DHCPv6 and DNS Test Bed Configuration in Next Generation IPv6 Networks

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ABSTRACT

This report presents a detailed account of configuring Dynamic Host Configuration Protocol version 6 (DHCPv6) and Domain Name System (DNS) servers, fundamental elements in deploying Internet Protocol version 6 (IPv6). Developed as part of a workshop conducted at the National Institute of Technology Karnataka (NITK), Surathkal, the document offers step-by-step instructions for implementing DHCPv6 for address allocation and DNS for domain name resolution. By following these guidelines, participants can gain practical insights into IPv6 network setup and management, contributing to their proficiency in modern networking technologies.

INTRODUCTION

The adoption of Internet Protocol version 6 (IPv6) is becoming increasingly essential as the depletion of available IPv4 addresses continues. As organizations transition to IPv6, understanding its deployment and configuration becomes paramount. This report serves as a comprehensive guide to setting up DHCPv6 and DNS servers, crucial components in an IPv6 network, within the context of a workshop held at the National Institute of Technology Karnataka (NITK), Surathkal.

1 TOPOLOGY OF IPv6 NETWORK

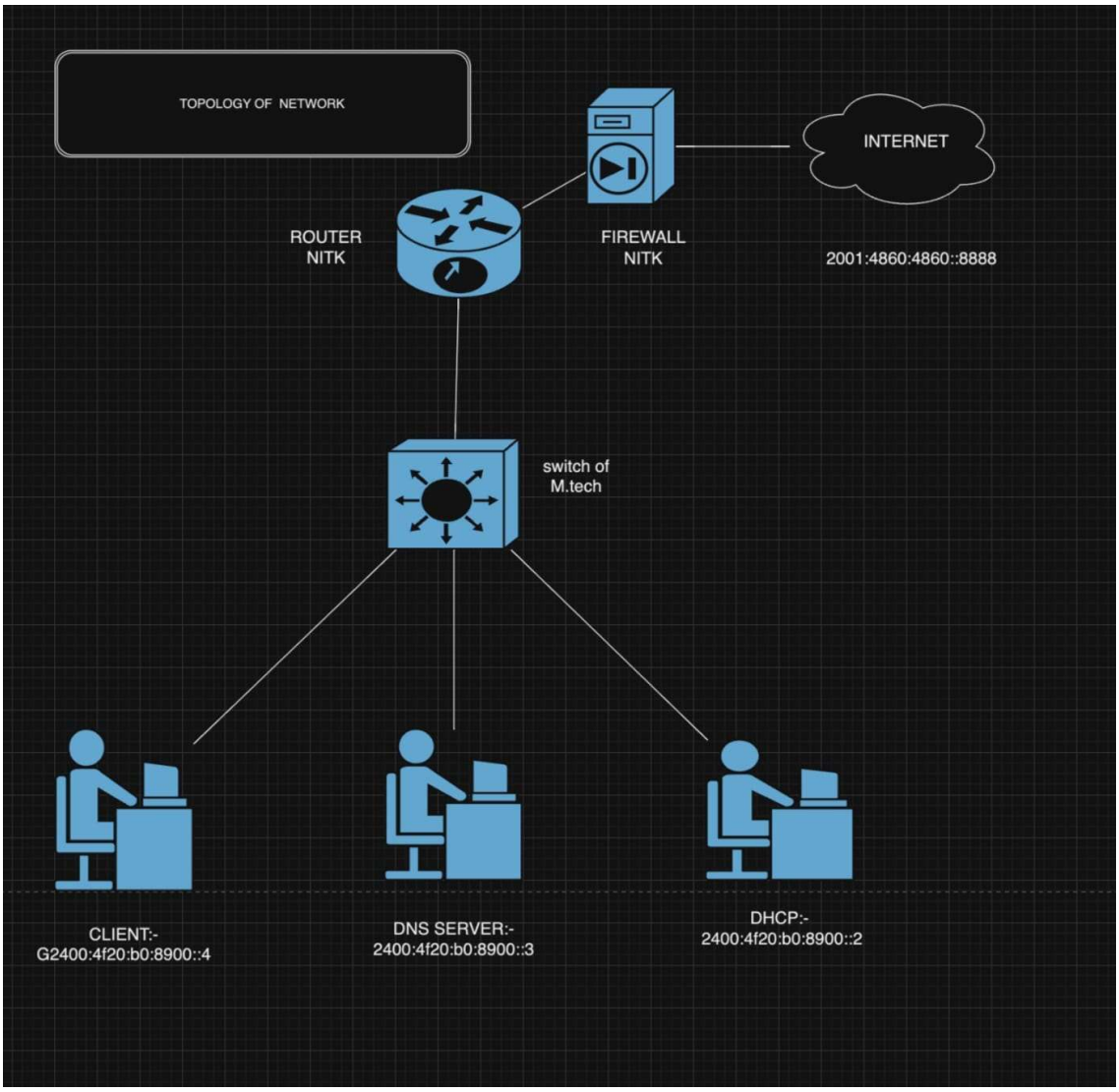


Fig: Topology of network of DNS server, DHCPv6 server and Client

2 DHCPv6 Installation and Configuration

DHCPv6 works by assigning unique IPv6 addresses to devices on a network. When a new gadget joins the network, it simply asks the DHCPv6 server for an address. The server gives it a unique address and important settings, a default gateway, and a map to find its way online. This address is leased for a while, and the device can ask to renew it or let it go when it's done. In simple terms, DHCPv6 makes it easy for devices to connect to the internet by handling the details of getting a special address and the necessary settings.

2.1 KEA DHCP Installation

Installation Steps

- Elevate Permissions:
  ```
  $ sudo su -
  ```
- Install Package:
  ```
  # apt install kea
  ```

2.2 Configuration of KEA DHCP for IPv6

2.2.1 Steps for configuring KEA DHCPv6

1: Navigate to Kea Configuration Directory

```
# cd /etc/kea/
```

2: Create a Configuration Backup

Before making changes, create a backup of the existing kea-dhcp6.conf file.

```
# cp kea-dhcp6.conf kea-dhcp6.conf.bak
```

3: Edit the KEA DHCPv6 Configuration

Open the kea-dhcp6.conf file for editing using your preferred text editor (e.g., nano).

