

# Лабораторная работа №3

Дисциплина: Администрирование сетевых подсистем

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# Раздел 1

## 1. Цель работы

## 1.1 Цель работы

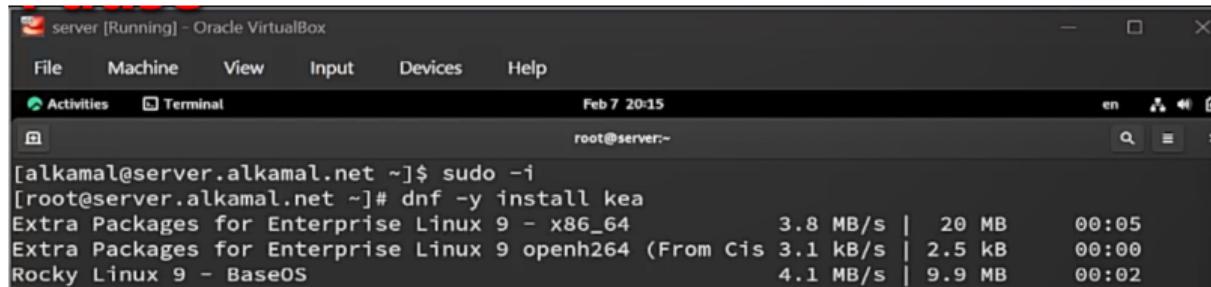
- Приобретение практических навыков установки и конфигурирования DHCP-сервера

## Раздел 2

### 2. Выполнение лабораторной работы

## 2.1 Установка DHCP-сервера

- Переход в режим суперпользователя
- Установка DHCP-сервера Kea через dnf



The screenshot shows a terminal window titled "server [Running] - Oracle VirtualBox". The window has a dark theme with white text. The terminal interface includes a header bar with "File", "Machine", "View", "Input", "Devices", and "Help" menus, and a status bar at the bottom showing "Feb 7 20:15" and "root@server:~". The main area of the terminal displays the following command and its execution:

```
[alkamal@server.alkamal.net ~]$ sudo -i
[root@server.alkamal.net ~]# dnf -y install kea
Extra Packages for Enterprise Linux 9 - x86_64           3.8 MB/s | 20 MB    00:05
Extra Packages for Enterprise Linux 9 openh264 (From Cis 3.1 kB/s | 2.5 kB    00:00
Rocky Linux 9 - BaseOS                  4.1 MB/s | 9.9 MB    00:02
```

Рисунок 1: Установка пакета kea через dnf

## 2.2 Конфигурирование DHCP-сервера

- Отредактирован /etc/kea/kea-dhcp4.conf
- Указан интерфейс eth1
- Настроен DNS 192.168.1.1
- Задан домен alkamal.net
- Определена подсеть 192.168.1.0/24
- Диапазон 192.168.1.30–192.168.1.199
- Указан шлюз 192.168.1.1

```
[root@server.alkamal.net ~]# cat /etc/kea/kea-dhcp4.conf
{
    "Dhcp4": {
        "interfaces-config": {
            "interfaces": ["eth1"]
        },
        "option-data": [
            {
                "name": "domain-name-servers",
                "data": "192.168.1.1"
            },
            {
                "code": 15,
                "data": "alkamal.net"
            },
            {
                "name": "domain-search",
                "data": "alkamal.net"
            }
        ]
    }
}
```



- Выполнена проверка `kea-dhcp4 -t`
- Ошибки отсутствуют
- Прослушивание на `eth1` активно

```
[root@server.alkamal.net ~]# kea-dhcp4 -t /etc/kea/kea-dhcp4.conf
2026-02-07 20:57:15.247 INFO  [kea-dhcp4.hosts/11135.139680581666944] HOSTS_BACKENDS_REGISTERED the following host backend types are available: mysql postgresql
2026-02-07 20:57:15.247 WARN  [kea-dhcp4.dhcpsrv/11135.139680581666944] DHCPSRV_MT_DISABLED_QUEUE_CONTROL disabling dhcp queue control when multi-threading is enabled.
2026-02-07 20:57:15.247 WARN  [kea-dhcp4.dhcp4/11135.139680581666944] DHCP4_RESERVATIONS_LOOKUP_FIRST_ENABLED Multi-threading is enabled and host reservations lookup is always performed first.
2026-02-07 20:57:15.247 INFO  [kea-dhcp4.dhcpsrv/11135.139680581666944] DHCPSRV_CFGMGR_NEW_SUBNET4 a new subnet has been added to configuration: 192.168.1.0/24 with params: valid-lifetime=7200
2026-02-07 20:57:15.247 INFO  [kea-dhcp4.dhcpsrv/11135.139680581666944] DHCPSRV_CFGMGR_SOCKET_TYPE_SELECT using socket type raw
2026-02-07 20:57:15.247 INFO  [kea-dhcp4.dhcpsrv/11135.139680581666944] DHCPSRV_CFGMGR_INTERFACE listening on interface eth1
2026-02-07 20:57:15.247 INFO  [kea-dhcp4.dhcpsrv/11135.139680581666944] DHCPSRV_CFGMGR_SOCKET_TYPE_DEFAULT "dhcp-socket-type" not specified , using default socket type raw
[root@server.alkamal.net ~]# systemctl --system daemon-reload
[root@server.alkamal.net ~]# systemctl enable kea-dhcp4.service
Created symlink /etc/systemd/system/multi-user.target.wants/kea-dhcp4.service → /usr/lib/systemd/system/kea-dhcp4.service.
```

