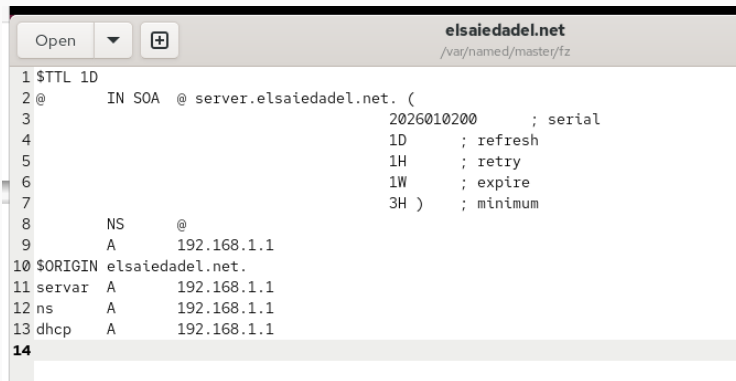
- подсеть: 192.168.1.0/24
- пул: 192.168.1.30 - 192.168.1.199
- шлюз (routers): 192.168.1.1



```
283 // ],
284
285 // Below an example of a simple IPv4 subnet declaration. Uncomment to enable
286 // it. This is a list, denoted with [ ], of structures, each denoted with
287 // { }. Each structure describes a single subnet and may have several
288 // parameters. One of those parameters is "pools" that is also a list of
289 // structures.
290 "subnet4": [
291     {
292         // This defines the whole subnet. Kea will use this information to
293         // determine where the clients are connected. This is the whole
294         // subnet in your network.
295
296         // Subnet identifier should be unique for each subnet.
297         "id": 1,
298
299         // This is mandatory parameter for each subnet.
300         "subnet": "192.168.1.0/24",
301
302         "pools": [ { "pool": "192.168.1.30 - 192.168.1.199" } ],
303
304         "option_data": [
```

DNS: добавление записей DHCP-сервера

- прямая зона: dhcp A 192.168.1.1

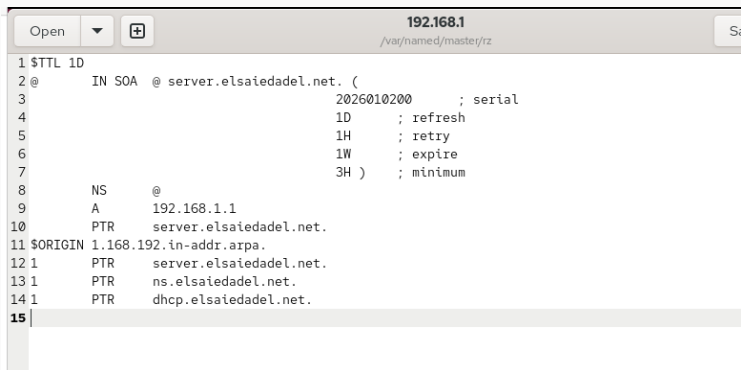


```
1 $TTL 1D
2 @      IN SOA  @ server.elsaiedadel.net. (
3                               2026010200      ; serial
4                               1D              ; refresh
5                               1H              ; retry
6                               1W              ; expire
7                               3H )            ; minimum
8      NS   @
9      A    192.168.1.1
10 $ORIGIN elsaiedadel.net.
11 servar  A    192.168.1.1
12 ns      A    192.168.1.1
13 dhcp    A    192.168.1.1
14
```

Рис. 4: Настройка прямой DNS-зоны

DNS: добавление записей DHCP-сервера

- обратная зона: 1 PTR dhcp.elsaiedadel.net.



```
1 $TTL 1D
2 @      IN SOA  @ server.elsaiedadel.net. (
3                               2026010200      ; serial
4                               1D              ; refresh
5                               1H              ; retry
6                               1W              ; expire
7                               3H )            ; minimum
8      NS   @
9      A    192.168.1.1
10     PTR   server.elsaiedadel.net.
11 $ORIGIN 1.168.192.in-addr.arpa.
12 1       PTR   server.elsaiedadel.net.
13 1       PTR   ns.elsaiedadel.net.
14 1       PTR   dhcp.elsaiedadel.net.
15
```

