

Администрирование системных подсистем

Настройка DHCP-сервера Kea и интеграция с DNS (Bind9 + DDNS)

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19 ноября 2025

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Цель работы

Приобретение практических навыков настройки DHCP-сервера Kea и интеграции его с DNS Bind9, включая механизм динамических обновлений DDNS.

Конфигурирование DHCP-сервера

Настройка параметров домена

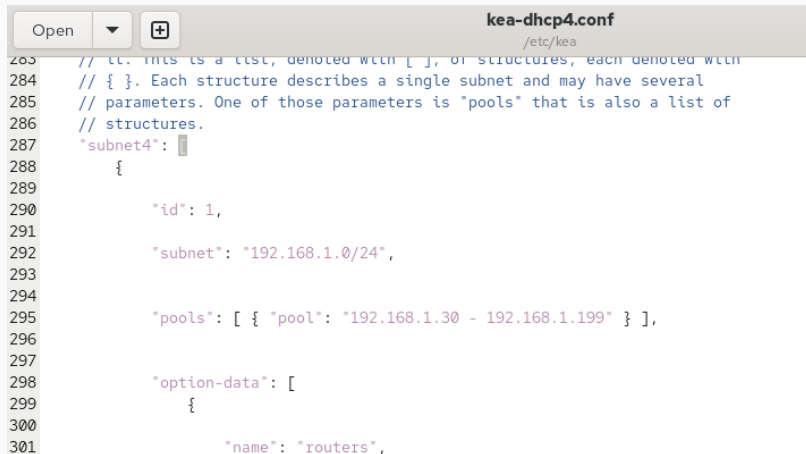
- Обновлено `domain-name`, `domain-search`
- DNS-сервер: `192.168.1.1`
- Внесены изменения в файл `/etc/kea/kea-dhcp4.conf`



```
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": "trseidaliev.net"
163 },
164
165 // Domain search is also a popular option. It tells the client to
166 // attempt to resolve names within those specified domains. For
167 // example, name "foo" would be attempted to be resolved as
```

Настройка подсети DHCP

- Сеть: 192.168.1.0/24
- Диапазон: 192.168.1.30–192.168.1.199
- Шлюз: 192.168.1.1



```
283 // i.e. this is a list, denoted with [ ], of structures, each denoted with
284 // { }. Each structure describes a single subnet and may have several
285 // parameters. One of those parameters is "pools" that is also a list of
286 // structures.
287 "subnet4": {
288     {
289
290         "id": 1,
291
292         "subnet": "192.168.1.0/24",
293
294
295         "pools": [ { "pool": "192.168.1.30 - 192.168.1.199" } ],
296
297
298         "option-data": [
299             {
300
301                 "name": "routers",
```