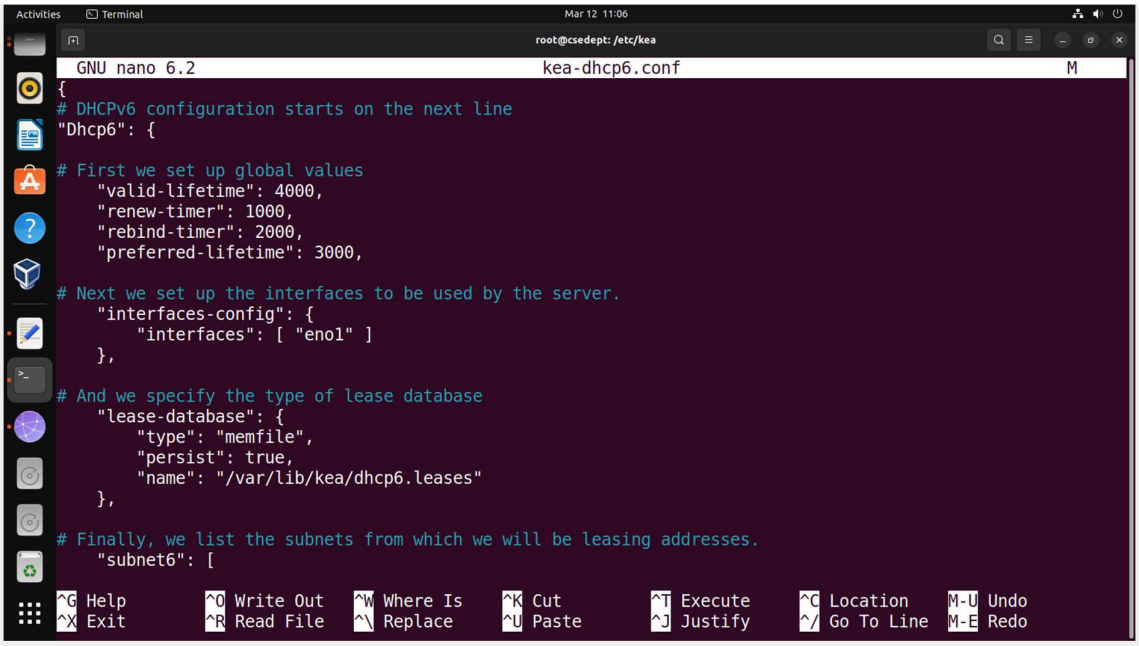
```
# nano kea-dhcp6.conf
```

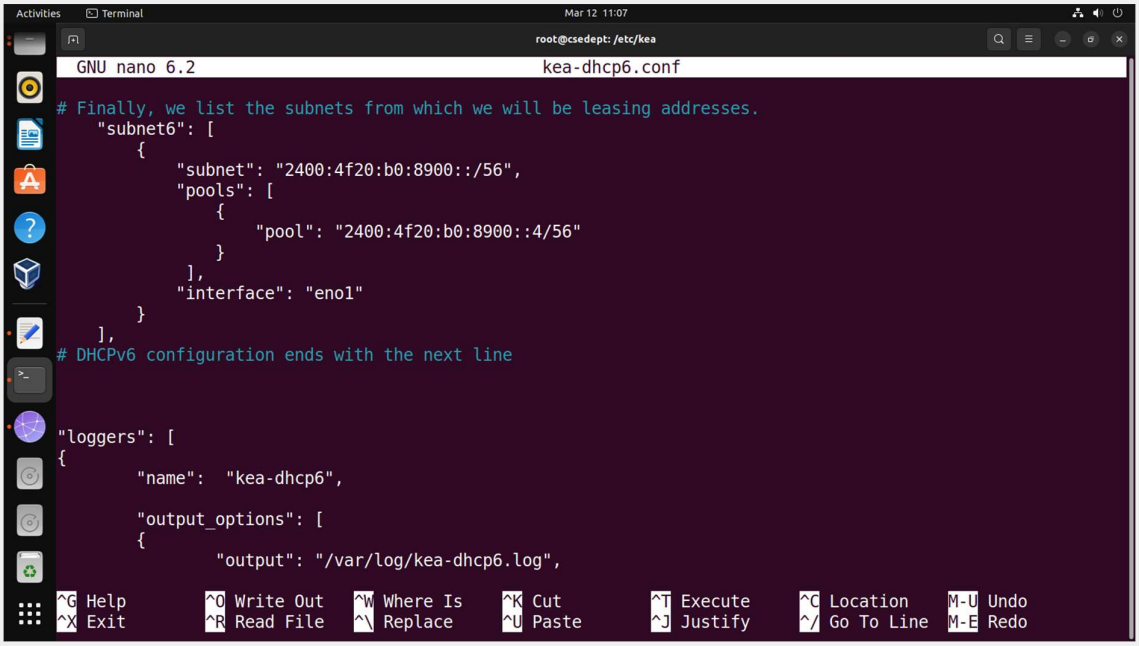
4: Configure KEA DHCPv6

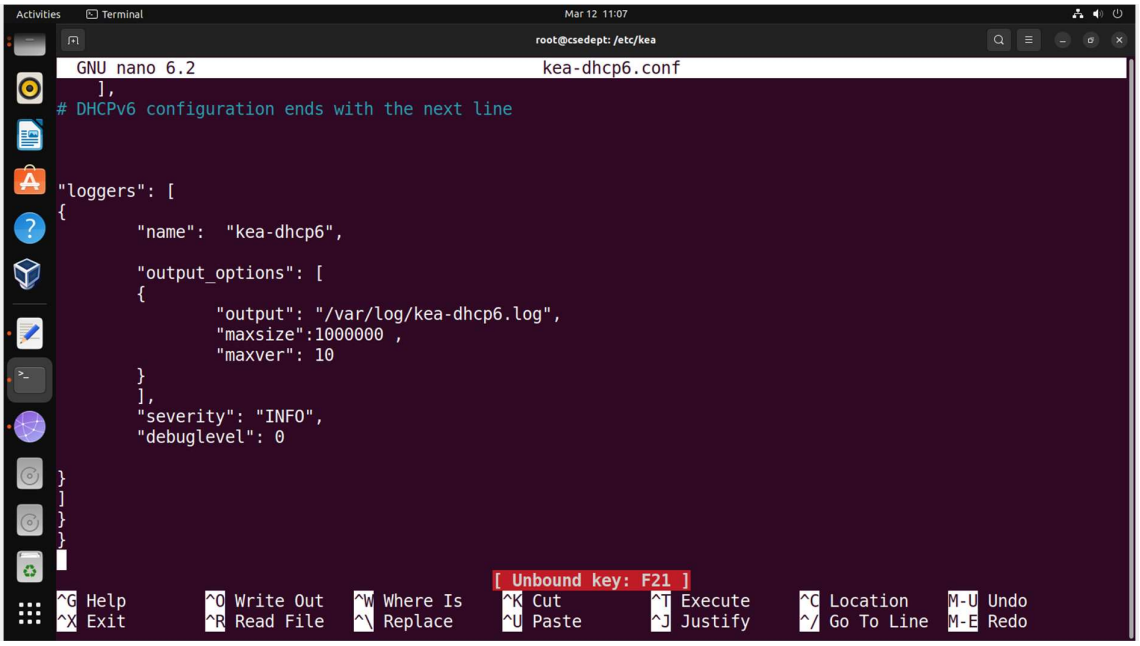
Add the following configuration to the file:

```
{
 "Dhcp6": {
   "Valid-lifetime": 4000,
   "renew-timer": 1000,
   "rebind-timer": 2000,
   "preferred-lifetime": 3000,
   "interfaces-config": {
    "interfaces": [
      “eno1/2400:4f20:b0:8900::2/56”
```

```
    ]
  },
  "lease-database": {
    "type": "memfile",
    "persist": true,
    "name": "/var/lib/kea/dhcp6.leases"
  },
  "subnet6": [
    {
      "subnet": "2400:4f20:b0:8900::/56",
      "pools": [
        {
          "pool": "2400:4f20:b0:8900::10/56-2400:4f20:b0:8900::1000”
        }
      ]
    }
  ],
  "loggers": [
    {
      "name": "kea-dhcp6",
      "output_options": [
        {
          "output": “/var/log/kea-dhcp6.log",
          "maxsize":100000,
          "maxver": 10
        }
      ],
      "severity": "INFO",
      "debuglevel": 0
    }
  ]
 }
}
```


Activities
Terminal
Mar 12 11:06
root@csedept: /etc/kea
GNU nano 6.2
kea-dhcp6.conf
M
{
# DHCPv6 configuration starts on the next line
"Dhcp6": {
# First we set up global values
"valid-lifetime": 4000,
"renew-timer": 1000,
"rebind-timer": 2000,
"preferred-lifetime": 3000,
# Next we set up the interfaces to be used by the server.
"interfaces-config": {
"interfaces": ["eno1"]
},
# And we specify the type of lease database
"lease-database": {
"type": "memfile",
"persist": true,
"name": "/var/lib/kea/dhcp6.leases"
},
Finally, we list the subnets from which we will be leasing addresses.
"subnet6": [