Рисунок 3: Проверка конфигурации `kea-dhcp4 -t`

- В прямую зону добавлена A-запись dhcp.alkamal.net
- Обновлён серийный номер зоны

```

server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Activities Terminal Feb 7 21:02
root@server:~
GNU nano 5.6.1 /var/named/master/fz/alkamal.net

$TTL 1D
@ IN SOA @ server.alkamal.net. (
    2026020801 ; serial
    1D          ; refresh
    1H          ; retry
    1W          ; expire
    3H )        ; minimum

@ IN NS server.alkamal.net.
@ IN A 192.168.1.1

$ORIGIN alkamal.net.
server IN A 192.168.1.1
ns IN A 192.168.1.1
dhcp A 192.168.1.1

```

Рисунок 4: Файл прямой DNS зоны fz.alkamal.net

- В обратную зону добавлена PTR-запись
- Связь 192.168.1.1 → dhcp.alkamal.net
- Обновлён серийный номер

The screenshot shows a terminal window titled "server [Running] - Oracle VirtualBox" running under root privileges on a Linux system. The terminal displays a BIND zone configuration file for the "server.alkamal.net" domain. The file includes SOA, NS, A, and PTR records, along with a \$ORIGIN statement for the reverse IP zone "1.168.192.in-addr.arpa".

```

GNU nano 5.6.1                               /var/named/master/rz/192.168.1
$TTL 1D
@ IN SOA @ server.alkamal.net. (
    2026020801 ; serial
    1D         ; refresh
    1H         ; retry
    1W         ; expire
    3H )       ; minimum

@ IN NS  server.alkamal.net.
@ IN A   192.168.1.1

$ORIGIN 1.168.192.in-addr.arpa.
1 IN PTR server.alkamal.net.
1 IN PTR ns.alkamal.net.
1 PTR dhcp.alkamal.net.

```

- Перезапущена служба named
- Проверено разрешение dhcp.alkamal.net
- Потерь пакетов нет

```
[root@server.alkamal.net ~]# systemctl restart named
[root@server.alkamal.net ~]# ping dhcp.alkamal.net
PING dhcp.alkamal.net (192.168.1.1) 56(84) bytes of data.
64 bytes from ns.alkamal.net (192.168.1.1): icmp_seq=1 ttl=64 time=0.017 ms
64 bytes from ns.alkamal.net (192.168.1.1): icmp_seq=2 ttl=64 time=0.061 ms
64 bytes from ns.alkamal.net (192.168.1.1): icmp_seq=3 ttl=64 time=0.050 ms
64 bytes from dhcp.alkamal.net (192.168.1.1): icmp_seq=4 ttl=64 time=0.030 ms
64 bytes from server.alkamal.net (192.168.1.1): icmp_seq=5 ttl=64 time=0.046 ms
64 bytes from dhcp.alkamal.net (192.168.1.1): icmp_seq=6 ttl=64 time=0.041 ms
64 bytes from ns.alkamal.net (192.168.1.1): icmp_seq=7 ttl=64 time=0.044 ms
64 bytes from dhcp.alkamal.net (192.168.1.1): icmp_seq=8 ttl=64 time=0.037 ms
64 bytes from ns.alkamal.net (192.168.1.1): icmp_seq=9 ttl=64 time=0.072 ms
^C
--- dhcp.alkamal.net ping statistics ---
9 packets transmitted, 9 received, 0% packet loss, time 8191ms
rtt min/avg/max/mdev = 0.017/0.044/0.072/0.015 ms
```