Рис. 5: Настройка обратной DNS-зоны

Проверка разрешения имени DHCP

- перезапуск Bind: `systemctl restart named`
- проверка: `ping dhcp.elsaiedadel.net`
- имя разрешается, потерь пакетов нет

```
[root@server.elsaiedadel.net server]#  
[root@server.elsaiedadel.net server]# ping dhcp.elsaiedadel.net  
PING dhcp.elsaiedadel.net (192.168.1.1) 56(84) bytes of data.  
64 bytes from server.elsaiedadel.net (192.168.1.1): icmp_seq=1 ttl=64 time=0.021 ms  
64 bytes from server.elsaiedadel.net (192.168.1.1): icmp_seq=2 ttl=64 time=0.032 ms  
64 bytes from server.elsaiedadel.net (192.168.1.1): icmp_seq=3 ttl=64 time=0.079 ms  
64 bytes from server.elsaiedadel.net (192.168.1.1): icmp_seq=4 ttl=64 time=0.033 ms  
64 bytes from server.elsaiedadel.net (192.168.1.1): icmp_seq=5 ttl=64 time=0.030 ms  
^C  
--- dhcp.elsaiedadel.net ping statistics ---  
5 packets transmitted, 5 received, 0% packet loss, time 4003ms  
rtt min/avg/max/mdev = 0.021/0.039/0.079/0.020 ms  
[root@server.elsaiedadel.net server]#
```

Рис. 6: Проверка разрешения имени DHCP-сервера

```
[root@server.elsaiedadel.net server]#  
[root@server.elsaiedadel.net server]# firewall-cmd --add-service=dhcp  
success  
[root@server.elsaiedadel.net server]# firewall-cmd --add-service=dhcp --permanent  
success  
[root@server.elsaiedadel.net server]# restorecon -vR /etc  
[root@server.elsaiedadel.net server]# restorecon -vR /var/named  
[root@server.elsaiedadel.net server]# restorecon -vR /var/lib/kea  
[root@server.elsaiedadel.net server]# systemctl start kea-dhcp4.service  
[root@server.elsaiedadel.net server]# █
```

Рис. 7: Запуск DHCP-сервера Kea

Provisioning маршрутизации на client

- шлюз по умолчанию назначается через **eth1**
- для **eth0** отключается default-route (IPv4/IPv6)
- переподнимаются соединения NetworkManager

```
1  #!/bin/bash
2
3  echo "Provisioning script $0"
4
5  nmcli connection modify "eth1" ipv4.gateway "192.168.1.1"
6  nmcli connection up "eth1"
7
8  nmcli connection modify eth0 ipv4.never-default true
9  nmcli connection modify eth0 ipv6.never-default true
10
11 nmcli connection down eth0
12 nmcli connection up eth0
13
14 # systemctl restart NetworkManager
15
```

Получение адреса и ifconfig на client

- eth1: получен адрес 192.168.1.30/24, broadcast 192.168.1.255
- eth0: активен, но не является дефолтным маршрутом
- lo: локальная петля 127.0.0.1

```
elsaiedadel@client:~  
  
ether 08:00:27:fb:07:db txqueuelen 1000 (Ethernet)  
RX packets 1293 bytes 158300 (154.5 KiB)  
RX errors 0 dropped 0 overruns 0 frame 0  
TX packets 1071 bytes 189644 (185.1 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::b99:10a2:5468:ed64 prefixlen 64 scopeid 0x20<link>  
ether 08:00:27:da:7d:fb txqueuelen 1000 (Ethernet)  
RX packets 267 bytes 35737 (34.8 KiB)  
RX errors 0 dropped 0 overruns 0 frame 0  
TX packets 426 bytes 38707 (37.7 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>
```

- `address` — выданный IP (192.168.1.30)
- `hwaddr` — MAC-адрес клиента
- `client_id` — идентификатор клиента (если используется)
- `valid_lifetime` — длительность аренды
- `expire` — время истечения аренды (epoch)
- `subnet_id` — ID подсети (в конфигурации `id: 1`)
- `state` — состояние записи аренды

```
[root@server.elsaiedadel.net server]# systemctl start kea-dhcp4.service
[root@server.elsaiedadel.net server]#
[root@server.elsaiedadel.net server]# 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:da:7d:fb,01:08:00:27:da:7d:fb,3600,1767353009,1,0,0,client,0,,0
[root@server.elsaiedadel.net server]#
```