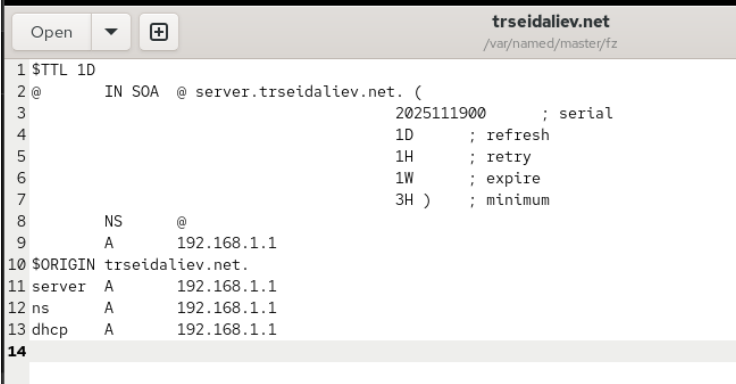
Проверка работы службы DHCP

- Проверка корректности конфигурации
- Перезапуск сервиса
- Включение автозагрузки

```
[root@server.trseidaliev.net server]#  
[root@server.trseidaliev.net server]# kea-dhcp4 -t /etc/kea/kea-dhcp4.conf  
2025-11-19 19:00:06.379 INFO [kea-dhcp4.hosts/21246.139875138164928] HOSTS_BACKENDS_REGISTERED the following host back  
end types are available: mysql postgresql  
2025-11-19 19:00:06.380 WARN [kea-dhcp4.dhcp4/21246.139875138164928] DHCP4_SRV_MT_DISABLED_QUEUE_CONTROL disabling dh  
cp queue control when multi-threading is enabled.  
2025-11-19 19:00:06.380 WARN [kea-dhcp4.dhcp4/21246.139875138164928] DHCP4_RESERVATIONS_LOOKUP_FIRST_ENABLED Multi-th  
reading is enabled and host reservations lookup is always performed first.  
2025-11-19 19:00:06.381 INFO [kea-dhcp4.dhcp4/21246.139875138164928] DHCP4_SRV_CFGMGR_NEW_SUBNET4 a new subnet has be  
en added to configuration: 192.168.1.0/24 with params: t1=900, t2=1800, valid-lifetime=3600  
2025-11-19 19:00:06.381 INFO [kea-dhcp4.dhcp4/21246.139875138164928] DHCP4_SRV_CFGMGR_SOCKET_TYPE_SELECT using socket  
type raw  
2025-11-19 19:00:06.381 INFO [kea-dhcp4.dhcp4/21246.139875138164928] DHCP4_SRV_CFGMGR_ADD_IFACE listening on interfac  
e eth1  
2025-11-19 19:00:06.381 INFO [kea-dhcp4.dhcp4/21246.139875138164928] DHCP4_SRV_CFGMGR_SOCKET_TYPE_DEFAULT "dhcp-socke  
t-type" not specified , using default socket type raw  
[root@server.trseidaliev.net server]# systemctl --system daemon-reload  
[root@server.trseidaliev.net server]# systemctl enable kea-dhcp4.service  
Created symlink '/etc/systemd/system/multi-user.target.wants/kea-dhcp4.service' -> '/usr/lib/systemd/system/kea-dhcp4.s  
ervice'.  
[root@server.trseidaliev.net server]#
```

Настройка DNS-зон

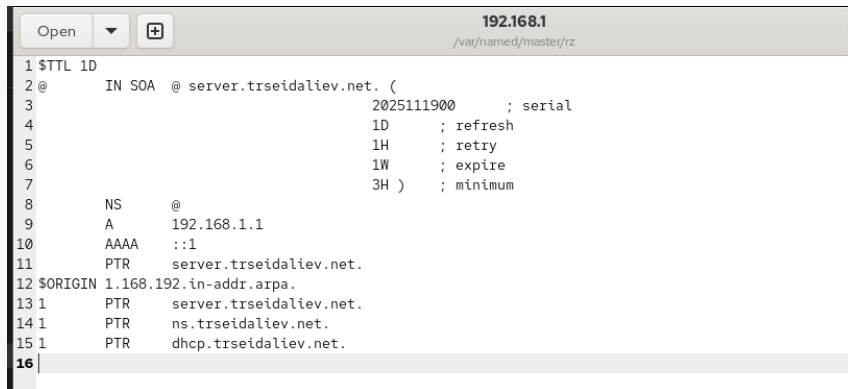
Добавлена A-запись для DHCP-сервера и обновлён серийный номер зоны.



```
1 $TTL 1D
2 @      IN SOA  @ server.trseidaliev.net. (
3                               2025111900      ; serial
4                               1D              ; refresh
5                               1H              ; retry
6                               1W              ; expire
7                               3H )            ; minimum
8      NS      @
9      A      192.168.1.1
10 $ORIGIN trseidaliev.net.
11 server A     192.168.1.1
12 ns     A     192.168.1.1
13 dhcp   A     192.168.1.1
14
```

Рис. 4: Файл прямой зоны после изменения

Добавлена PTR-запись и обновлён SOA serial.



```
1 $TTL 1D
2 @      IN SOA  @ server.trseidaliev.net. (
3                               2025111900      ; serial
4                               1D              ; refresh
5                               1H              ; retry
6                               1W              ; expire
7                               3H )            ; minimum
8 NS     @
9 A      192.168.1.1
10 AAAA   ::1
11 PTR    server.trseidaliev.net.
12 $ORIGIN 1.168.192.in-addr.arpa.
13 1      PTR    server.trseidaliev.net.
14 1      PTR    ns.trseidaliev.net.
15 1      PTR    dhcp.trseidaliev.net.
16
```