Рисунок 6: Проверка разрешения имени dhcp.alkamal.net командой ping

- В firewalld добавлена служба dhcp
- Правило добавлено в текущую и постоянную конфигурацию
- Восстановлены SELinux-контексты

```
[root@server.alkamal.net ~]# chown -R named:named /var/named
[root@server.alkamal.net ~]# firewall-cmd --list-services
cockpit dhcpcv6-client dns ssh
[root@server.alkamal.net ~]# firewall-cmd --get-services
RH-Satellite-6 RH-Satellite-6-capsule afp amanda-client amanda-k5-client amqps apcup
sd audit ausweisapp2 bacula bacula-client bareos-director bareos-filedaemon bareos-storag
e bb bgp bitcoin bitcoin-rpc bitcoin-testnet bitcoin-testnet-rpc bittorrent-lsd ceph ceph
-exporter ceph-mon cfengine checkmk-agent cockpit collectd condor-collector cratedb ctdb
dds dds-multicast dds-unicast dhcp dhcpcv6 dhcpcv6-client distcc dns dns-over-tls docker-re
gistry docker-swarm dropbox-lansync elasticsearch etcd-client etcd-server finger foreman
foreman-proxy freeipa-4 freeipa-ldap freeipa-ldaps freeipa-replication freeipa-trust ftp
galera ganglia-client ganglia-master git gpgsql grafana gre high-availability http http3 ht
tps ident imap imaps ipfs ipp ipp-client ipsec irc ircs iscsi-target isns jenkins kadmin
kdeconnect kerberos kibana klogin kpasswd kprop kshell kube-api kube-apiserver kube-contr
ol-plane kube-control-plane-secure kube-controller-manager kube-controller-manager-secure
kube-node-services kube-scheduler kube-scheduler-secure kube-worker kubelet kubelet-
readonly kubelet-worker ldap ldaps libvirt libvirt-tls lightning-network llmnr llmnr-clie
nt llmnr-tcp llmnr-udp managesieve matrix mdns memcache minidlna mongodb mosh mountd mqtt
mqtt-tls ms-wbt mssql murmur mysql nbd nebula netbios-ns netdata-dashboard nfs nfs3 nmea
-nrpe nrpe ntp nut opentelemetry openvpn ovirt-imageio ovirt-storageconsole ovirt-vmconso
le plex pmcd pmproxy pmwebapi pmwebapis pop3 pop3s postgresql privoxy prometheus promethe
us-node-exporter proxy-dhcp ps2link ps3netsrv ptp pulseaudio puppetmaster quassel radius
rdp redis redis-sentinel roottd rpc-bind rquotad rsh rsyncd rtsp salt-master samba samba-c
lient samba-dc sane sip sips slp smtp smtp-submission smtpts snmp snmpelts snmptls-snmptrap snm
ptrap spideroak-lansync spotify-sync squid ssdp ssh steam-streaming svdrp svn syncthing s
yncthing-gui syncthing-relay synergy syslog syslog-tls telnet tentacle tftp tile38 tinc t
or-socks transmission-client upnp-client vdsm vnc-server warpinator wbem-http wbem-https
wireguard ws-discovery ws-discovery-client ws-discovery-tcp ws-discovery-udp wsmans
xdmcp xmpp-bosh xmpp-client xmpp-local xmpp-server zabbix-agent zabbix-server zerotier
[root@server.alkamal.net ~]# firewall-cmd --add-service=dhcp
success
[root@server.alkamal.net ~]# firewall-cmd --add-service=dhcp --permanent
```



- Выполнен мониторинг /var/log/messages
- Запущена служба kea-dhcp4.service
- Состояние – рабочее

```
[root@server.alkamal.net ~]# tail -f /var/log/messages
Feb  7 21:11:15 server named[11274]: zone 1.168.192.in-addr.arpa/IN: sending notifies (se
rial 2026020801)
Feb  7 21:11:15 server named[11274]: all zones loaded
Feb  7 21:11:15 server systemd[1]: Started Berkeley Internet Name Domain (DNS).
Feb  7 21:11:15 server named[11274]: running
Feb  7 21:11:16 server named[11274]: timed out resolving './DNSKEY/IN': 127.0.0.1#53
Feb  7 21:11:16 server named[11274]: timed out resolving './DNSKEY/IN': 127.0.0.1#53
Feb  7 21:11:25 server named[11274]: resolver priming query complete
Feb  7 21:11:25 server named[11274]: managed-keys-zone: Unable to fetch DNSKEY set '.': t
imed out
Feb  7 21:13:11 server systemd[1]: Starting PackageKit Daemon...
Feb  7 21:13:11 server systemd[1]: Started PackageKit Daemon.
Feb  7 21:18:16 server systemd[1]: packagekit.service: Deactivated successfully.
^C
[root@server.alkamal.net ~]# systemctl start kea-dhcp4.service
[root@server.alkamal.net ~]# █
```

