Администрирование сетевых подсистем

Настройка DHCP-сервера

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Цели и задачи работы

Цель лабораторной работы

Приобрести практические навыки по установке и конфигурации DHCP-сервера, а также закрепить знания по работе протокола DHCP и динамическому обновлению DNS-зон.

Выполнение лабораторной работы

Установка DHCP-сервера

```
--------------------------------------------------------------------------------
Total                                                  287 kB/s | 5.3 MB     00:18
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-2.6.3-1.el10_0.x86_64                         5/6
  Running scriptlet: kea-2.6.3-1.el10_0.x86_64                              6/6
  Installing       : kea-2.6.3-1.el10_0.x86_64                              6/6
  Running scriptlet: kea-2.6.3-1.el10_0.x86_64                              6/6

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
  mariadb-connector-c-3.4.4-1.el10.x86_64  mariadb-connector-c-config-3.4.4-1.el10.noarch

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

Рис. 1: Установка пакета kea

Настройка конфигурации

```
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": "ahmedfarg.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
168         // foo.mydomain.example.com and if it fails, then as foo.example.com
169         {
170             "name": "domain-search",
171             "data": "ahmedfarg.net"
172         },
```

Настройка конфигурации

```
// 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"
            }
```

Проверка конфигурации

```
[root@server.ahmedfarg.net server]#
[root@server.ahmedfarg.net server]# cp /etc/kea/kea-dhcp4.conf /etc/kea/kea-dhcp4.conf__$(date -I)
[root@server.ahmedfarg.net server]#
[root@server.ahmedfarg.net server]#
[root@server.ahmedfarg.net server]# gedit /etc/kea/kea-dhcp4.conf
[root@server.ahmedfarg.net server]#
[root@server.ahmedfarg.net server]# kea-dhcp4 -t  /etc/kea/kea-dhcp4.conf
2025-09-17 09:12:28.212 INFO  [kea-dhcp4.hosts/35444.140521348294848] HOSTS_BACKENDS_REGISTERED the following host
 backend types are available: mysql postgresql
2025-09-17 09:12:28.214 WARN  [kea-dhcp4.dhcpsrv/35444.140521348294848] DHCPSRV_MT_DISABLED_QUEUE_CONTROL disablin
g dhcp queue control when multi-threading is enabled.
2025-09-17 09:12:28.214 WARN  [kea-dhcp4.dhcp4/35444.140521348294848] DHCP4_RESERVATIONS_LOOKUP_FIRST_ENABLED Mult
i-threading is enabled and host reservations lookup is always performed first.
2025-09-17 09:12:28.214 INFO  [kea-dhcp4.dhcpsrv/35444.140521348294848] DHCPSRV_CFGMGR_NEW_SUBNET4 a new subnet ha
s been added to configuration: 192.168.1.0/24 with params: t1=900, t2=1800, valid-lifetime=3600
2025-09-17 09:12:28.214 INFO  [kea-dhcp4.dhcpsrv/35444.140521348294848] DHCPSRV_CFGMGR_SOCKET_TYPE_SELECT using so
cket type raw
2025-09-17 09:12:28.215 INFO  [kea-dhcp4.dhcpsrv/35444.140521348294848] DHCPSRV_CFGMGR_ADD_IFACE listening on inte
rface eth1
2025-09-17 09:12:28.215 INFO  [kea-dhcp4.dhcpsrv/35444.140521348294848] DHCPSRV_CFGMGR_SOCKET_TYPE_DEFAULT "dhcp-s
ocket-type" not specified , using default socket type raw
[root@server.ahmedfarg.net server]# systemctl --system daemon-reload
[root@server.ahmedfarg.net server]# systemctl enable kea-dhcp4.service
Created symlink '/etc/systemd/system/multi-user.target.wants/kea-dhcp4.service' → '/usr/lib/systemd/system/kea-dhc
p4.service'.
[root@server.ahmedfarg.net server]# gedit /var/named/master/fz/ahmedfarg.net
[root@server.ahmedfarg.net server]#
```

Рис. 4: Проверка kea-dhcp4.conf

Настройка DNS-зон

Open

ahmedfarg.net
/var/named/master/fz

```
1  $TTL 1D
2  @       IN SOA  @ server.ahmedfarg.net. (
3                                           2025091700      ; serial
4                                           1D      ; refresh
5                                           1H      ; retry
6                                           1W      ; expire
7                                           3H )    ; minimum
8          NS      @
9          A       192.168.1.1
10 $ORIGIN ahmedfarg.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

Настройка DNS-зон

Open

192.168.1
/var/named/master/rz

```
$TTL 1D
@       IN SOA  @ server.ahmedfarg.net. (
                                        2025091700      ; serial
                                        1D      ; refresh
                                        1H      ; retry
                                        1W      ; expire
                                        3H )    ; minimum
        NS      @
        A       192.168.1.1
        PTR     server.ahmedfarg.net.
$ORIGIN 1.168.192.in-addr.arpa.
1       PTR     server.ahmedfarg.net.
1       PTR     ns.ahmedfarg.net.
1       PTR     dhcp.ahmedfarg.net.
```