^G Help ^O Write Out ^W Where Is ^K Cut ^T Execute ^C Location M-U Undo
^X Exit ^R Read File ^\ Replace ^U Paste ^J Justify ^/ Go To Line M-E Redo


Activities
Terminal
Mar 12 11:07
root@csedept: /etc/kea
GNU nano 6.2
kea-dhcp6.conf
Finally, we list the subnets from which we will be leasing addresses.
"subnet6": [
{
"subnet": "2400:4f20:b0:8900::/56",
"pools": [
{
"pool": "2400:4f20:b0:8900::4/56"
}
],
"interface": "eno1"
}
],
DHCPv6 configuration ends with the next line
"loggers": [
{
"name": "kea-dhcp6",
"output_options": [
{
"output": "/var/log/kea-dhcp6.log",
^G Help ^O Write Out ^W Where Is ^K Cut ^T Execute ^C Location M-U Undo
^X Exit ^R Read File ^\ Replace ^U Paste ^J Justify ^/ Go To Line M-E Redo



6: Start KEA DHCPv6

Run the following command to start KEA DHCPv6 using the configured file:

```
# kea-dhcp6 -c /etc/kea/kea-dhcp6.conf
```

7: Enable KEA DHCPv6 Service

If you want KEA DHCPv6 to start automatically on system boot, enable the service:

```
$ sudo systemctl enable kea-dhcp6
```

2.3 KEA Control and KEA Control Agent Configuration

The 'keactrl' utility is a shell script designed to facilitate the control, initiation, and reconfiguration processes for various KEA servers, including *kea-dhcp6* and *kea-ctrl-agent*. It also offers functionalities for checking the current operational status of these servers and identifying the configuration files in use.

2.3.1 Configuration Steps for keactrl.conf and kea-ctrl-agent.conf

keactrl.conf Configuration:

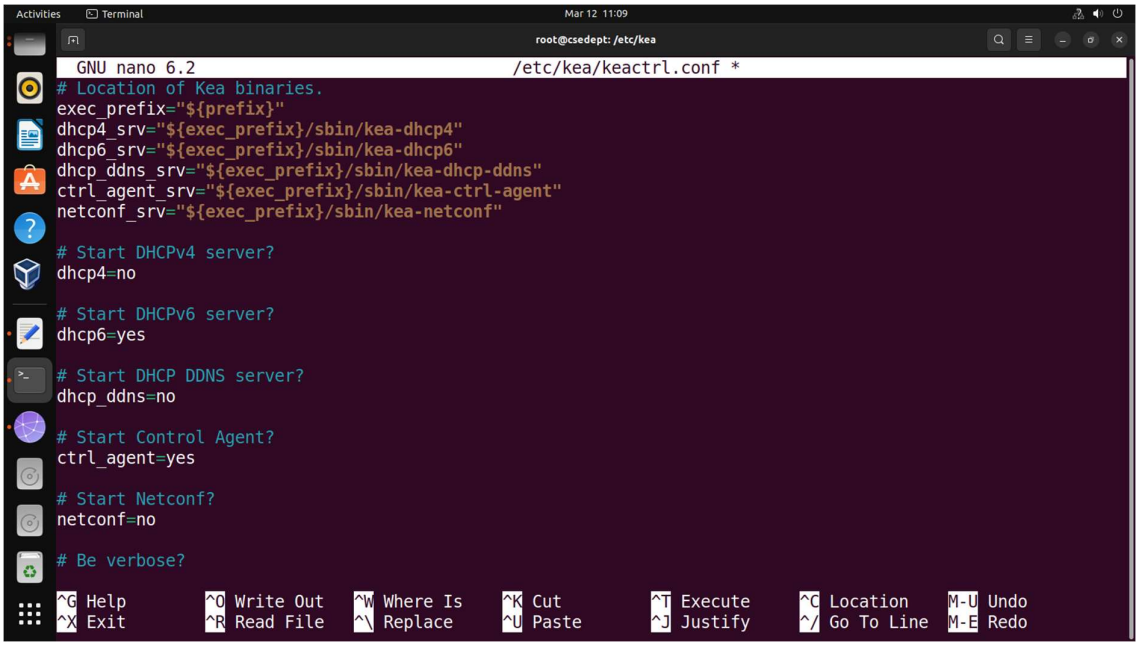
1. Access the keactrl.conf file for editing:

```
sudo nano /etc/kea/keactrl.conf
```

