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# Study and Optimized Simulation of OSPFv3 Routing Protocol in IPv6 Network

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*Abstract-* Routing is a design way to pass the data packet. User is assigns the path in a routing configuration. A significant role played by the router for providing the dynamic routing in the network. Structure and Configuration are different for each routing protocols. Next generation internet protocol IPv6 which provides large address space, simple header format. It is mainly effective and efficient routing. It is also ensure good quality of service and also provide security. Routing protocol (OSPFv3) in IPv6 network has been studied and implemented using 'cisco packet tracer'. 'Ping' the ping command is used to check the results. The small virtual network created in Cisco platform .It is also used to test the OSPFv3 protocol in the IPv6 network. This paper also contains step by step configuration and explanation in assigning of IPv6 address in routers and end devices. The receiving and sending the packet of data in a network is the responsibility of the internet protocol layer. It also contains the data analysis of packet forwarding through IPv6 on OSPFv3 in simulation mode of cisco packet virtual environment to make the decision eventually secure and faster protocol in IPv6 environment.

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*GJCST-E Classification: C.2.2*

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## I. Introduction

The Internet is growing throughout the world, and different kinds of devices are becoming part of the internet every day. IP (Internet Protocol) is the most used routing protocol for communication over the network .The data packets are selecting the path of routing which mainly depends on the devices attached to the network. Packet destination address (IP) must be known from one device to another so that they can easily communicate with each other also wanted the neighboring devices information. Network topology studies the path for that region we can use OSPF technique. IPv4 and IPv6 are two categories of internet protocol. The IPv6 protocols represent an advance version of the IPv4 *(Oliveira, De Sousa, et al. 2011)*. IPv6 uses 128 bits addressing scheme which is more complicated than IPv4. IPv4 provides 32-bit addressing space in which 4.3 billion internet protocol address *(Hinds, Atojoko, et al. 2013)*. A study report shows that (10-15) % IPv6 replaces IPv4 around the world after 25 years later *(I.v.Beijnum. 2016)*. Routing protocol of IPv6 is OSPFv3, EIGRPv6, BGPv4, RIPng *(C.carthern, W.wilson, et al. 2015)*. The issue is the ability to exchange and use information with utility for OSPFv3 routing protocol of IPv6 environment. Now, corporate and enterprise networks area uses OSPFv3 routing protocol. We deploy and configure this mechanism on virtual environment of cisco packet tracer. It provides the idea and capability of next-generation network with IPv6 protocol.

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## II. Routing Protocol

*IPv6:*

IETF (Internet Engineering Task Force) in 1990 designed IPv6 protocol (S.E.Decring and R.Hinden 1998). IPv6 makes use of 128-bit addresses and so the next address space supports 2^128 addresses (Hui and Thubert 2011). The 128-bit addresses subdivide into eight groups. Further four digits hexadecimal number divide among eight groups and separate in colons. The resulting representation of hexadecimal is called colon-hexadecimal (Sarma 2015). It makes of 128 bits, the IPv6 address subdivides into eight 16-bits blocks. 4-digit hexadecimal numbers contain each block and each block separates by a colon (Nisha Devi, Er.Brijbhushansharma, et al.2016). Types of IPv6 addresses are Multicast addresses, Anycast address and Unicast address. Now, Multicast address format of IPv6 shows below in bits:

| | | | |
|---|---|---|---|
| 8 | 4 | 4 | 112 |

*Fig. 1:* Multicast Address Format of IPv6 (128 bits)

## III. OSPF(Open Shortest Path First)

*OSPFv3:*

For IPv6 environment, OSPFv3 has been designed. It follows the shortest path first algorithm and OSPFv3 is a dynamic routing protocol *(R.Coltun, O.Fergusonet al.2008)*. OSPFv3 incorporates some changes essentially operating an IPv6 network. OSPFv3 contains packet header. It is more complex than the OSPFv2 .It includes instance ID fields. In this point routing protocols for IPv6 are more concernment about links and nodes they are enabling on. Multiple addresses are concerning to be connected in the same interfaces and are establishing neighbourship using an IP subnet mask. To establish adjacencies OSPFv3 uses link-local addresses. In OSPFv3 HELLO packet structure has been changed because of IPv6 (Anibrika, Ashigbi, et al.2016).OSPFv3 provides security mechanisms for protecting routing update. IPv6 environment gets these services through IPsec.

## IV. Packet Tracer

Training, Education, and Research for computer network simulations can utilize through packet tracer which is Cisco router simulator. The tool creates Cisco systems. It provides free for distribution to faculty, alumni and students who participate in the Cisco networking academy. Users can create of visualizations animation and simulations of networking phenomena to use packet tracer. The tool of packet tracer relies on a specific simple model of networking device and protocols for simulation. Simulation is processed by different kinds of networking devices like as routers, switches, and wireless access points. Computers and various end devices visualize with animations. It is easy to describe. The main principle of networking depend on Cisco technology. Its development makes skill for learning. It also offers students and teachers a tool for learning networking environment.