Рис. 10: Файл аренды DHCP kea-leases4.csv

TSIG-ключ для динамических обновлений

- сгенерирован ключ:
 - `tsig-keygen -a HMAC-SHA512 DHCP_UPDATER > /etc/named/keys/dhcp_updater.key`

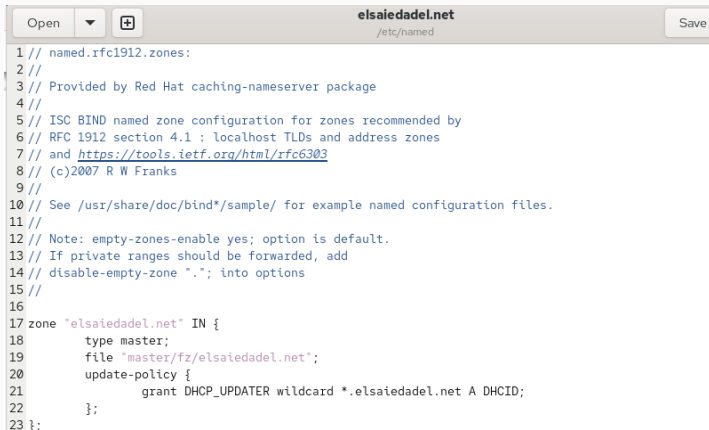
```
[root@server.elsaiedadel.net server]#  
[root@server.elsaiedadel.net server]# mkdir -p /etc/named/keys  
[root@server.elsaiedadel.net server]# tsig-keygen -a HMAC-SHA512 DHCP_UPDATER > /etc/named/keys/dhcp_updater.key  
[root@server.elsaiedadel.net server]# chown -R name:named /etc/named/keys/  
chown: invalid user: 'name:named'  
[root@server.elsaiedadel.net server]# chown -R named:named /etc/named/keys/  
[root@server.elsaiedadel.net server]# cat /etc/named/keys/dhcp_updater.key  
key "DHCP_UPDATER" {  
    algorithm hmac-sha512;  
    secret "tLMsCypkhKt45PEQzpDHPDntHnJttKxf0rtuFv9AFKv2Nua3voX9ZJMGr+J8CBu4UBmpsZpzDBcLnWrktYZe1A==";  
};  
[root@server.elsaiedadel.net server]#
```

Рис. 11: Генерация TSIG-ключа DHCP_UPDATER

Bind: разрешение обновлений зон (update-policy)

В конфигурации зон включены правила:

- прямая зона `elsaiedadel.net`: разрешить A по ключу `DHCP_UPDATER`
- обратная зона `1.168.192.in-addr.arpa`: разрешить PTR по ключу `DHCP_UPDATER`



The screenshot shows a text editor window titled "elsaiedadel.net" with the file path "/etc/named" displayed below the title. The editor contains a BIND configuration file snippet. The configuration defines a zone for "elsaiedadel.net" as a master zone. It includes comments about the Red Hat caching-nameserver package, ISC BIND configuration, and RFC 1912 section 4.1. The zone configuration block starts at line 17 and includes the following settings:

```
1 // named.rfc1912.zones:
2 //
3 // Provided by Red Hat caching-nameserver package
4 //
5 // ISC BIND named zone configuration for zones recommended by
6 // RFC 1912 section 4.1 : localhost TLDs and address zones
7 // and https://tools.ietf.org/html/rfc6303
8 // (c)2007 R W Franks
9 //
10 // See /usr/share/doc/bind*/sample/ for example named configuration files.
11 //
12 // Note: empty-zones-enable yes; option is default.
13 // If private ranges should be forwarded, add
14 // disable-empty-zone "."; into options
15 //
16
17 zone "elsaiedadel.net" IN {
18     type master;
19     file "master/fz/elsaiedadel.net";
20     update-policy {
21         grant DHCP_UPDATER wildcard *.elsaiedadel.net A DHCID;
22     };
23 };
```