2. Apply the following configurations:

```
dhcp4=no # Disable DHCPv4 server
```

```
dhcp6=yes # Enable DHCPv6 server
dhcp_ddns=no # Disable DHCP DDNS server
ctrl_agent=yes # Enable Control Agent
```



kea-ctrl-agent.conf Configuration:

1. Open the kea-ctrl-agent.conf file for editing:

```
nano /etc/kea/kea-ctrl-agent.conf
```

2. Find the part with HTTP settings and update accordingly:

```
"Control-agent": {
"http-host": "192.168.2.100", # Set the HTTP host IP
"http-port": 8080 # Set the HTTP port
```

2.3.2 Initiate KEA Servers and Control Agent

1. Explicitly start DHCPv6 server:

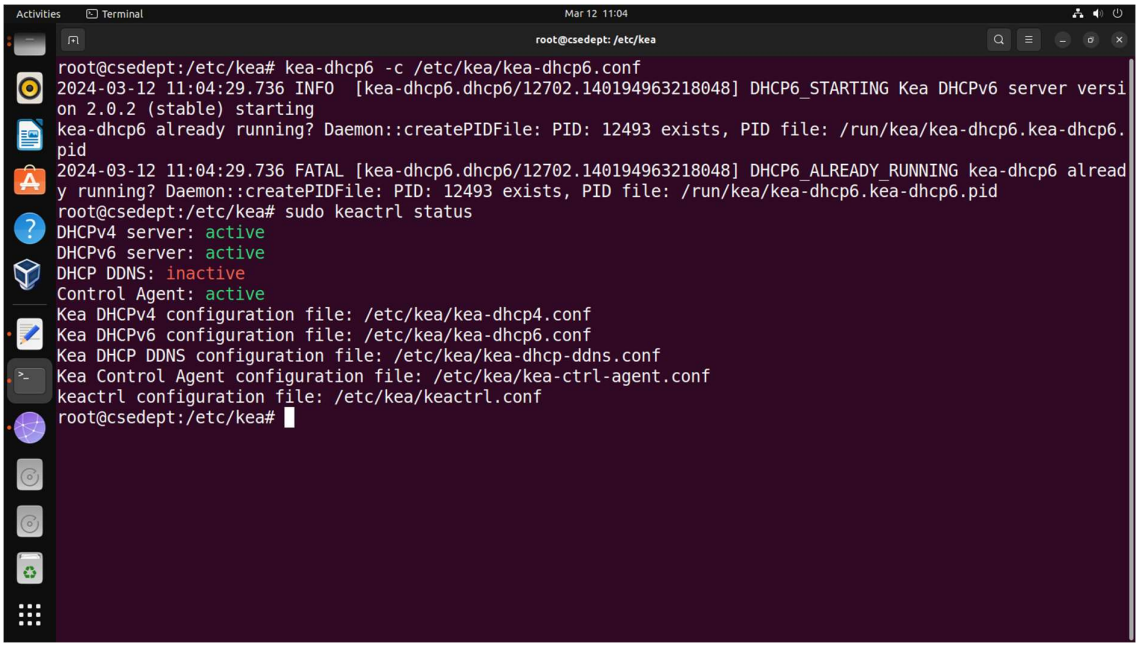
```
keactrl start -c /etc/kea/keactrl.conf -s dhcp6
```

2. Commence all servers, including DHCPv6, using default parameters:

```
keactrl start
```

3. Verify the status of KEA servers:

```
keactrl status
```



3 DNS SERVER

A DNS (Domain Name System) server is like the internet's phonebook. Instead of remembering complex numerical IP addresses for websites, your device asks the DNS server to translate easy-to-recall domain names (like www.google.com) into the actual numerical addresses that computers use to find each other on the internet. It acts like a guide for your device on the internet. When you want to visit a website, it helps by providing the right address and turning easy-to-remember names into the actual locations your device needs to reach online.

3.1 DNS Server Configuration

This section outlines the steps taken to configure a DNS server on the testbed. The configuration guide was used to set up a BIND9 recursive server with only an IPv6 interface. Note that the configuration detailed in this section does not create an authoritative nameserver to serve AAAA records.

3.2 General Information

- Installation:

```
$ sudo apt update
$ sudo apt install bind9
```

- Check BIND Version:

```
$ named -v
```

Output:

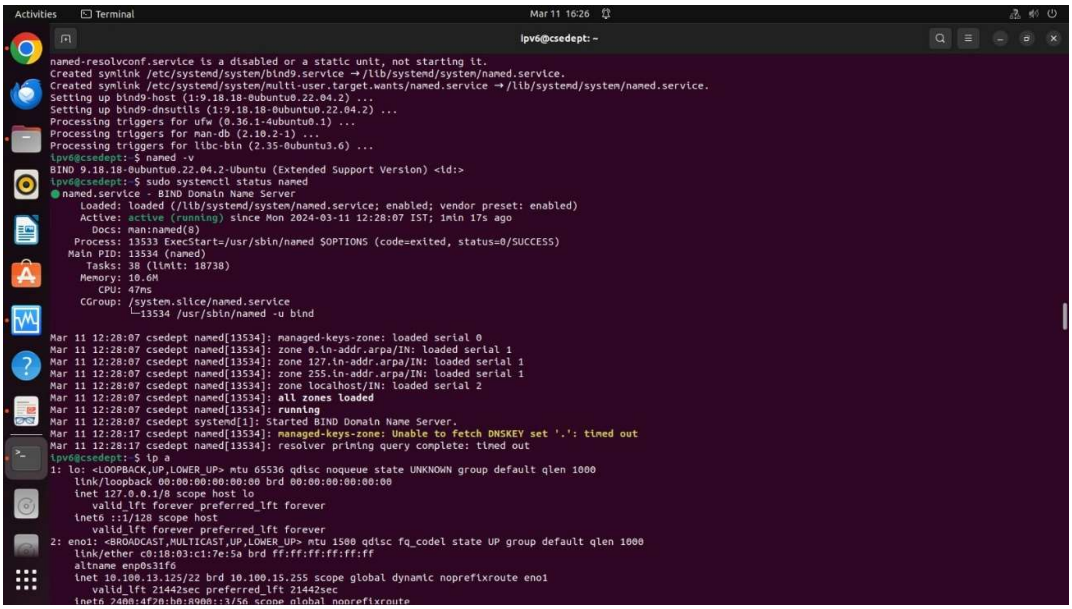
BIND 9.18.18-0ubuntu0.22.04.2-Ubuntu (Extended Support Version) <id:>

Note that the exact output may vary depending on the version installed.

3.3 Initial Setup

- Check that the BIND9 server is up and running:

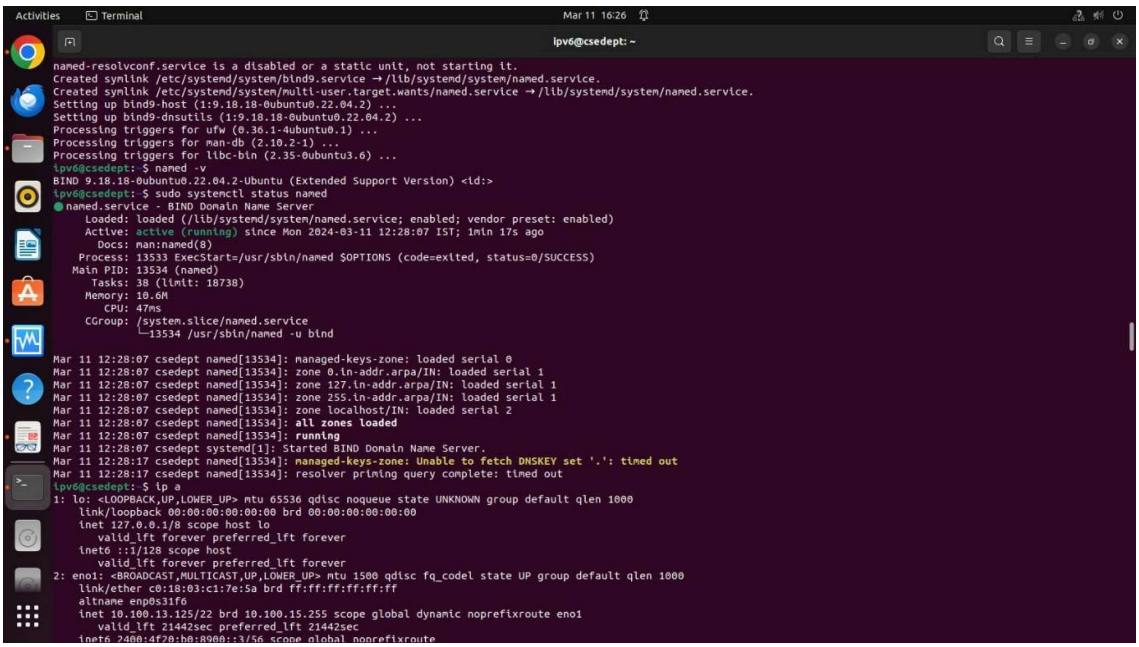
```
$ sudo systemctl status named
```



- Check network interface configuration and IPv6 addresses:

```
$ ip a
```

The interface and IP address information obtained as output will be used to configure the DNS server.



3.4 Server Configuration

The DNS server configured on the testbed is a recursive resolver. When it does not find an answer in its local database, it queries other DNS servers to resolve the query.

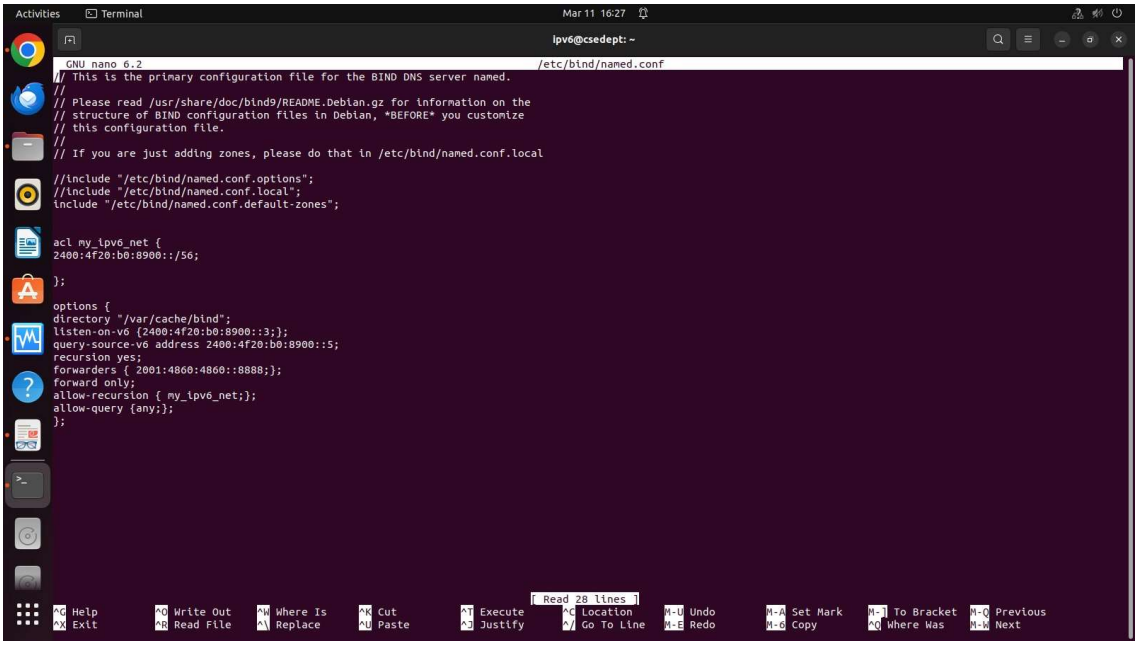
The main configuration file is '**/etc/bind/named.conf**', which contains the following lines:

```
// This is the primary configuration file for the BIND DNS server named.
// Please read /usr/share/doc/bind9/README.Debian.gz for information on the
// structure of BIND configuration files in Debian, *BEFORE* you customize
// this configuration file.
// If you are just adding zones, please do that in /etc/bind/named.conf.local

// include "/etc/bind/named.conf.options";
//include "/etc/bind/named.conf.local";
include "/etc/bind/named.conf.default-zones";

acl my_ipv6_net {
   2401:4f20:b0:8900::56;
};


options {
   directory "/var/cache/bind";
   listen-on-v6 {2400:4f29:b0:8900::3};
   query-source-v6 address 2400:4f20:b0:8900::5;
   recursion yes;
   forwarders { 2001:4860:4860::8888; };
   forward only;
   allow-recursion {my_ipv6_net;};
   allow-query {any;};
};
```