Рис. 5: Файл обратной зоны

Проверка сетевого взаимодействия

```
[root@server.trseidaliev.net server]#  
[root@server.trseidaliev.net server]# systemctl restart named  
[root@server.trseidaliev.net server]#  
[root@server.trseidaliev.net server]# ping dhcp.trseidaliev.net  
PING dhcp.trseidaliev.net (192.168.1.1) 56(84) bytes of data.  
64 bytes from server.trseidaliev.net (192.168.1.1): icmp_seq=1 ttl=64 time=0.012 ms  
64 bytes from server.trseidaliev.net (192.168.1.1): icmp_seq=2 ttl=64 time=0.084 ms  
64 bytes from server.trseidaliev.net (192.168.1.1): icmp_seq=3 ttl=64 time=0.037 ms  
64 bytes from server.trseidaliev.net (192.168.1.1): icmp_seq=4 ttl=64 time=0.064 ms  
64 bytes from server.trseidaliev.net (192.168.1.1): icmp_seq=5 ttl=64 time=0.061 ms  
64 bytes from server.trseidaliev.net (192.168.1.1): icmp_seq=6 ttl=64 time=0.077 ms  
^C  
--- dhcp.trseidaliev.net ping statistics ---  
6 packets transmitted, 6 received, 0% packet loss, time 5577ms  
rtt min/avg/max/mdev = 0.012/0.055/0.084/0.024 ms  
[root@server.trseidaliev.net server]#
```

Рис. 6: Проверка ping по имени dhcp..net

- Разрешена служба DHCP
- Восстановлены контексты SELinux `/etc`, `/var/named`, `/var/lib/kea`

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

Рис. 7: Изменения в firewall и SELinux

Анализ работы DHCP-сервера

Скрипт маршрутизации клиента



The image shows a Vagrant terminal window with three tabs: 'Vagrantfile', 'dns.sh', and '01-routing.sh'. The '01-routing.sh' tab is active and displays a shell script for configuring network settings. The script includes a shebang, an echo statement, nmcli commands to modify the 'eth1' connection's IPv4 gateway and bring it up, nmcli commands to modify the 'eth0' connection's IPv4 and IPv6 'never-default' settings, and a systemctl command to restart the NetworkManager service.

```
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
```

Рис. 8: Скрипт настройки маршрутизации клиента

```
trseidaliev@client:~  
~  
RX packets 1927  bytes 232458 (227.0 KiB)  
RX errors 0  dropped 0  overruns 0  frame 0  
TX packets 1660  bytes 268730 (262.4 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::86cf:247e:f9d1:8ac9  prefixlen 64  scopeid 0x20<link>  
    ether 08:00:27:36:98:16  txqueuelen 1000  (Ethernet)  
    RX packets 62  bytes 7039 (6.8 KiB)  
    RX errors 0  dropped 0  overruns 0  frame 0  
    TX packets 238  bytes 22681 (22.1 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 2112 (2.0 KiB)  
    RX errors 0  dropped 0  overruns 0  frame 0  
    TX packets 18  bytes 2112 (2.0 KiB)  
    TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
  
[trseidaliev@client.trseidaliev.net ~]$
```



```
[root@server.trseidaliev.net server]#  
[root@server.trseidaliev.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  
192.168.1.30,08:00:27:36:98:16,01:08:00:27:36:98:16,3600,1763571977,1,0,0,client,0,,0  
192.168.1.30,08:00:27:36:98:16,01:08:00:27:36:98:16,3600,1763571977,1,0,0,client,0,,0  
192.168.1.30,08:00:27:36:98:16,01:08:00:27:36:98:16,3600,1763571982,1,0,0,client,0,,0  
[root@server.trseidaliev.net server]#
```

