

Администрирование сетевых подсистем

Настройка DHCP-сервера (Лабораторная работа №3)

Заур Мустафаев

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Российский университет дружбы народов, Москва, Россия

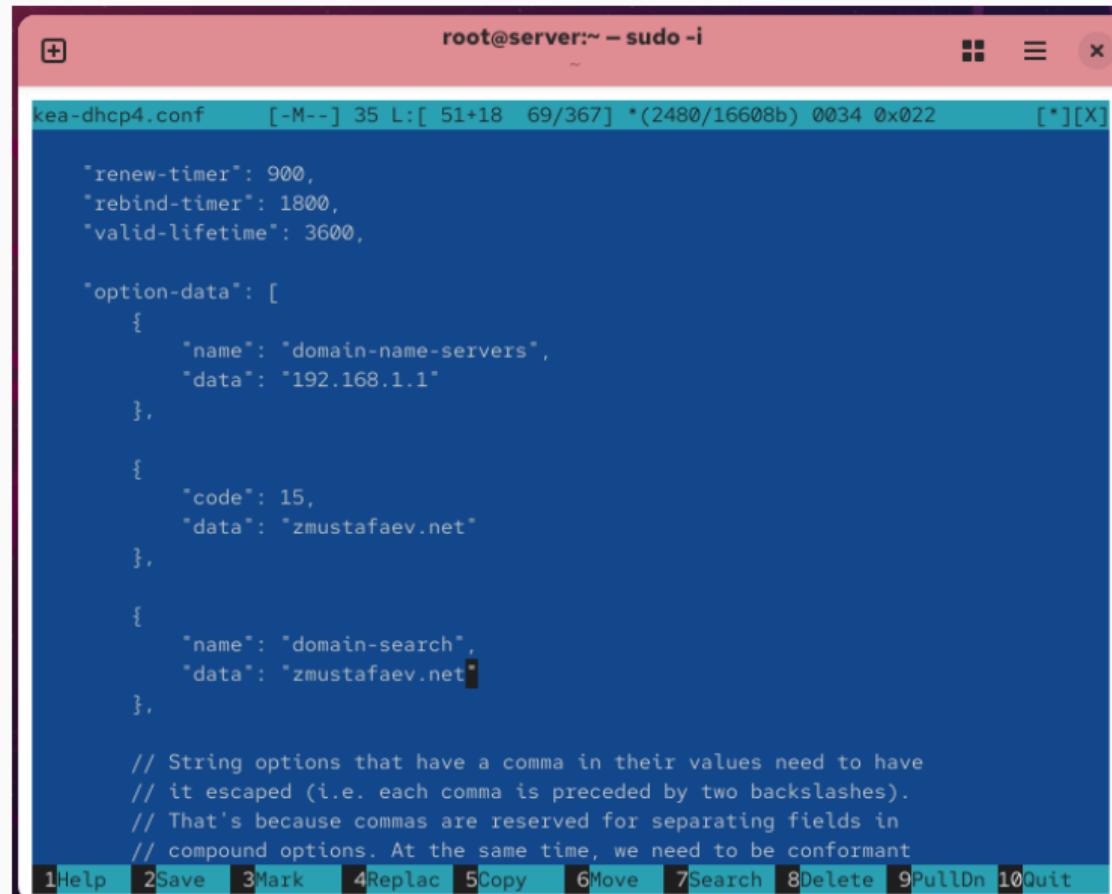
Цели и задачи работы

Цель лабораторной работы

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

Выполнение лабораторной работы

Конфигурирование DHCP-сервера



The screenshot shows a terminal window titled "root@server:~ - sudo -i" displaying the contents of the "kea-dhcp4.conf" configuration file. The file contains JSON-like configuration for a DHCPv4 server, including renew and rebinding timers, valid lifetime, and option data for domain name servers and search domains.

```
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
    ]
```

At the bottom of the terminal window, there is a footer with numbered buttons for navigation: 1Help, 2Save, 3Mark, 4Replace, 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
```

Прямая зона DNS

```
zmustafaev.net      [---] 48 L:[ 1+ 2   3/ 14] *(57 / 242b) 0048 0x030      [*][X]
$TTL 10
@<---->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

Обратная зона 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

Проверка работы DHCP

```
[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

Интерфейсы клиента

```
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 ~]$
```

База аренд DHCP

```
[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  
192.168.1.30,08:00:27:3b:a1:76,01:08:00:27:3b:a1:76,3600,1757845586,1,0,0,client,,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  
[root@server.zmustafaev.net ~]#
```

Рис. 7: Файл с арендой DHCP-адресов

Настройка обновления DNS-зоны

Внесение изменений в Bind

```
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 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;
<----->};
};

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

Рис. 8: Настройка зон с поддержкой обновления

TSIG-ключи Kea

```
tsig-keys.json      [---] 2 L:[ 1+ 6 7/ 8] *(186 / 187b) 0010 0x00A      [*][X]
"tsig-keys" : [
    {
<----->"name": "DHCP_UPDATER",
<----->"algorithm": "hmac-sha512",
<----->"secret": "pdHpaU9bTVKwnXkE/Fd8mSDXPtZo0WvoKgJ1Q4u2qedTPRApL0r/pI59MFK4Q8zqfVfJ
    }
],
```

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

```
Linux@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_CHANGE_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 --now kea-dhcp-ddns.service
systemctl: unrecognized option '--now'
[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_STARTED>
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 Kea>
lines 1-17/17 (END)
```

DHCP и DDNS вместе

```
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: disabled)
    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 DHCPv4 Server.
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: 9e528836b7dff4d00100000068c6919f46c6484c6c485b5c (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

Вывод

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.