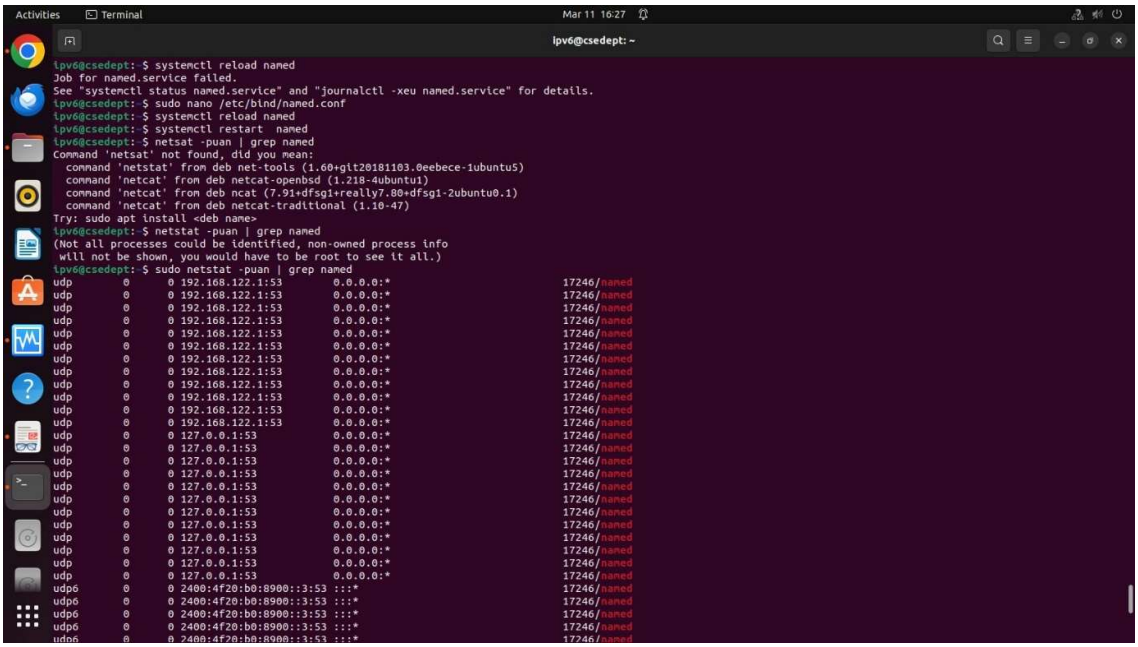


Note: The IPv6 addresses in the */etc/bind/named.conf* file are specific to the testbed at NITK, and are to be changed as per the configurations available to the reader.

- Apply changes:
  ```
  # systemctl reload named
  ```

```
# systemctl restart named
```