## V. Topology Simulation for OSPFv3

Now, we considered the model of the network for OSPFv3 that contains three routers, two switches, four computers (mainly, end devices) for using the simulation of OSPFv3 routing. Serial DCE cables establish connection among routers. The automatic and copper straight through cable use to establish connection between switch to end devices. The network model gives below:

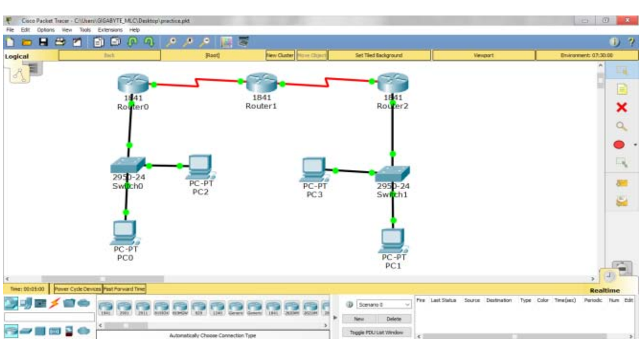


*Fig. 2:* OSPFv3 network model for simulation

## VI. Configuring OSPFv3 Network Model

IPv6 assigning for end devices (pc) following two ways:

1. Static & Auto-configuration:

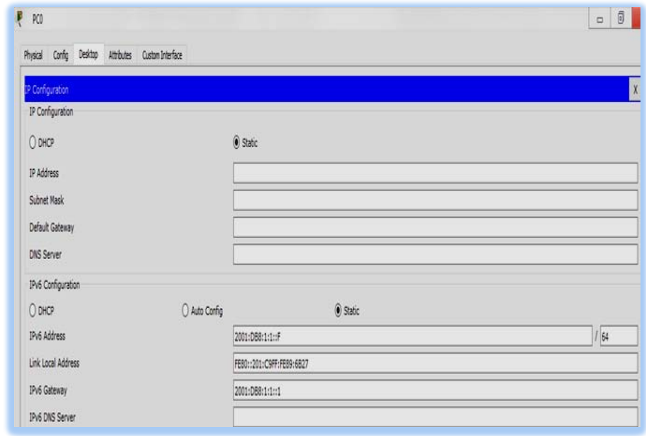


*Fig. 3:* IP address assigning in pc0 with Static configuration

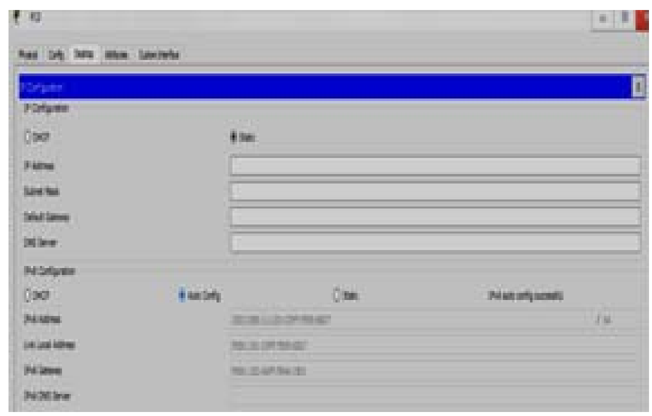


*Fig. 4:* IP address assigning in pc0 with auto configuration

In this way, we can adjust and assign IPv6 in Pc's of this virtual configuration.

2. In the all Pc's the gateway is the router physical device view serial connection between routers. Routers are connected with switches by Fast Ethernet with copper straight through cable. Pc's also connect with switches.
3. Firstly, connect the router physically. Then, configure the routers. In Fig: 2, router 0 are configured as follows using CLI (command line interface)

```
continue with configuration dialog?[yes/no]:
no
press RETURN to get started !
Router>enable
Router#config terminal
Enter configuration commands,one perline.End with CNTL/Z
Router(config)#ipv6 unicast-routing
Router(config)#int fa0/0
Router(config-if)#ipv6 address 2001:db8:1:1::1/64
Router(config-if)#no shut
Router(config-if)#
% LINK-5-CHANGED:Interface FastEthernet 0/0,
changed state to up
%LINKPROTO-5-UPDOWN:Line protocol on interface
Fast Ethernet 0/0,changed state to up.
Router(config-if)#int se0/0/0
Router(config-if)#ipv6 address 2001:db8:1:a001::1/64
Router(config-if)#no shut
% LINK-5-CHANGED:Interface serial 0/0/0,
changed state to down
Router(config-if)#clock rate 64000
This command applies only to DCE interfaces
Router(config-if)#end
```