Рисунок 8: Мониторинг журнала и запуск kea-dhcp4.service

## 2.3 Анализ работы DHCP-сервера

- Создан скрипт 01-routing.sh
- Настроен шлюз 192.168.1.1 для eth1
- Отключён eth0 как default-route

```
C: > work > alkamal > vagrant > provision > client > $ 01-routing.sh
1  #!/bin/bash
2  echo "Provisioning script $0"
3  nmcli connection modify "eth1" ipv4.gateway "192.168.1.1"
4  nmcli connection up "eth1"
5  nmcli connection modify eth0 ipv4.never-default true
6  nmcli connection modify eth0 ipv6.never-default true
7  nmcli connection down eth0
8  nmcli connection up eth0
9  # systemctl restart NetworkManager
```

Рисунок 9: Скрипт 01-routing.sh для настройки маршрутизации клиента

- Скрипт подключён в Vagrantfile
- Параметр run: "always"

```
C: > work > alkamal > vagrant > Vagrantfile
 99    ## Client configuration
100    config.vm.define "client", autostart: false do |client|
101      client.vm.box = "rocky9"
102      client.vm.hostname = 'client'
103      client.vm.boot_timeout = 1440
104      client.ssh.insert_key = false
105      client.ssh.username = 'vagrant'
106      client.ssh.password = 'vagrant'
107      client.vm.network :private_network,
108        type: "dhcp",
109        virtualbox_intnet: true
110      client.vm.provision "client dummy",
111        type: "shell",
112        preserve_order: true,
113        path: "provision/client/01-dummy.sh"
114      client.vm.provision "client routing",
115        type: "shell",
116        preserve_order: true.
```



- В /var/lib/kea/kea-leases4.csv зафиксирована аренда 192.168.1.30
- MAC клиента 08:00:27:ef:c7:e6
- Время аренды 7200 секунд
- Подсеть ID 1
- Имя клиента client

```
[root@server.alkamal.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:ef:c7:e6,01:08:00:27:ef:c7:e6,7200,1770507066,1,0,0,client,,,
192.168.1.30,08:00:27:ef:c7:e6,01:08:00:27:ef:c7:e6,7200,1770507098,1,0,0,client,,,
192.168.1.30,08:00:27:ef:c7:e6,01:08:00:27:ef:c7:e6,7200,1770507100,1,0,0,client,,,
[root@server.alkamal.net ~]#
```

Рисунок 11: Файл kea-leases4.csv с выданными арендами

- Выполнена команда `ifconfig` на клиенте
- `eth0` – `10.0.2.15/24` (NAT)
- `eth1` – `192.168.1.30/24` (DHCP)
- Подтверждён MAC-адрес

```
[root@client.alkamal.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 fe80::a00:27ff:fe7d:8de8 prefixlen 64 scopeid 0x20<link>
        inet6 fd17:625c:f037:2:a00:27ff:fe7d:8de8 prefixlen 64 scopeid 0x0<global>
          ether 08:00:27:7d:8d:e8 txqueuelen 1000 (Ethernet)
            RX packets 1431 bytes 164746 (160.8 KiB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 1181 bytes 192002 (187.5 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::a00:27ff:feef:c7e6 prefixlen 64 scopeid 0x20<link>
          ether 08:00:27:ef:c7:e6 txqueuelen 1000 (Ethernet)
            RX packets 197 bytes 18918 (18.4 KiB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 605 bytes 57415 (56.0 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 16 bytes 1995 (1.9 KiB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 16 bytes 1995 (1.9 KiB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

- Повторная проверка leases
- Аренда активна
- DHCP работает корректно

```
[root@server.alkamal.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:ef:c7:e6,01:08:00:27:ef:c7:e6,7200,1770507066,1,0,0,client,0,,0
192.168.1.30,08:00:27:ef:c7:e6,01:08:00:27:ef:c7:e6,7200,1770507098,1,0,0,client,0,,0
192.168.1.30,08:00:27:ef:c7:e6,01:08:00:27:ef:c7:e6,7200,1770507100,1,0,0,client,0,,0
[root@server.alkamal.net ~]
```

Рисунок 13: Повторная проверка списка выданных адресов

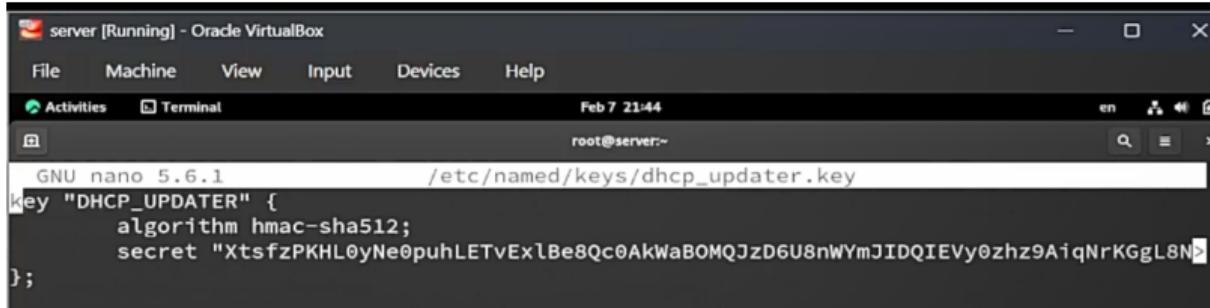
## 2.4 Настройка обновления DNS-зоны

- Создан каталог /etc/named/keys
- Сгенерирован TSIG-ключ DHCP\_UPDATER (HMAC-SHA512)
- Настроены права доступа