- Validate that BIND9 is listening on IPv6:
```
# netstat -puan | grep named
```

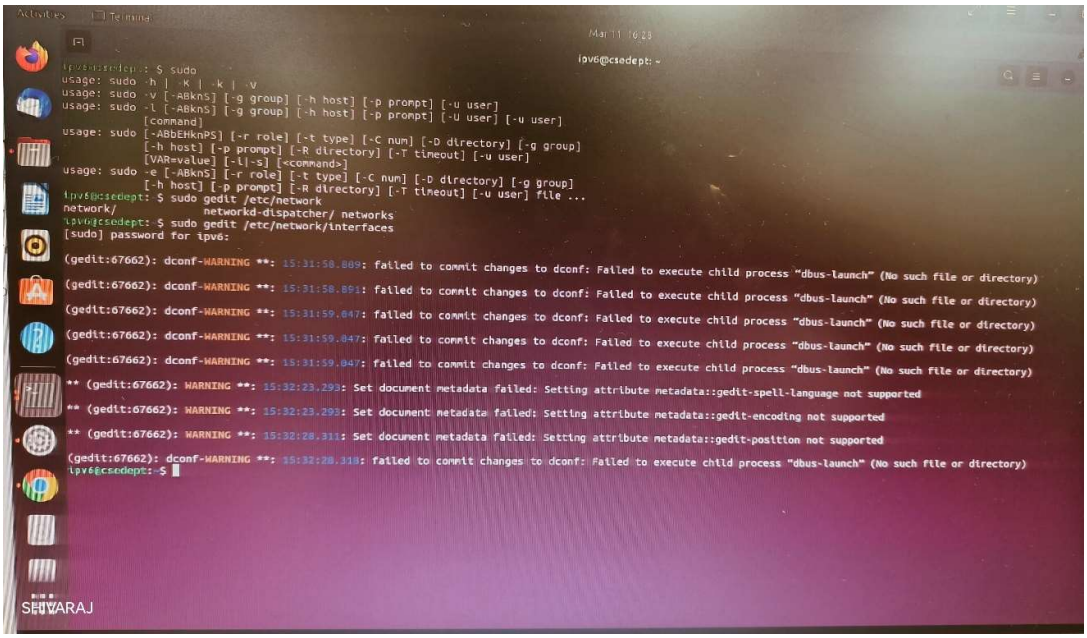


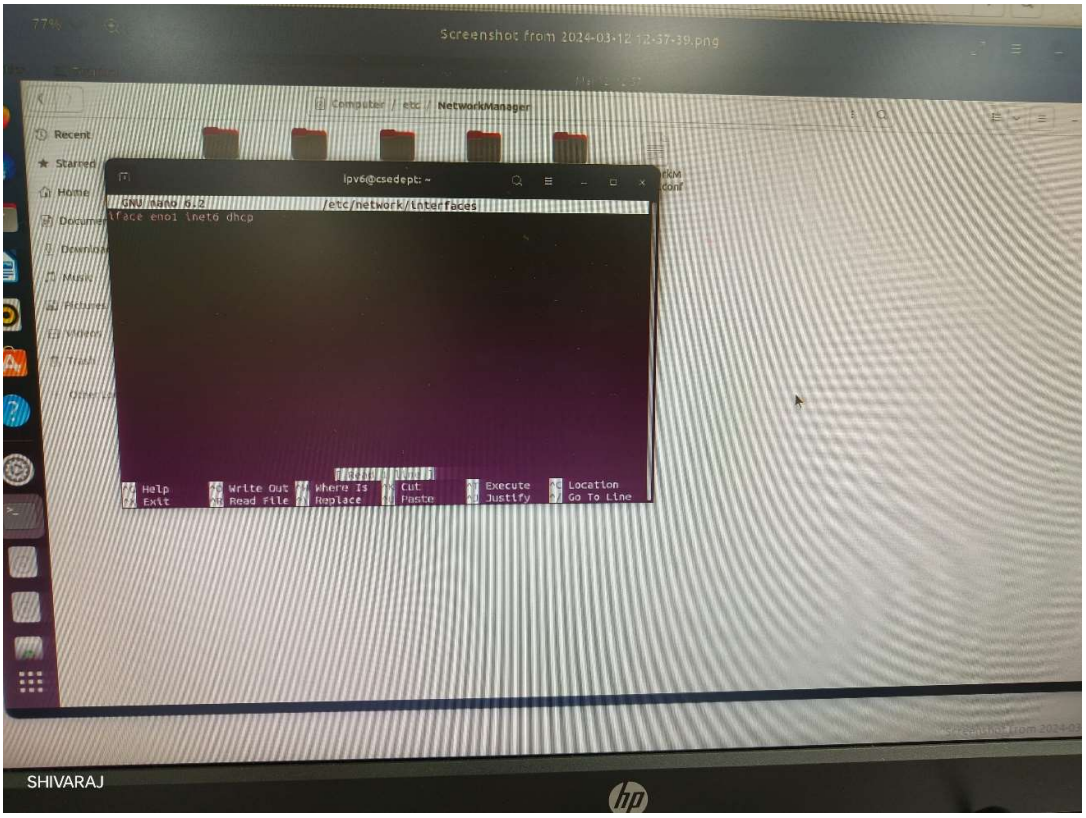
4 On Client Side:

Edit the network interface configuration file on the client to use DHCPv6:

```
$sudo nano /etc/network/interface
```

This completes the configuration of KEA DHCPv6 on your system. Ensure the client's network interface configuration is set to obtain IPv6 addresses via DHCPv6.


Activities
Terminal
Mar 11 16:23
ipv6@csedept: ~
usage: sudo -h | -K | -k | -V
usage: sudo -v [-ABknS] [-g group] [-h host] [-p prompt] [-u user]
usage: sudo -l [-ABknS] [-g group] [-h host] [-p prompt] [-U user] [-u user]
[command]
usage: sudo [-ABbEHknPS] [-r role] [-t type] [-C num] [-D directory] [-g group]
[-h host] [-p prompt] [-R directory] [-T timeout] [-u user]
[VAR=value] [-i|-s] [<command>]
usage: sudo -e [-ABknS] [-r role] [-t type] [-C num] [-D directory] [-g group]
[-h host] [-p prompt] [-R directory] [-T timeout] [-u user] file ...
ipv6@csedept: $ sudo gedit /etc/network
network/ networkd-dispatcher/ networks
ipv6@csedept: $ sudo gedit /etc/network/interfaces
[sudo] password for ipv6:
(gedit:67662): dconf-WARNING **: 15:31:58.889: failed to commit changes to dconf: Failed to execute child process "dbus-launch" (No such file or directory)
(gedit:67662): dconf-WARNING **: 15:31:58.891: failed to commit changes to dconf: Failed to execute child process "dbus-launch" (No such file or directory)
(gedit:67662): dconf-WARNING **: 15:31:59.047: failed to commit changes to dconf: Failed to execute child process "dbus-launch" (No such file or directory)
(gedit:67662): dconf-WARNING **: 15:31:59.047: failed to commit changes to dconf: Failed to execute child process "dbus-launch" (No such file or directory)
(gedit:67662): dconf-WARNING **: 15:31:59.047: failed to commit changes to dconf: Failed to execute child process "dbus-launch" (No such file or directory)
** (gedit:67662): WARNING **: 15:32:23.293: Set document metadata failed: Setting attribute metadata::gedit-spell-language not supported
** (gedit:67662): WARNING **: 15:32:23.293: Set document metadata failed: Setting attribute metadata::gedit-encoding not supported
** (gedit:67662): WARNING **: 15:32:28.311: Set document metadata failed: Setting attribute metadata::gedit-position not supported
(gedit:67662): dconf-WARNING **: 15:32:28.318: failed to commit changes to dconf: Failed to execute child process "dbus-launch" (No such file or directory)
ipv6@csedept:~$
SHIVARAJ


Screenshot from 2024-03-12 12-37-39.png
Computer / etc / NetworkManager
Recent
Starred
Home
ipv6@csedept: ~
GNU nano 6.2
/etc/network/interfaces
iface eno1 inet6 dhcp
Help
Exit
Write Out
Read File
Where Is
Replace
Cut
Paste
Execute
Justify
Location
Go To Line
SHIVARAJ