Kea: ключ в JSON и конфигурация DHCP-DDNS


- 1) Создан файл `/etc/kea/tsig-keys.json` (TSIG в формате JSON)
- 2) Настроен `/etc/kea/kea-dhcp-ddns.conf`:



```
1 "tsig-keys" [
2 {
3     "name": "DHCP_UPDATER",
4     "algorithm": "hmac-sha512",
5     "secret": "tLMsCypkhKt45PEQzpDHPDntHnJttKxf@rtuFv9AFKv2Nua3voX9ZJMGr+J8CBu4UBmpsZpzDBcLnWrktYZeIA=="
6 }
7 ]
8
```

Рис. 13: TSIG-ключ в формате JSON для Kea

Кеа: ключ в JSON и конфигурация DHCP-DDNS



```
1
2 "DhcpDdns":
3 {
4   "ip-address": "127.0.0.1",
5   "port": 53001,
6   "control-socket": {
7     "socket-type": "unix",
8     "socket-name": "kea-ddns-ctrl-socket"
9   },
10  <?include "/etc/kea/tsig-keys.json"?>
11
12  "forward-ddns" : {
13    "ddns-domains" : [
14      {
15        "name": "elsaiedadel.net.",
16        "key-name": "DHCP_UPDATER",
17        "dns-servers": [
18          { "ip-address": "192.168.1.1" }
19        ]
20      }
21    ]
22  },
23
24  "reverse-ddns" : {
25    "ddns-domains" : [
26      {
27        "name": "1.168.192.in-addr.arpa.",
28        "key-name": "DHCP_UPDATER",
29        "dns-servers": [
30          { "ip-address": "192.168.1.1" }
31        ]
32      }
33    ]
34  },
35
```

Saving file "/etc/kea/kea-dhcp-ddns.conf"

Plain Text Tab Width: 8 Ln 52, Col 2 INS

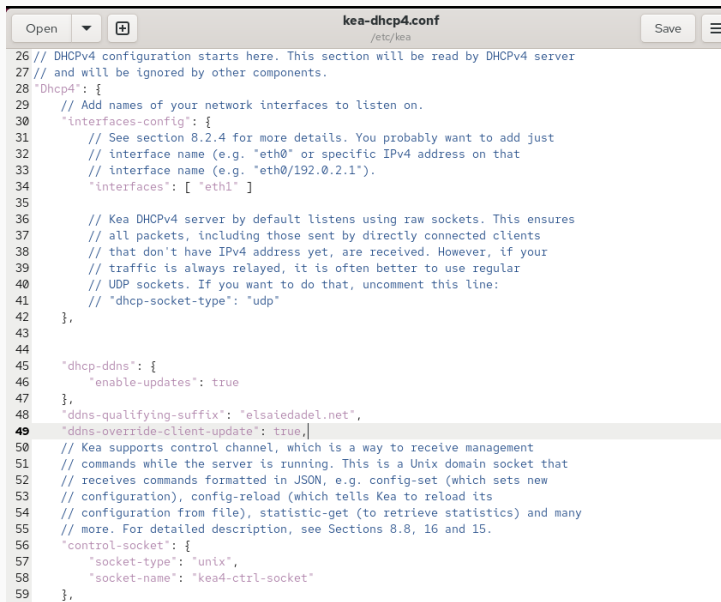
Запуск kea-dhcp-ddns и включение обновлений в DHCPv4

```
[root@server.elsaiedadel.net server]#
[root@server.elsaiedadel.net server]# chown kea:kea /etc/kea/kea-dhcp-ddns.conf
[root@server.elsaiedadel.net server]# kea-dhcp-ddns -t /etc/kea/kea-dhcp-ddns.conf
2026-01-02 10:47:18.224 INFO [kea-dhcp-ddns.dctl/28706.140591095048064] DCTL_CONFIG_CHECK_COMPLETE server has completed
configuration check: listening on 127.0.0.1, port 53001, using UDP, result: success(0), text=Configuration check successf
ul
[root@server.elsaiedadel.net server]# 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-d
dns.service'.
[root@server.elsaiedadel.net server]# 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 Fri 2026-01-02 10:47:39 UTC; 10s ago
 Invocation: 3a48cb14de254b0a84ddfd12ea2a33fa
    Docs: man:kea-dhcp-ddns(8)
   Main PID: 28920 (kea-dhcp-ddns)
      Tasks: 5 (limit: 10275)
     Memory: 2.2M (peak: 7.2M)
        CPU: 10ms
    CGroup: /system.slice/kea-dhcp-ddns.service
            └─28920 /usr/sbin/kea-dhcp-ddns -c /etc/kea/kea-dhcp-ddns.conf

Jan 02 10:47:39 server.elsaiedadel.net systemd[1]: Started kea-dhcp-ddns.service - Kea DHCP-DDNS Server.
Jan 02 10:47:39 server.elsaiedadel.net kea-dhcp-ddns[28920]: 2026-01-02 10:47:39.944 INFO [kea-dhcp-ddns.dctl/28920.1395
Jan 02 10:47:39 server.elsaiedadel.net kea-dhcp-ddns[28920]: INFO COMMAND_ACCEPTOR_START Starting to accept connections>
Jan 02 10:47:39 server.elsaiedadel.net kea-dhcp-ddns[28920]: INFO DCTL_CONFIG_COMPLETE server has completed configurati>
Jan 02 10:47:39 server.elsaiedadel.net kea-dhcp-ddns[28920]: INFO DHCP_DDNS_STARTED Kea DHCP-DDNS server version 3.0.1 >
[root@server.elsaiedadel.net server]#
```