Рис. 6: Файл обратной зоны

Проверка доступности DHCP

```
[root@server.ahmedfarg.net server]# gedit /var/named/master/fz/ahmedfarg.net
[root@server.ahmedfarg.net server]#
[root@server.ahmedfarg.net server]# gedit /var/named/master/rz/192.168.1
[root@server.ahmedfarg.net server]#
[root@server.ahmedfarg.net server]# systemctl restart named
[root@server.ahmedfarg.net server]# ping dhcp.ahmedfarg.net
PING dhcp.ahmedfarg.net (192.168.1.1) 56(84) bytes of data.
64 bytes from ns.ahmedfarg.net (192.168.1.1): icmp_seq=1 ttl=64 time=0.016 ms
64 bytes from ns.ahmedfarg.net (192.168.1.1): icmp_seq=2 ttl=64 time=0.091 ms
64 bytes from ns.ahmedfarg.net (192.168.1.1): icmp_seq=3 ttl=64 time=0.087 ms
64 bytes from ns.ahmedfarg.net (192.168.1.1): icmp_seq=4 ttl=64 time=0.059 ms
64 bytes from ns.ahmedfarg.net (192.168.1.1): icmp_seq=5 ttl=64 time=0.093 ms
^C
--- dhcp.ahmedfarg.net ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4077ms
rtt min/avg/max/mdev = 0.016/0.069/0.093/0.029 ms
[root@server.ahmedfarg.net server]#
```

Рис. 7: Проверка ping dhcp.ahmedfarg.net

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

Рис. 8: firewalld и restorecon

```
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. 9: Скрипт маршрутизации на клиенте

Анализ работы DHCP-сервера

```
[ahmedfarg@client.ahmedfarg.net ~]$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fd17:625c:f037:2:a00:27ff:fefb:7db  prefixlen 64  scopeid 0x0<glob
al>
        inet6 fe80::a00:27ff:fefb:7db  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:fb:07:db  txqueuelen 1000  (Ethernet)
        RX packets 1945  bytes 235040 (229.5 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1684  bytes 271164 (264.8 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::ad1a:1063:9e58:33f6  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:56:5a:98  txqueuelen 1000  (Ethernet)
        RX packets 78  bytes 9071 (8.8 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 258  bytes 25147 (24.5 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Рис. 10: Сетевые интерфейсы клиента

Анализ работы DHCP-сервера

```
[root@server.ahmedfarg.net server]#
[root@server.ahmedfarg.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
192.168.1.30,08:00:27:56:5a:98,01:08:00:27:56:5a:98,3600,1758104403,1,0,0,client,0,,0
192.168.1.30,08:00:27:56:5a:98,01:08:00:27:56:5a:98,3600,1758104403,1,0,0,client,0,,0
192.168.1.30,08:00:27:56:5a:98,01:08:00:27:56:5a:98,3600,1758104408,1,0,0,client,0,,0
[root@server.ahmedfarg.net server]#
```

Рис. 11: Выданные адреса в leases4.csv

Настройка обновления DNS-зоны

```
// named.rfc1912.zones:
//
// Provided by Red Hat caching-nameserver package
//
// ISC BIND named zone configuration for zones recommended by
// RFC 1912 section 4.1 : localhost TLDs and address zones
// and https://tools.ietf.org/html/rfc6303
// (c)2007 R W Franks
//
// See /usr/share/doc/bind*/sample/ for example named configuration files.
//
// Note: empty-zones-enable yes; option is default.
// If private ranges should be forwarded, add
// disable-empty-zone "."; into options
//

zone "ahmedfarg.net" IN {
        type master;
        file "master/fz/ahmedfarg.net";
        update-policy {
                grant DHCP_UPDATER wildcard *.ahmedfarg.net A DHCID;
        };
};

zone "1.168.192.in-addr.arpa" IN {
        type master;
        file "master/rz/192.168.1";
        update-policy {
                grant DHCP_UPDATER wildcard *.1.168.192.in-addr.arpa PTR DHCID;
        };
};
```

Настройка обновления DNS-зоны

Рис. 13: Файл tsig-keys.json

Настройка обновления DNS-зоны

```
"DhcpDdns":
{
  "ip-address": "127.0.0.1",
  "port": 53001,
  "control-socket": {
      "socket-type": "unix",
      "socket-name": "/run/kea/kea-ddns-ctrl-socket"
  },
  <?include "/etc/kea/tsig-keys.json"?>

  "forward-ddns" : {
        "ddns-domains": [
                {
                        "name": "ahmedfarg.net.",
                        "key-name": "DHCP_UPDATER",
                        "dns-servers": [
                                {"ip-address": "192.168.1.1"}
                        ]
                }
        ]
  },
  "reverse-ddns" : {
        "ddns-domains": [
                {
                        "name": "1.168.192.in-addr.arpa.",
                        "key-name": "DHCP_UPDATER",
                        "dns-servers": [
                                {"ip-address": "192.168.1.1"}
                        ]
                }
```

