

# Администрирование сетевых подсистем

## Настройка DHCP-сервера (Лабораторная работа №3)

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## Цели и задачи работы

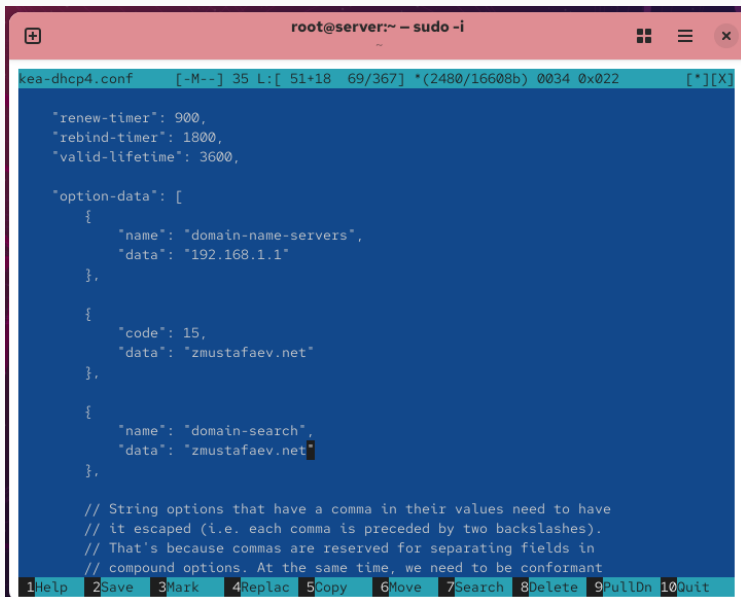
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Получить практические навыки установки и настройки DHCP-сервера, а также интеграции его с DNS для динамического обновления зон.

## Выполнение лабораторной работы

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# Конфигурирование DHCP-сервера



```
root@server:~ - sudo -i
kea-dhcp4.conf  [-M--] 35 L:[ 51+18 69/367] *(2480/16608b) 0034 0x022  [*][X]

    "renew-timer": 900,
    "rebind-timer": 1800,
    "valid-lifetime": 3600,

    "option-data": [
      {
        "name": "domain-name-servers",
        "data": "192.168.1.1"
      },
      {
        "code": 15,
        "data": "zmustafaev.net"
      },
      {
        "name": "domain-search",
        "data": "zmustafaev.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
    // compound options. At the same time, we need to be conformant
```

1Help 2Save 3Mark 4Replac 5Copy 6Move 7Search 8Delete 9PullDn 10Quit

## Настройка подсети

```
root@server:~ - sudo -i
kea-dhcp4.conf [----] 4 L:[ 94+18 112/165] *(3319/5374b) 0093 0x05D [*][X]
],
  "subnet4": [
    {
      "id": 1,

      "subnet": "192.168.1.0/24",

      "pools": [ { "pool": "192.168.1.30 - 192.168.1.199" } ],

      "option-data": [
        {
          "name": "routers",
          "data": "192.168.1.1"
        }
      ],
    }
  ],

  // There are many, many more parameters that DHCPv4 server is able to use.
  // They were not added here to not overwhelm people with too much
  // information at once.

  // Logging configuration starts here. Kea uses different loggers to log various
1Help 2Save 3Mark 4Replac 5Copy 6Move 7Search 8Delete 9PullDn 10Quit
```

```
zmustafaev.net  [----] 48 L:[ 1+ 2 3/ 14] *(57 / 242b) 0048 0x030  [*][X]
$TTL 1D
@<----->IN SOA<@ server.zmustafaev.net. (
<-----><-----><-----><-----><----->2025091400<----->; serial
<-----><-----><-----><-----><----->1D<----->; refresh
<-----><-----><-----><-----><----->1H<----->; retry
<-----><-----><-----><-----><----->1W<----->; expire
<-----><-----><-----><-----><----->3H )<----->; minimum
<----->NS<----->@
<----->A<----->192.168.1.1
$ORIGIN zmustafaev.net.
server<@>A<----->192.168.1.1
ns<----->A<----->192.168.1.1
dhcp<-->A<----->192.168.1.1
```

Рис. 3: Редактирование прямой зоны DNS

```
192.168.1      [----] 0 L:[ 1+14 15/ 15] *(302 / 302b) <EOF>      [*][X]
$TTL 1D
@<----->IN SOA<-->@ server.zmustafaev.net. (
<-----><-----><-----><-----><----->2025091400<----->; serial
<-----><-----><-----><-----><----->1D<----->; refresh
<-----><-----><-----><-----><----->1H<----->; retry
<-----><-----><-----><-----><----->1W<----->; expire
<-----><-----><-----><-----><----->3H )<-->; minimum
<----->NS<----->@
<----->A<----->192.168.1.1
<----->PTR<--->server.zmustafaev.net.
$ORIGIN 1.168.192.in-addr.arpa.
1<----->PTR<--->server.zmustafaev.net.
1<----->PTR<--->ns.zmustafaev.net.
1<----->PTR<--->dhcp.zmustafaev.net.
```