Рис. 15: Состояние службы kea-dhcp-ddns

Запуск kea-dhcp-ddns и включение обновлений в DHCPv4



```
26 // DHCPv4 configuration starts here. This section will be read by DHCPv4 server
27 // and will be ignored by other components.
28 "dhcp4": {
29     // Add names of your network interfaces to listen on.
30     "interfaces-config": {
31         // See section 8.2.4 for more details. You probably want to add just
32         // interface name (e.g. "eth0" or specific IPv4 address on that
33         // interface name (e.g. "eth0/192.0.2.1").
34         "interfaces": [ "eth1" ]
35
36         // Kea DHCPv4 server by default listens using raw sockets. This ensures
37         // all packets, including those sent by directly connected clients
38         // that don't have IPv4 address yet, are received. However, if your
39         // traffic is always relayed, it is often better to use regular
40         // UDP sockets. If you want to do that, uncomment this line:
41         // "dhcp-socket-type": "udp"
42     },
43
44     "dhcp-ddns": {
45         "enable-updates": true
46     },
47     "ddns-qualifying-suffix": "elsaiedadel.net",
48     "ddns-override-client-update": true,
49     // Kea supports control channel, which is a way to receive management
50     // commands while the server is running. This is a Unix domain socket that
51     // receives commands formatted in JSON, e.g. config-set (which sets new
52     // configuration), config-reload (which tells Kea to reload its
53     // configuration from file), statistic-get (to retrieve statistics) and many
54     // more. For detailed description, see Sections 8.8, 16 and 15.
55     "control-socket": {
56         "socket-type": "unix",
57         "socket-name": "kea4-ctrl-socket"
58     },
59 }
```

Запуск kea-dhcp-ddns и включение обновлений в DHCPv4

- перезапуск DHCP

```
[root@server.elsaiedadel.net server]# systemctl restart kea-dhcp4.service
[root@server.elsaiedadel.net server]# 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 Fri 2026-01-02 10:51:00 UTC; 9s ago
     Invocation: 707bc63ffab349e3b4158922879e5e1b
       Docs: man:kea-dhcp4(8)
    Main PID: 29450 (kea-dhcp4)
      Status: "Dispatching packets..."
        Tasks: 7 (limit: 10275)
      Memory: 2.5M (peak: 7.2M)
         CPU: 12ms
    CGroup: /system.slice/kea-dhcp4.service
            └─29450 /usr/sbin/kea-dhcp4 -c /etc/kea/kea-dhcp4.conf

Jan 02 10:51:00 server.elsaiedadel.net systemd[1]: Starting kea-dhcp4.service - Kea DHCPv4 Server...
Jan 02 10:51:00 server.elsaiedadel.net kea-dhcp4[29450]: 2026-01-02 10:51:00.971 INFO [kea-dhcp4.dhcp4/29450.13982404498
Jan 02 10:51:00 server.elsaiedadel.net kea-dhcp4[29450]: 2026-01-02 10:51:00.972 INFO [kea-dhcp4.commands/29450.13982404
Jan 02 10:51:00 server.elsaiedadel.net systemd[1]: Started kea-dhcp4.service - Kea DHCPv4 Server.
[root@server.elsaiedadel.net server]#
```