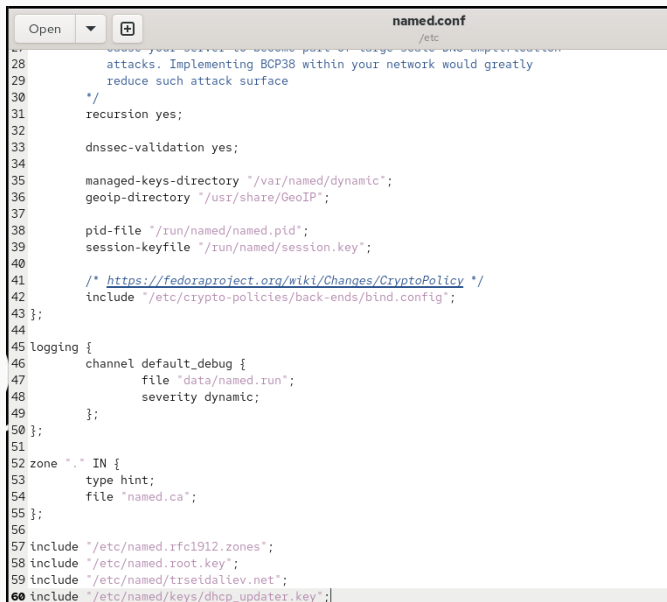
Рис. 10: Содержимое файла kea-leases4.csv

Настройка DDNS

```
[root@server.trseidaliev.net server]#  
[root@server.trseidaliev.net server]# mkdir -p /etc/named/keys  
[root@server.trseidaliev.net server]# tsig-keygen -a HMAC-SHA512 DHCP_UPDATER > /etc/named/keys/dhcp_updater.key  
[root@server.trseidaliev.net server]# cat /etc/named/keys/dhcp_updater.key  
key "DHCP_UPDATER" {  
    algorithm hmac-sha512;  
    secret "vn63cmyZgm5UQRNJs0feoxh5aWl//QexHcWouly6Kn6IuLJBvEvQ0/RIWTad/lkdBShKiVa+OmwAa3AGyoSrlA=";  
};  
[root@server.trseidaliev.net server]# chown -R named:named /etc/named/keys/  
[root@server.trseidaliev.net server]# █
```

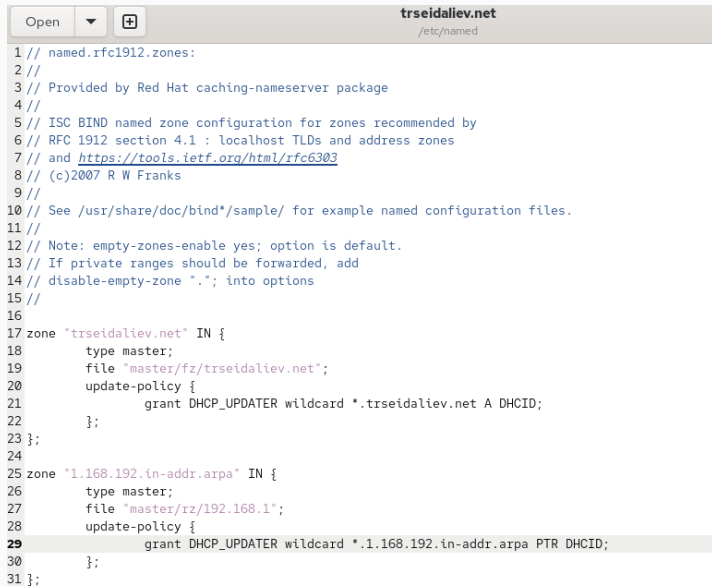
Рис. 11: Создание ключа DHCP_UPDATER

Включение ключа в named.conf



```
28     attacks. Implementing BCP38 within your network would greatly
29     reduce such attack surface
30 */
31 recursion yes;
32
33 dnssec-validation yes;
34
35 managed-keys-directory "/var/named/dynamic";
36 geoip-directory "/usr/share/GeoIP";
37
38 pid-file "/run/named/named.pid";
39 session-keyfile "/run/named/session.key";
40
41 /* https://fedoraproject.org/wiki/Changes/CryptoPolicy */
42 include "/etc/crypto-policies/back-ends/bind.config";
43 };
44
45 logging {
46     channel default_debug {
47         file "data/named.run";
48         severity dynamic;
49     };
50 };
51
52 zone "." IN {
53     type hint;
54     file "named.ca";
55 };
56
57 include "/etc/named.rfc1912.zones";
58 include "/etc/named.root.key";
59 include "/etc/named/trseidaliev.net";
60 include "/etc/named/keys/dhcp_updater.key";
```