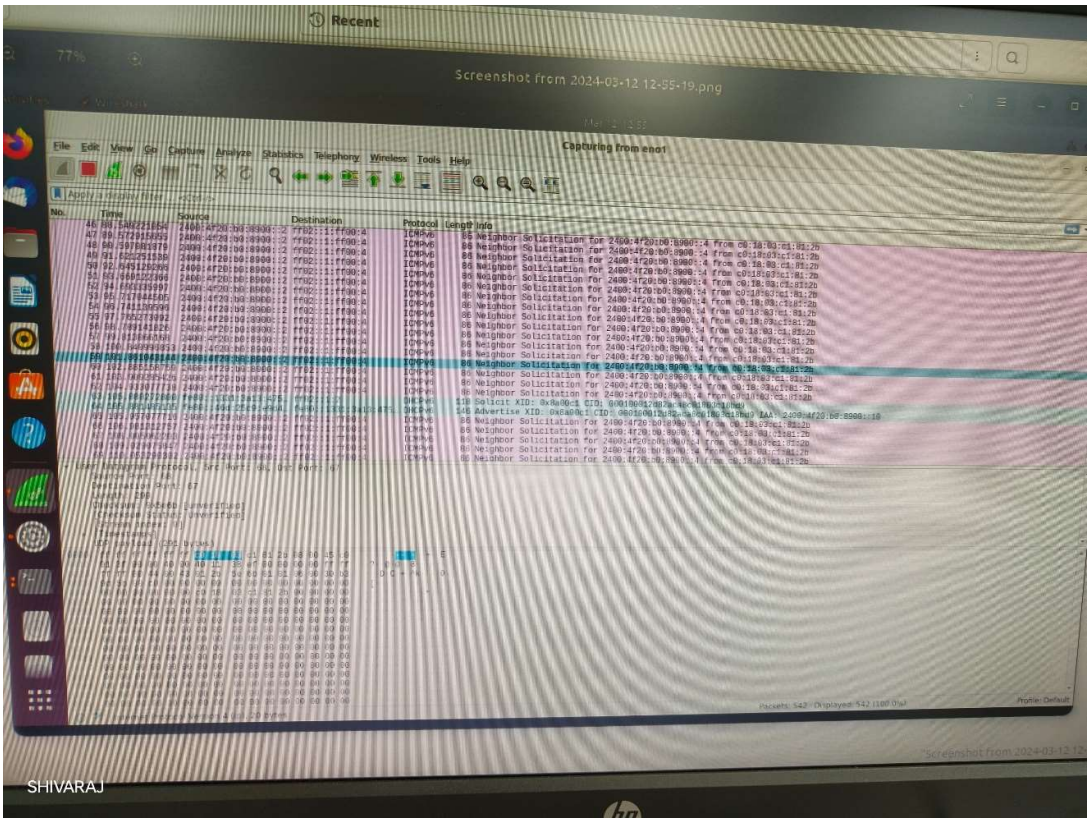


Fig 1: wireshark data captures from client side

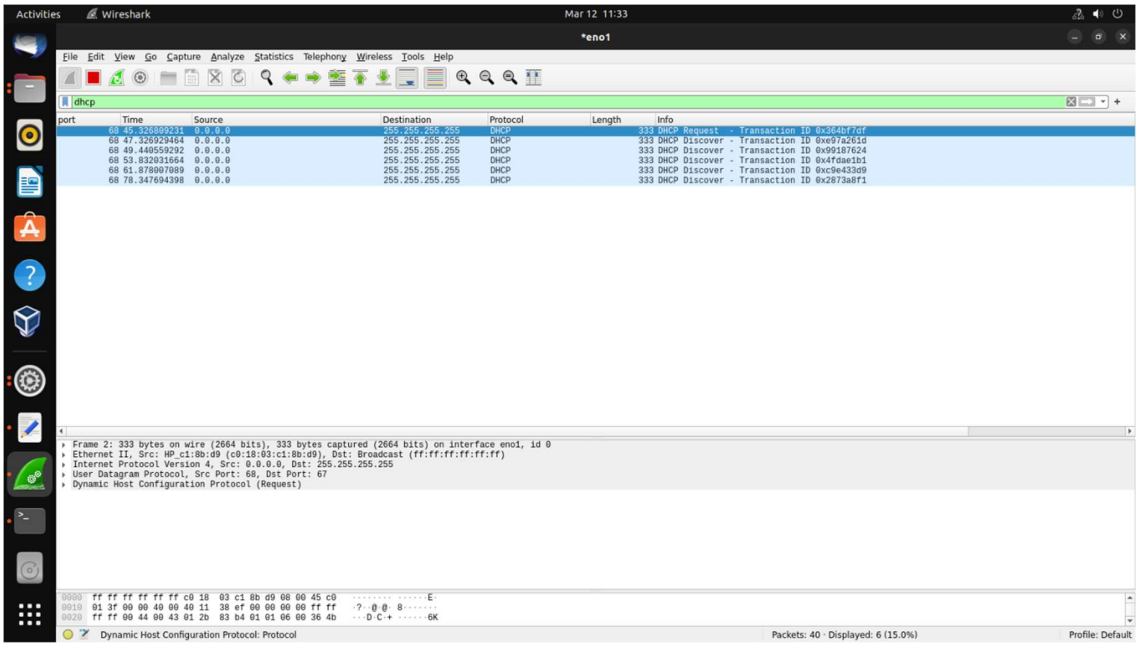


Fig 2: wireshark data captures from dhcpv6 server side

CONCLUSION

In conclusion, the workshop on IPv6 deployment, focusing on DHCPv6 and DNS server configuration, held at the National Institute of Technology Karnataka (NITK), Surathkal, has provided attendees with invaluable knowledge and practical experience in modern networking technologies. Participants have gained proficiency in setting up and configuring DHCPv6 for address allocation and DNS for domain name resolution, crucial components in the transition to IPv6.

Through hands-on exercises and step-by-step guidance outlined in this report, workshop participants have acquired the necessary skills to deploy IPv6 networks effectively. As organizations worldwide continue to migrate from IPv4 to IPv6, the insights gained from this workshop will empower attendees to contribute actively to the advancement and adoption of IPv6 technologies, ensuring the seamless integration of next-generation networking protocols into their respective environments.

Overall, the workshop has equipped participants with the tools and expertise needed to navigate the complexities of IPv6 deployment, positioning them as proficient practitioners in the ever-evolving landscape of network infrastructure. The knowledge gained from this workshop will undoubtedly serve as a solid foundation for attendees as they continue to explore and implement IPv6 solutions in their professional endeavors.