Рис. 4: Редактирование обратной зоны DNS



```
[root@server.zmustafaev.net ~]# systemctl restart named
[root@server.zmustafaev.net ~]# ping dhcp.zmustafaev.net
PING dhcp.zmustafaev.net (192.168.1.1) 56(84) bytes of data:
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=1 ttl=64 time=0.015 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=2 ttl=64 time=0.038 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=3 ttl=64 time=0.086 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=4 ttl=64 time=0.060 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=5 ttl=64 time=0.090 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=6 ttl=64 time=0.072 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=7 ttl=64 time=0.022 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=8 ttl=64 time=0.086 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=9 ttl=64 time=0.076 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=10 ttl=64 time=0.125 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=11 ttl=64 time=0.040 ms
64 bytes from dhcp.zmustafaev.net (192.168.1.1): icmp_seq=12 ttl=64 time=0.021 ms
```

Рис. 5: Проверка доступности DHCP-сервера

## Анализ работы DHCP-сервера

---

```
zmustafaev@client:~  
  
RX packets 1935  bytes 233563 (228.0 KiB)  
RX errors 0  dropped 0  overruns 0  frame 0  
TX packets 1666  bytes 269428 (263.1 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::4ab1:706f:7bd4:646  prefixlen 64  scopeid 0x20<link>  
    ether 08:00:27:3b:a1:76  txqueuelen 1000  (Ethernet)  
    RX packets 84  bytes 9675 (9.4 KiB)  
    RX errors 0  dropped 0  overruns 0  frame 0  
    TX packets 322  bytes 29355 (28.6 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  
  
[zmustafaev@client.zmustafaev.net ~]$
```

```
[root@server.zmustafaev.net ~]#  
[root@server.zmustafaev.net ~]# cat /var/lib/kea/kea-leases4.csv  
address,hwaddr,client_id,valid_lifetime,expire,subnet_id,fqdn_fwd,fqdn_rev,hostname,sta  
te,user_context,pool_id  
192.168.1.30,08:00:27:3b:a1:76,01:08:00:27:3b:a1:76,3600,1757845586,1,0,0,client,0,,0  
192.168.1.30,08:00:27:3b:a1:76,01:08:00:27:3b:a1:76,3600,1757845586,1,0,0,client,0,,0  
192.168.1.30,08:00:27:3b:a1:76,01:08:00:27:3b:a1:76,3600,1757845591,1,0,0,client,0,,0  
[root@server.zmustafaev.net ~]#
```

Рис. 7: Файл с арендой DHCP-адресов

## Настройка обновления DNS-зоны

---

```
zmustafaev.net  [----] 0 L:[ 11+22 33/ 33] *(824 / 824b) <EOF>  [*][X]
//
// Note: empty-zones-enable yes; option is default.
// If private ranges should be forwarded, add.
// disable-empty-zone "."; into options
//.

zone "zmustafaev.net" IN {
<----->type master;
<----->file "master/fz/zmustafaev.net";
<----->update-policy {
<----->    grant DHCP_UPDATER wildcard *.zmustafaev.net A DHCPID;
<----->};
};

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 DHCPID;
<----->};
};

1Help 2Save 3Mark 4Replac 5Copy 6Move 7Search 8Delete 9PullDn 10Quit
```

Рис. 8: Настройка зон с поддержкой обновления

```
tsig-keys.json  [----]  2 L:[ 1+ 6 7/ 8] *(186 / 187b) 0010 0x00A  [*][X]  
{  
  "name": "DHCP_UPDATER",  
  "algorithm": "hmac-sha512",  
  "secret": "pdHpaU9bTVKwnXkE/Fd8mSDXPtZo0WvoKgJl04u2qedTPRApL0r/pIS9MFK408zqfVfJ  
},
```

Рис. 9: Файл tsig-keys.json

# Конфигурация kea-dhcp-ddns

```
<?include "/etc/kea/tsig-keys.json"?>
"forward-ddns" : {
  "ddns-domains" : [
<----->{
<----->  "name": "zmustafaev.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" }
<----->  ]
<----->}
  ]
},

"loggers": [
{
  "name": "kea-dhcp-ddns",
  "output-options": [
    {
      "output": "stdout",
      "pattern": "%-5p %m\n"
```