```
[root@server.alkamal.net ~]# mkdir -p /etc/named/keys
[root@server.alkamal.net ~]# tsig-keygen -a HMAC-SHA512 DHCP_UPDATER > /etc/named/keys/dhcp_updater.key
[root@server.alkamal.net ~]# nano /etc/named/keys/dhcp_updater.key
[root@server.alkamal.net ~]# chown -R named:named /etc/named/keys
[root@server.alkamal.net ~]#
```

Рисунок 14: Создание TSIG-ключа и настройка прав доступа

- В файле `dhcp_updater.key` указаны имя, алгоритм и секрет



```
GNU nano 5.6.1          /etc/named/keys/dhcp_updater.key
key "DHCP_UPDATER" {
    algorithm hmac-sha512;
    secret "XtsfzPKHL0yNe0puhLETvExlBe8Qc0AkWaBOMQJzD6U8nWYmJIDQIEVy0zhz9AiqNrKGgL8N";
};
```

Рисунок 15: Содержимое файла `dhcp_updater.key`

- В named.conf добавлена директива include для ключа

```
include "/etc/named.rfc1912.zones";
include "/etc/named.root.key";
include "/etc/named/alkamal.net";
include "/etc/named/keys/dhcp_updater.key";
File Name to Write: /etc/named.conf
^G Help          M-D DOS Format      M-A Append        M-B Backup File
^C Cancel        M-M Mac Format      M-P Prepend      ^T Browse
```

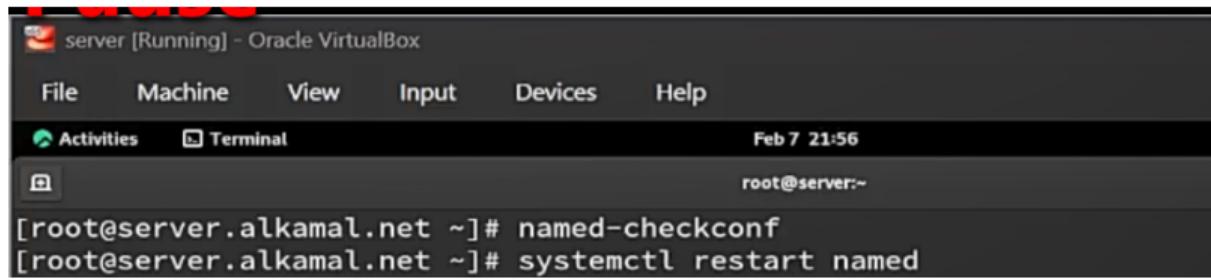
Рисунок 16: Подключение TSIG-ключа в named.conf

- В зонах добавлена update-policy
- Разрешено обновление A- и PTR-записей
- Используется механизм DHCID

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

Рисунок 17: Настройка update-policy для прямой и обратной зоны

- Проверка named-checkconf
- Перезапуск named
- Ошибки отсутствуют



The screenshot shows a terminal window titled "server [Running] - Oracle VirtualBox". The window has a dark theme with white text. At the top, there is a menu bar with "File", "Machine", "View", "Input", "Devices", and "Help". Below the menu is a toolbar with "Activities" and "Terminal" icons. The status bar at the bottom shows the date and time as "Feb 7 21:56" and the user as "root@server:~". The terminal itself contains the following command history:  
[root@server.alkamal.net ~]# named-checkconf  
[root@server.alkamal.net ~]# systemctl restart named

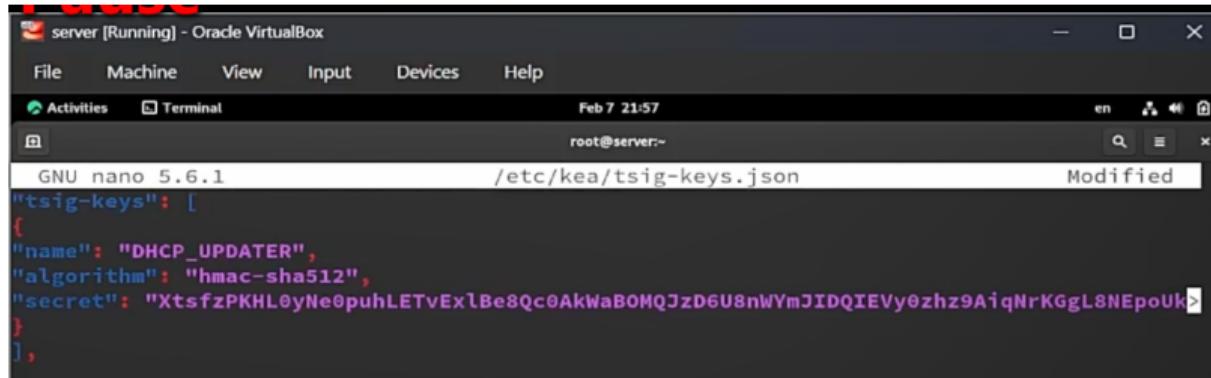
Рисунок 18: Проверка конфигурации и перезапуск named

- Создан /etc/kea/tsig-keys.json
- Перенесён секретный ключ
- Владелец kea:kea, права 640