Разрешения на обновления зоны



The image shows a text editor window with a title bar that includes an "Open" button, a dropdown arrow, and a "+" icon. The title text is "trseidaliev.net" and the file path is "/etc/named". The editor contains a BIND configuration file with the following content:

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

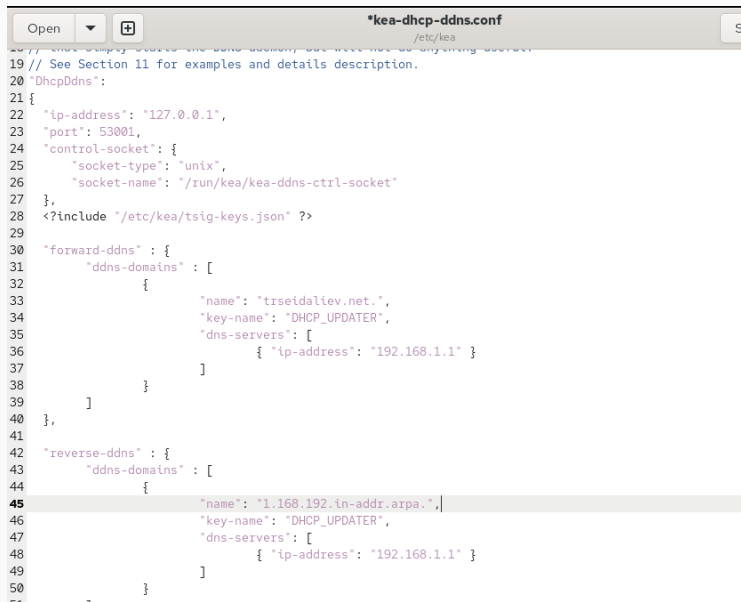
Разрешения на обновления зоны



```
1 "tsig-keys" [
2 {
3     "name": "DHCP_UPDATER",
4     "algorithm": "hmac-sha512",
5     "secret": "vn63cmyZgm5UQRNJs0feoxh5aWl//QexHcWouly6Kn6IuLJBvEvQ0/RIWTad/lkdBShKiVa+0mwAa3AGyoSr1A=="
6 }
7 ]
8
```

Рис. 14: Разрешение обновлений в обратной зоне

Настройка tsig-keys.json



```
Open [v] [+]  
*kea-dhcp-ddns.conf  
/etc/kea  
18 // This sample shows the basic schema, but will not do anything useful.  
19 // See Section 11 for examples and details description.  
20 "DhcpDdns":  
21 {  
22   "ip-address": "127.0.0.1",  
23   "port": 53001,  
24   "control-socket": {  
25     "socket-type": "unix",  
26     "socket-name": "/run/kea/kea-ddns-ctrl-socket"  
27   },  
28   <?include "/etc/kea/tsig-keys.json" ?>  
29  
30   "forward-ddns" : {  
31     "ddns-domains" : [  
32       {  
33         "name": "trseidaliev.net.",  
34         "key-name": "DHCP_UPDATER",  
35         "dns-servers" : [  
36           { "ip-address": "192.168.1.1" }  
37         ]  
38       }  
39     ]  
40   },  
41  
42   "reverse-ddns" : {  
43     "ddns-domains" : [  
44       {  
45         "name": "1.168.192.in-addr.arpa.",  
46         "key-name": "DHCP_UPDATER",  
47         "dns-servers" : [  
48           { "ip-address": "192.168.1.1" }  
49         ]  
50       }  
51     ]  
52   }  
53 }
```