## Проверка работы Kea DDNS

```
[root@server.zmustafaev.net ~]#  
[root@server.zmustafaev.net ~]# chown kea:kea /etc/kea/kea-dhcp-ddns.conf  
[root@server.zmustafaev.net ~]# kea-dhcp-ddns -t /etc/kea/kea-dhcp-ddns.conf  
2025-09-14 09:51:33.145 INFO [kea-dhcp-ddns.dctl/19540.140337589502272] 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.zmustafaev.net ~]# systemctl enable --npw kea-dhcp-ddns.service  
systemctl: unrecognized option '--npw'  
[root@server.zmustafaev.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.zmustafaev.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 09:52:12 UTC; 9s ago  
 Invocation: e1b14862df844ccbbcca71305062ed8f  
    Docs: man:kea-dhcp-ddns(8)  
 Main PID: 19779 (kea-dhcp-ddns)  
   Tasks: 5 (limit: 10381)  
  Memory: 1.7M (peak: 6M)  
    CPU: 9ms  
   CGroup: /system.slice/kea-dhcp-ddns.service  
           └─19779 /usr/sbin/kea-dhcp-ddns -c /etc/kea/kea-dhcp-ddns.conf  
  
Sep 14 09:52:12 server.zmustafaev.net systemd[1]: Started kea-dhcp-ddns.service - Kea >  
Sep 14 09:52:12 server.zmustafaev.net kea-dhcp-ddns[19779]: 2025-09-14 09:52:12.273 IN>  
Sep 14 09:52:12 server.zmustafaev.net kea-dhcp-ddns[19779]: INFO  COMMAND_ACCEPTOR_STA>  
Sep 14 09:52:12 server.zmustafaev.net kea-dhcp-ddns[19779]: INFO  DCTL_CONFIG_COMPLETE>  
Sep 14 09:52:12 server.zmustafaev.net kea-dhcp-ddns[19779]: INFO  DHCP_DDNS_STARTED Ke>  
lines 1-17/17 (END)
```

```
kea-dhcp4.conf  [----] 40 L:[ 20+28 48/172] *(1999/5529b) 0010 0x00A  [*][X]
//
// This configuration file contains only DHCPv4 server's configuration.
// If configurations for other Kea services are also included in this file they
// are ignored by the DHCPv4 server.
{
// DHCPv4 configuration starts here. This section will be read by DHCPv4 server
// and will be ignored by other components.
"Dhcp4": {
    "interfaces-config": {
        "interfaces": [ "eth1" ]
    },

    "control-socket": {
        "socket-type": "unix",
        "socket-name": "kea4-ctrl-socket"
    },

    "lease-database": {
        "type": "memfile",
        "lfc-interval": 3600
    },

    ....
    "dhcp-ddns": {
<----->"enable-updates": true
    },
    ....
    "ddns-qualifying-suffix": "zmustafaev.net",
    "ddns-override-client-update": true,

    "expired-leases-processing": {
        "reclaim-timer-wait-time": 10,
        ....
    }
}
```

## Перезапуск DHCP-сервера

```
[root@server.zmustafaev.net ~]# systemctl restart kea-dhcp4.service
[root@server.zmustafaev.net ~]# systemctl status kea-dhcp4.service
● kea-dhcp4.service - Kea DHCPv4 Server
   Loaded: loaded (/usr/lib/systemd/system/kea-dhcp4.service; enabled; preset: disab>
   Active: active (running) since Sun 2025-09-14 09:56:15 UTC; 7s ago
 Invocation: e2066163d84145e28692718c85e16249
    Docs: man:kea-dhcp4(8)
 Main PID: 20411 (kea-dhcp4)
   Tasks: 7 (limit: 10381)
  Memory: 2.5M (peak: 6.1M)
     CPU: 14ms
    CGroup: /system.slice/kea-dhcp4.service
           └─20411 /usr/sbin/kea-dhcp4 -c /etc/kea/kea-dhcp4.conf

Sep 14 09:56:15 server.zmustafaev.net systemd[1]: Started kea-dhcp4.service - Kea DHCP>
Sep 14 09:56:15 server.zmustafaev.net kea-dhcp4[20411]: 2025-09-14 09:56:15.196 INFO >
Sep 14 09:56:15 server.zmustafaev.net kea-dhcp4[20411]: 2025-09-14 09:56:15.197 INFO >
lines 1-15/15 (END)
```

Рис. 13: Запуск DHCP-сервера после изменений

## Проверка DNS-записи клиента

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

; <<>> DiG 9.18.33 <<>> @192.168.1.1 client.zmustafaev.net
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 64433
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 1232
; COOKIE: 9e528836b7dffa4d00100000068c6919f46c6484c6c485b5c (good)
;; QUESTION SECTION:
;client.zmustafaev.net.          IN      A

;; ANSWER SECTION:
client.zmustafaev.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 09:57:51 UTC 2025
;; MSG SIZE rcvd: 94

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

Рис. 14: Проверка DNS-записи клиента

## Выводы по проделанной работе

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В ходе работы была развернута инфраструктура с двумя виртуальными машинами — **server** и **client**.

На сервере установлены и настроены службы **DNS** и **DHCP**, реализована поддержка **DDNS**.

Клиенты автоматически получают IP-адреса и регистрируются в DNS-зоне.

Конфигурации вынесены в окружение Vagrant для автоматизации запуска.