```
[root@server.alkamal.net ~]# touch /etc/kea/tsig-keys.json
[root@server.alkamal.net ~]# nano /etc/kea/tsig-keys.json
[root@server.alkamal.net ~]# cat /etc/named/keys/dhcp_updater.key
key "DHCP_UPDATER" {
    algorithm hmac-sha512;
    secret "XtsfzPKHL0yNe0puhLETVExlBe8Qc0AkWaBOMQJzD6U8nWYmJIDQIEVy0zhz9AiqNrKGgL8NE
poUkH4nR3w4SQ==";
};
[root@server.alkamal.net ~]# nano /etc/kea/tsig-keys.json
[root@server.alkamal.net ~]# chown kea:kea /etc/kea/tsig-keys.json
[root@server.alkamal.net ~]# chmod 640 /etc/kea/tsig-keys.json
```

Рисунок 19: Создание и настройка файла tsig-keys.json для Kea

- В файле описан ключ DHCP\_UPDATER
- Алгоритм hmac-sha512



The screenshot shows a terminal window titled "server [Running] - Oracle VirtualBox". The window has a dark theme with white text. The terminal title bar includes "File", "Machine", "View", "Input", "Devices", and "Help". The status bar at the top right shows the date and time: "Feb 7 21:57" and the user: "root@server:~". The main terminal area displays the following JSON content:

```
GNU nano 5.6.1          /etc/kea/tsig-keys.json      Modified
"tsig-keys": [
(
  "name": "DHCP_UPDATER",
  "algorithm": "hmac-sha512",
  "secret": "XtsfzPKHL0yNe0puhLETvExlBe8Qc0AkWaBOMQJzD6U8nWYmJIDQIEVy0zhz9AiqNrKGgL8NEpoUk>"
)
],
```

Рисунок 20: Содержимое файла tsig-keys.json

- Настроен /etc/kea/kea-dhcp-ddns.conf
- Адрес 127.0.0.1, порт 53001
- Подключён tsig-keys.json
- Указаны зоны alkamal.net. и 1.168.192.in-addr.arpa.

```

server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Activities Terminal Feb 7 22:11
root@server:~/
GNU nano 5.6.1          /etc/kea/kea-dhcp-ddns.conf

{
  "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": "alkamal.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" }
            ]
          }
        ]
      ]
    }
  ]
}

```

- Проверка kea-dhcp-ddns -t
- Служба запущена
- Статус active (running)

```
[root@server.alkamal.net ~]# nano /etc/kea/kea-dhcp-ddns.conf
[root@server.alkamal.net ~]# chown kea:kea /etc/kea/kea-dhcp-ddns.conf
[root@server.alkamal.net ~]# kea-dhcp-ddns -t /etc/kea/kea-dhcp-ddns.conf
Syntax check failed with: /etc/kea/kea-dhcp-ddns.conf:11.5-18: syntax error, unexpected forward-ddns, expecting "," or }
[root@server.alkamal.net ~]# nano /etc/kea/kea-dhcp-ddns.conf
[root@server.alkamal.net ~]# kea-dhcp-ddns -t /etc/kea/kea-dhcp-ddns.conf
2026-02-07 22:13:48.682 INFO [kea-dhcp-ddns.dctl/11444.140134037352576] 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.alkamal.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.alkamal.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 Sat 2026-02-07 22:14:35 UTC; 9s ago
      Docs: man:kea-dhcp-ddns(8)
   Main PID: 11480 (kea-dhcp-ddns)
     Tasks: 5 (limit: 4493)
    Memory: 1.9M (peak: 2.1M)
       CPU: 6ms
      CGroup: /system.slice/kea-dhcp-ddns.service
              └─11480 /usr/sbin/kea-dhcp-ddns -c /etc/kea/kea-dhcp-ddns.conf