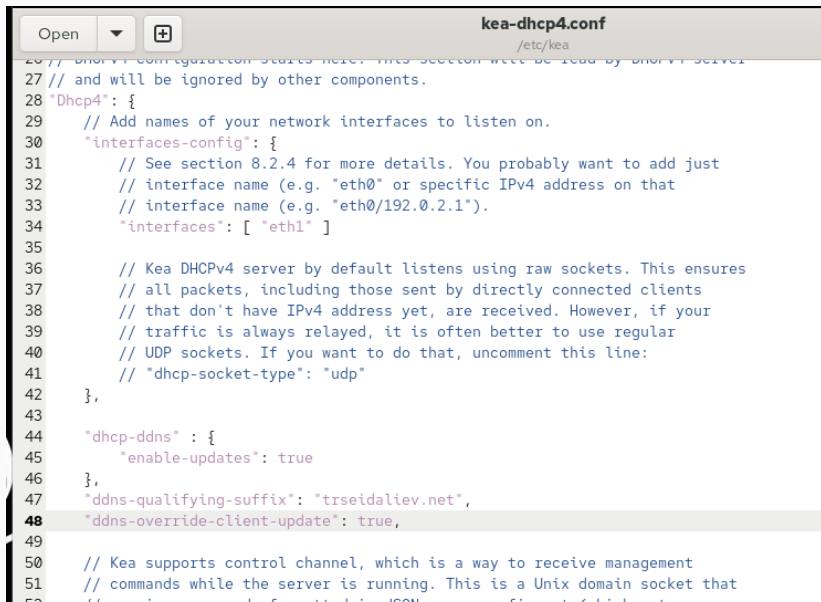
Настройка kea-dhcp-ddns.conf

```
[root@server.trseidaliev.net server]#
[root@server.trseidaliev.net server]# kea-dhcp-ddns -t /etc/kea/kea-dhcp-ddns.conf
2025-11-19 19:21:41.818 INFO [kea-dhcp-ddns.dctl/24626.140596514251072] 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 successful
[root@server.trseidaliev.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-ddns.service'.
[root@server.trseidaliev.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 Wed 2025-11-19 19:22:08 MSK; 13s ago
 Invocation: 0fe9927993944887969997b06645d8ef
    Docs: man:kea-dhcp-ddns(8)
  Main PID: 24872 (kea-dhcp-ddns)
    Tasks: 5 (limit: 10381)
   Memory: 1.7M (peak: 6.1M)
      CPU: 10ms
   CGroup: /system.slice/kea-dhcp-ddns.service
           └─24872 /usr/sbin/kea-dhcp-ddns -c /etc/kea/kea-dhcp-ddns.conf

Nov 19 19:22:08 server.trseidaliev.net systemd[1]: Started kea-dhcp-ddns.service - Kea DHCP-DDNS Server.
Nov 19 19:22:08 server.trseidaliev.net kea-dhcp-ddns[24872]: 2025-11-19 19:22:08.247 INFO [kea-dhcp-ddns.dctl/24872.140596514251072] 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 successful
Nov 19 19:22:08 server.trseidaliev.net kea-dhcp-ddns[24872]: INFO COMMAND_ACCEPTOR_START Starting to accept connections
Nov 19 19:22:08 server.trseidaliev.net kea-dhcp-ddns[24872]: INFO DCTL_CONFIG_COMPLETE server has completed configuration check: listening on 127.0.0.1, port 53001, using UDP, result: success(0), text=Configuration check successful
Nov 19 19:22:08 server.trseidaliev.net kea-dhcp-ddns[24872]: INFO DHCP_DDNS_STARTED Kea DHCP-DDNS server version 2.6.0
lines 1-17/17 (END)
```

Рис. 16: Фрагмент kea-dhcp-ddns.conf

Запуск службы DDNS



```
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": "trseidaliev.net",
48     "ddns-override-client-update": true,
49
50     // Kea supports control channel, which is a way to receive management
51     // commands while the server is running. This is a Unix domain socket that
52     // communicates with a daemon listening on "/var/run/kea/control.socket".
```