Рис. 17: Состояние службы kea-dhcp4

Проверка: запись клиента появилась в DNS (dig)

Ключевые признаки корректной работы:

- **status: NOERROR** — запись найдена
- **aa** — ответ авторитетный
- в **ANSWER: A 192.168.1.30** — имя сопоставлено выданному адресу

```
[elsaiedadel@client.elsaiedadel.net ~]$ dig @192.168.1.1 client.elsaiedadel.net

; <<>> DiG 9.18.33 <<>> @192.168.1.1 client.elsaiedadel.net
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 62719
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: ed2d1a28ca528f5f010000006957a3714d85bd8399d1facd (good)
;; QUESTION SECTION:
;client.elsaiedadel.net.                IN      A
```

Сохранение конфигураций и скрипт dhcp.sh

```
[root@server.elsaiedadel.net server]#  
[root@server.elsaiedadel.net server]# cd /vagrant/provision/server/  
[root@server.elsaiedadel.net server]# mkdir -p /vagrant/provision/server/dhcp/etc/kea  
[root@server.elsaiedadel.net server]# cp -R /etc/kea/* /vagrant/provision/server/dhcp/etc/kea/  
[root@server.elsaiedadel.net server]# cd /vagrant/provision/server/dns/  
[root@server.elsaiedadel.net dns]# cp -R /var/named/* /vagrant/provision/server/dns/var/named/  
cp: overwrite '/vagrant/provision/server/dns/var/named/master/fz/elsaiedadel.net'? y  
cp: overwrite '/vagrant/provision/server/dns/var/named/master/rz/192.168.1'? y  
[root@server.elsaiedadel.net dns]# cp -R /etc/named/* /vagrant/provision/server/dns/etc/named/  
cp: overwrite '/vagrant/provision/server/dns/etc/named/elsaiedadel.net'? y  
[root@server.elsaiedadel.net dns]# cd /vagrant/provision/server/  
[root@server.elsaiedadel.net server]# touch dhcp.sh  
[root@server.elsaiedadel.net server]# chmod +x dhcp.sh  
[root@server.elsaiedadel.net server]#
```

Рис. 19: Копирование конфигурации DNS и DHCP

Сохранение конфигураций и скрипт dhcp.sh



```
1 #!/bin/bash
2 echo "Provisioning script $0"
3 echo "Install needed packages"
4 dnf -y install kea
5 echo "Copy configuration files"
6 cp -R /vagrant/provision/server/dhcp/etc/kea/* /etc/kea/
7 echo "Fix permissions"
8 chown -R kea:kea /etc/kea
9 chmod 640 /etc/kea/tsig-keys.json
10 restorecon -vR /etc
11 restorecon -vR /var/lib/kea
12 echo "Configure firewall"
13 firewall-cmd --add-service dhcp
14 firewall-cmd --add-service dhcp --permanent
15 echo "Start dhcpd service"
16 systemctl --system daemon-reload
17 systemctl enable --now kea-dhcp4.service
18 systemctl enable --now kea-dhcp-ddns.service
19
```

Рис. 20: Provisioning-скрипт dhcp.sh

Выводы

- Настроен Kea DHCPv4: выдача адресов и сетевых параметров
- Проанализирована работа DHCP на клиенте (маршрутизация, ifconfig, leases)
- Реализована интеграция DHCP и Bind через DDNS (TSIG + update-policy)
- Подтверждено автоматическое создание DNS-записи клиента (dig)
- Выполнена автоматизация действий через provisioning-скрипты Vagrant