Feb 07 22:14:35 server.alkamal.net systemd[1]: Started Kea DHCP-DDNS Server.
Feb 07 22:14:35 server.alkamal.net kea-dhcp-ddns[11480]: 2026-02-07 22:14:35.839 INFO [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]
Feb 07 22:14:35 server.alkamal.net kea-dhcp-ddns[11480]: INFO COMMAND_ACCEPTOR_START
Feb 07 22:14:35 server.alkamal.net kea-dhcp-ddns[11480]: INFO DCTL_CONFIG_COMPLETE
Feb 07 22:14:35 server.alkamal.net kea-dhcp-ddns[11480]: INFO DHCP_DDNS_STARTED Kea DHCP-DDNS
lines 1-16/16 (END)
```

- В kea-dhcp4.conf включены:
- "enable-updates": true
- "ddns-qualifying-suffix": "alkamal.net"
- "ddns-override-client-update": true

The screenshot shows a terminal window titled "server [Running] - Oracle VirtualBox". The window has a dark theme with white text. At the top, there's a menu bar with "File", "Machine", "View", "Input", "Devices", and "Help". Below the menu is a toolbar with "Activities" and "Terminal". The status bar at the bottom shows the date and time as "Feb 7 22:19" and the user as "root@server:~". The main area of the terminal shows the configuration file "/etc/kea/kea-dhcp4.conf" being edited with "GNU nano 5.6.1". The file contains the following JSON configuration:

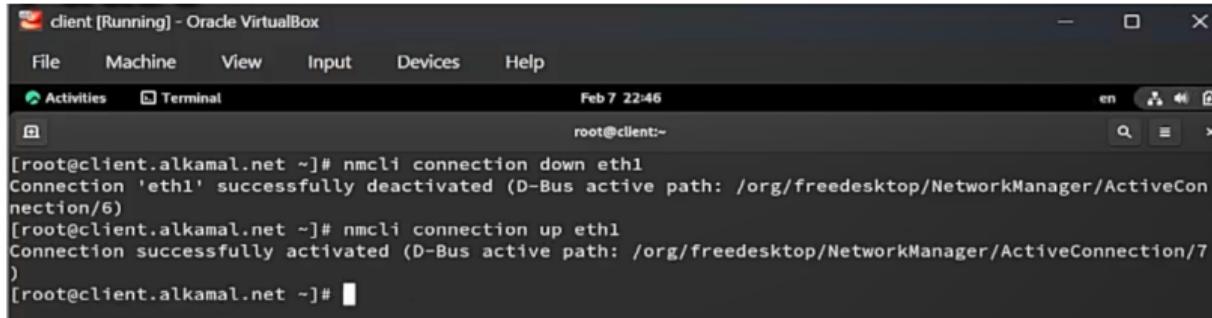
```
{
  "Dhcp4": {
    "interfaces-config": {
      "interfaces": ["eth1"]
    },
    "dhcp-ddns": {
      "enable-updates": true
    },
    "ddns-qualifying-suffix": "alkamal.net",
    "ddns-override-client-update": true,
  }
}
```

- Проверка kea-dhcp4 -t
- Перезапуск kea-dhcp4.service
- Статус active (running)

```
[root@server.alkamal.net ~]# kea-dhcp4 -t /etc/kea/kea-dhcp4.conf
2026-02-07 22:20:14.999 INFO  [kea-dhcp4.hosts/11497.139803674556544] HOSTS_BACKENDS_REGISTERED the following host backend types are available: mysql postgresql
2026-02-07 22:20:14.999 WARN   [kea-dhcp4.dhcpsrv/11497.139803674556544] DHCPSRV_MT_DISABLED_QUEUE_CONTROL disabling dhcp queue control when multi-threading is enabled.
2026-02-07 22:20:14.999 WARN   [kea-dhcp4.dhcp4/11497.139803674556544] DHCP4_RESERVATIONS_LOOKUP_FIRST_ENABLED Multi-threading is enabled and host reservations lookup is always performed first.
2026-02-07 22:20:14.999 INFO   [kea-dhcp4.dhcpsrv/11497.139803674556544] DHCPSRV_CFGMGR_NEW_SUBNET4 a new subnet has been added to configuration: 192.168.1.0/24 with params: valid-lifetime=7200
2026-02-07 22:20:14.999 INFO   [kea-dhcp4.dhcpsrv/11497.139803674556544] DHCPSRV_CFGMGR_SOCKET_TYPE_SELECT using socket type raw
2026-02-07 22:20:15.000 INFO   [kea-dhcp4.dhcpsrv/11497.139803674556544] DHCPSRV_CFGMGR_INTERFACE listening on interface eth1
2026-02-07 22:20:15.000 INFO   [kea-dhcp4.dhcpsrv/11497.139803674556544] DHCPSRV_CFGMGR_SOCKET_TYPE_DEFAULT "dhcp-socket-type" not specified , using default socket type raw
[root@server.alkamal.net ~]# systemctl restart kea-dhcp4.service
[root@server.alkamal.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 Sat 2026-02-07 22:21:47 UTC; 4s ago
      Docs: man:kea-dhcp4(8)
   Main PID: 11506 (kea-dhcp4)
     Tasks: 6 (limit: 4493)
    Memory: 2.6M (peak: 2.8M)
       CPU: 10ms
      CGroup: /system.slice/kea-dhcp4.service
              └─11506 /usr/sbin/kea-dhcp4 -c /etc/kea/kea-dhcp4.conf