Включение DDNS в DHCP4

```
[root@server.trseidaliev.net server]# kea-dhcp4 -t /etc/kea/kea-dhcp4.conf
2025-11-19 19:24:27.584 INFO [kea-dhcp4.hosts/25203.139864501876928] HOSTS_BACKENDS_REGISTERED the following host backend types are available: mysql postgresql
2025-11-19 19:24:27.585 WARN [kea-dhcp4.dhcp4/25203.139864501876928] DHCP4_SRV_MT_DISABLED_QUEUE_CONTROL disabling dhcp queue control when multi-threading is enabled.
2025-11-19 19:24:27.585 WARN [kea-dhcp4.dhcp4/25203.139864501876928] DHCP4_RESERVATIONS_LOOKUP_FIRST_ENABLED Multi-threading is enabled and host reservations lookup is always performed first.
2025-11-19 19:24:27.585 INFO [kea-dhcp4.dhcp4/25203.139864501876928] DHCP4_SRV_CFGMGR_NEW_SUBNET4 a new subnet has been added to configuration: 192.168.1.0/24 with params: t1=900, t2=1800, valid-lifetime=3600
2025-11-19 19:24:27.585 INFO [kea-dhcp4.dhcp4/25203.139864501876928] DHCP4_SRV_CFGMGR_SOCKET_TYPE_SELECT using socket type raw
2025-11-19 19:24:27.585 INFO [kea-dhcp4.dhcp4/25203.139864501876928] DHCP4_SRV_CFGMGR_ADD_IFACE listening on interface eth1
2025-11-19 19:24:27.585 INFO [kea-dhcp4.dhcp4/25203.139864501876928] DHCP4_SRV_CFGMGR_SOCKET_TYPE_DEFAULT "dhcp-socket-type" not specified, using default socket type raw
[root@server.trseidaliev.net server]#
[root@server.trseidaliev.net server]# systemctl restart kea-dhcp4.service
[root@server.trseidaliev.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 Wed 2025-11-19 19:24:41 MSK; 5s ago
 Invocation: cb7e5da1c0e840fb954f99de7c5ce3c3
    Docs: man:kea-dhcp4(8)
 Main PID: 25273 (kea-dhcp4)
   Tasks: 7 (limit: 10381)
  Memory: 2.5M (peak: 6M)
     CPU: 13ms
   CGroup: /system.slice/kea-dhcp4.service
           └─25273 /usr/sbin/kea-dhcp4 -c /etc/kea/kea-dhcp4.conf
```

Nov 19 19:24:41 server.trseidaliev.net systemd[1]: Started kea-dhcp4.service - Kea DHCPv4 Server.

Nov 19 19:24:41 server.trseidaliev.net kea-dhcp4[25273]: 2025-11-19 19:24:41.161 INFO [kea-dhcp4.dhcp4/25273.13990955]

Nov 19 19:24:41 server.trseidaliev.net kea-dhcp4[25273]: 2025-11-19 19:24:41.161 INFO [kea-dhcp4.commands/25273.13990955]

lines 1-15/15 (END)

Проверка DDNS

Проверка А-записи, созданной автоматически

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

; <<>> DiG 9.18.33 <<>> @192.168.1.1 client.trseidaliev.net
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->HEADER<- opcode: QUERY, status: NOERROR, id: 58475
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: 129fa27f46fdda9e01000000691def862038615073907298 (good)
;; QUESTION SECTION:
;client.trseidaliev.net.                IN      A

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

;; Query time: 1 msec
;; SERVER: 192.168.1.1#53(192.168.1.1) (UDP)
;; WHEN: Wed Nov 19 16:30:50 UTC 2025
;; MSG SIZE rcvd: 95

[trseidaliev@client.trseidaliev.net ~]$
```

Итоги работы

- Настроен DHCP-сервер Kea с автоматической выдачей IP
- Настроены прямые и обратные зоны Bind9
- Реализован механизм DDNS с TSIG
- Проверены A- и PTR-записи, создаваемые автоматически
- Перенесены конфигурации в структуру Vagrant
- Создан сценарий `dhcp.sh` для автоматического развёртывания