Настройка обновления DNS-зоны

```
[root@server.ahmedfarg.net server]#
[root@server.ahmedfarg.net server]# chown kea:kea /etc/kea/kea-dhcp-ddns.conf
[root@server.ahmedfarg.net server]# kea-dhcp-ddns -t /etc/kea/kea-dhcp-ddns.conf
2025-09-17 09:38:27.225 INFO  [kea-dhcp-ddns.dctl/39396.140003322601792] DCTL_CONFIG_CHECK_COMPLETE server has com
pleted configuration check: listening on 127.0.0.1, port 53001, using UDP, result: success(0), text=Configuration
check successful
[root@server.ahmedfarg.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.ahmedfarg.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 2025-09-17 09:38:49 UTC; 9s ago
 Invocation: f43e7720d7ce47d7b90b25df044e7eb3
       Docs: man:kea-dhcp-ddns(8)
   Main PID: 39625 (kea-dhcp-ddns)
      Tasks: 5 (limit: 10398)
     Memory: 1.7M (peak: 6M)
        CPU: 10ms
     CGroup: /system.slice/kea-dhcp-ddns.service
             └─39625 /usr/sbin/kea-dhcp-ddns -c /etc/kea/kea-dhcp-ddns.conf

Sep 17 09:38:49 server.ahmedfarg.net systemd[1]: Started kea-dhcp-ddns.service - Kea DHCP-DDNS Server.
Sep 17 09:38:49 server.ahmedfarg.net kea-dhcp-ddns[39625]: 2025-09-17 09:38:49.182 INFO  [kea-dhcp-ddns.dctl/3962
[root@server.ahmedfarg.net server]#
```

Рис. 15: Запуск kea-dhcp-ddns

Настройка обновления DNS-зоны

```
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
48      "ddns-qualifying-suffix": "ahmedfarg.net",
49      "ddns-override-client-update": true,
50
51      // Kea supports control channel, which is a way to receive management
52      // commands while the server is running. This is a Unix domain socket that
```

Рис. 16: Изменения в kea-dhcp4.conf

Настройка обновления DNS-зоны

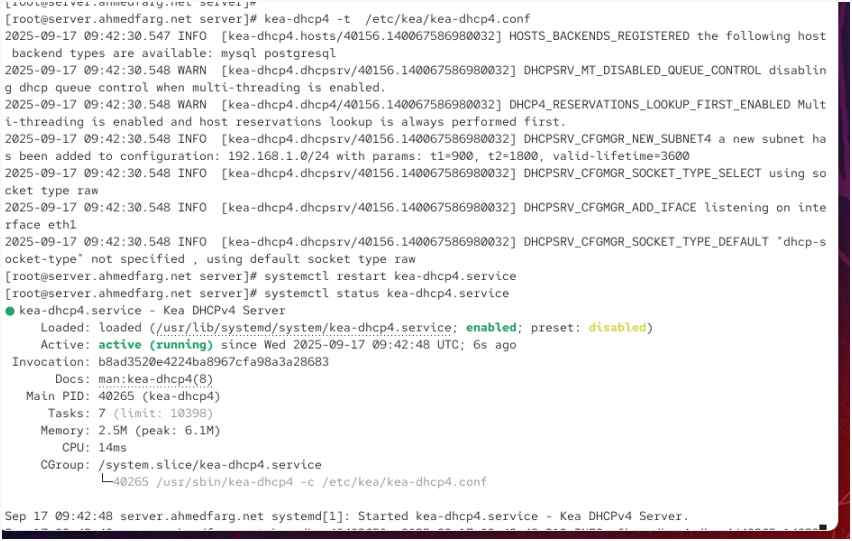

Рис. 17: Перезапуск kea-dhcp4

Проверка обновлений зоны

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

; <<>> DiG 9.18.33 <<>> @192.168.1.1 client.ahmedfarg.net
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 56335
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: ec93b58f54bbda140100000068ca82f95f2acfc9606a8347 (good)
;; QUESTION SECTION:
;client.ahmedfarg.net.          IN      A

;; ANSWER SECTION:
client.ahmedfarg.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 Sep 17 09:44:25 UTC 2025
;; MSG SIZE  rcvd: 93

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

```
#!/bin/bash
echo "Provisioning script $0"
echo "Install needed packages"
dnf -y install kea
echo "Copy configuration files"
cp -R /vagrant/provision/server/dhcp/etc/kea/* /etc/kea/
echo "Fix permissions"
chown -R kea:kea /etc/kea
chmod 640 /etc/kea/tsig-keys.json
restorecon -vR /etc
restorecon -vR /var/lib/kea
echo "Configure firewall"
firewall-cmd --add-service dhcp
firewall-cmd --add-service dhcp --permanent
echo "Start dhcpd service"
systemctl --system daemon-reload
systemctl enable --now kea-dhcp4.service
systemctl enable --now kea-dhcp-ddns.service
```

Рис. 19: Скрипт dhcp.sh

Выводы по проделанной работе

Вывод

В ходе работы был установлен и сконфигурирован DHCP-сервер на базе **Kea**, настроено динамическое обновление DNS-зон через Bind9, проверена корректность автоматической регистрации клиентов, а также подготовлены скрипты для автоматизации в Vagrant.