Feb 07 22:21:47 server.alkamal.net kea-dhcp4[11506]: 2026-02-07 22:21:47.175 INFO  [kea->
Feb 07 22:21:47 server.alkamal.net kea-dhcp4[11506]: 2026-02-07 22:21:47.176 INFO  [kea->
Feb 07 22:21:47 server.alkamal.net kea-dhcp4[11506]: 2026-02-07 22:21:47.178 INFO  [kea->
```

- На клиенте выполнено переполучение IP (`nmcli down/up`)
- Инициировано динамическое обновление DNS



```
[root@client.alkamal.net ~]# nmcli connection down eth1
Connection 'eth1' successfully deactivated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/6)
[root@client.alkamal.net ~]# nmcli connection up eth1
Connection successfully activated (D-Bus active path: /org/freedesktop/NetworkManager/ActiveConnection/7)
[root@client.alkamal.net ~]#
```

Рисунок 25: Переполучение IP-адреса на клиенте

- В каталоге зоны появился файл alkamal.net.jnl
- Подтверждено динамическое обновление

```
[root@server.alkamal.net ~]# cd /var/named/master/fz
[root@server.alkamal.net fz]# ls
alkamal.net  alkamal.net.jnl
[root@server.alkamal.net fz]# █
```

Рисунок 26: Появление файла зоны alkamal.net.jnl

## 2.5 Анализ работы DHCP-сервера после настройки обновления DNS-зоны

- Выполнен dig @192.168.1.1 client.alkamal.net
- Статус NOERROR
- Флаг aa – сервер авторитетный
- Получена запись A 192.168.1.30
- TTL 2400 секунд

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

; <>> DiG 9.16.23-RH <>> @192.168.1.1 client.alkamal.net
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 27755
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: 25aec0aaaf4ae7fce010000006987c11dafe8d0958330c3b4 (good)
;; QUESTION SECTION:
;client.alkamal.net.      IN      A

;; ANSWER SECTION:
client.alkamal.net. 2400    IN      A      192.168.1.30
```



## 2.6 Внесение изменений в настройки внутреннего окружения виртуальной машины

- Создан каталог /vagrant/provision/server/dhcp/etc/kea
- Скопированы конфигурации DHCP и DNS

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

Рисунок 28: Копирование конфигураций DHCP и DNS в каталог provisioning

- Создан скрипт dhcp.sh
- Установка kea
- Копирование конфигураций
- Настройка прав доступа
- Восстановление SELinux
- Настройка firewalld
- Запуск kea-dhcp4 и kea-dhcp-ddns

```

server [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Activities Terminal Feb 7 22:53
root@server:/vagrant/provision/server
GNU nano 5.6.1          dhcp.sh

#!/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

```

- В Vagrantfile добавлен provision-блок
- Путь provision/server/dhcp.sh
- Сохранён порядок выполнения

```
C: > work > alkamal > vagrant > Vagrantfile
  38   server.vm.provision "server dhcp",
  39     type: "shell",
  40     preserve_order: true,
  41     path: "provision/server/dhcp.sh"
```

Рисунок 30: Подключение dhcp.sh в Vagrantfile

## Раздел 3

### 3. Выводы

### 3.1 Выводы

- Установлен и настроен DHCP-сервер Kea
- Реализована выдача адресов в сети 192.168.1.0/24
- Настроено динамическое обновление DNS через TSIG
- Подтверждено создание записи client.alkamal.net
- Проверена корректность работы DHCP и DDNS
- Зафиксированы аренды в kea-leases4.csv
- Реализована автоматизация через dhcp.sh и Vagrantfile