*Fig. 5:* Configuration of the 1st router

```
press RETURN to get started !
Router>enable
Router#config terminal
Enter configuration commands,one perline.End with CNTL/Z
Router(config)#ipv6 unicast-routing
Router(config)#int fa0/0
Router(config-if)#ipv6 address 2001:db8:1:2::1/64
Router(config-if)#no shut
Router(config-if)#
% LINK-5-CHANGED:Interface FastEthernet 0/0,
changed state to up
%LINKPROTO-5-UPDOWN:Line protocol on interface
Fast Ethernet 0/0,changed state to up.
Router(config-if)#int se0/0/0
Router(config-if)#ipv6 address 2001:db8:1:a001::2/64
Router(config-if)#no shut
% LINK-5-CHANGED:Interface serial 0/0/0,
changed state to up
Router(config-if)#int se0/0/1
Router(config-if)#ipv6 address 2001:db8:1:a002::1/64
Router(config-if)#no shut
%LINK-5-CHANGED:Interface serial 0/0/1,
changed state to down
Router(config-if)#clock rate 64000
This command applies only to DCE interfaces
Router(config-if)#end
%SYS-5-CONFIG-I:configured from console by console
```

*Fig. 6:* Configure of 2nd router

```
continue with configuration dialog?[yes/no]:
no
press RETURN to get started !
Router>enable
Router#config terminal
Enter configuration commands,one perline.End with CNTL/Z
Router(config)#ipv6 unicast-routing
Router(config)#int fa0/0
Router(config-if)#ipv6 address 2001:db8:1:3::1/64
Router(config-if)#no shut
Router(config-if)#
% LINK-5-CHANGED:Interface FastEthernet 0/0,
changed state to up
%LINKPROTO-5-UPDOWN:Line protocol on interface
Fast Ethernet 0/0,changed state to up.
Router(config-if)#int se0/0/1
Router(config-if)#ipv6 address 2001:db8:1:a002::2/64
Router(config-if)#no shut
% LINK-5-CHANGED:Interface serial 0/0/1,
changed state to up
Router(config-if)#end
Router#
%SYS-5-CONFIG-I:configured from console by console
%LINKPROTO-5-UPDOWN:Line protocol on Interface serial 0/0/1,
changed state to up
```

*Fig. 7:* Configure of the 3rd router

4. A link – up line protocol makes according to the above code. As a result, the OSPF v3 has done.
5. Fa0/0 is the Fast Ethernet, and serial 0/0/0 is the serial port of the router.

```
Router#enable
Router#config terminal
Enter Configuration Commands,
one per line.End with CNTL/Z
Router(config)#ipv6 router ospf 1
%OSPFv3-4-NORTRID:OSPFv3
process 1 could not pick a router-id,
please configure manually
Router(config-rtr)#router-id 1.1.1.1
router(config-rtr)#exit
router(config)#int fa0/0
router(config-if)#ipv6 ospf 1 area 0
router(config-if)#int se0/0/0
router(config-if)#ipv6 ospf 1 area 0
router(config-if)#end
router#
%SYS-5-CONFIG-I:Configured from console by console
```

*Fig. 8:* Area defining and manually configure router 0 in OSPFv3

```
Router#enable
Router#config terminal
Enter Configuration Commands,
one per line.End with CNTL/Z
Router(config)#ipv6 router ospf 1
%OSPFv3-4-NORTRID:OSPFv3
process 1 could not pick a router-id,
please configure manually
Router(config-rtr)#router-id 2.2.2.2
router(config-rtr)#exit
router(config)#int fa0/0
router(config-if)#ipv6 ospf 1 area 0
router(config-if)#int se0/0/0
router(config-if)#ipv6 ospf 1 area 0
router(config-if)#int se0/0/1
router(config-if)#ipv6 ospf 1 area 0
router(config-if)#end
router#
%SYS-5-CONFIG-I:Configured from console by console
```

*Fig. 9:* Area defining and manually configure router one in OSPFv3

```
Router#enable
Router#config terminal
Enter Configuration Commands,
one per line.End with CNTL/Z
Router(config)#ipv6 router ospf 1
%OSPFv3-4-NORTRID:OSPFv3
process 1 could not pick a router-id,
please configure manually
Router(config-rtr)#router-id 3.3.3.3
router(config-rtr)#exit
router(config)#int fa0/0
router(config-if)#ipv6 ospf 1 area 0
router(config-if)#int se0/0/1
router(config-if)#ipv6 ospf 1 area 0
router(config-if)#end
router#
%SYS-5-CONFIG-I:Configured from console by console
```

*Fig.10:* Area defining and manually configure router two in OSPFv3

6. Router OSPFv3 '1' the '1' gives the area 0 which same for all router in the same domain. In IPv6

router-id is manually set up for the domain and area specification. But it can be any number.

## VII. Exiting Configuration of OSPFv3 with IPv6

The model of the network that is implemented and verified using 'ping' command from any pc's that attached to the router. Now, the result shows below are using the pc0 and pc1 through pinging the address to another. Now, show in the below:

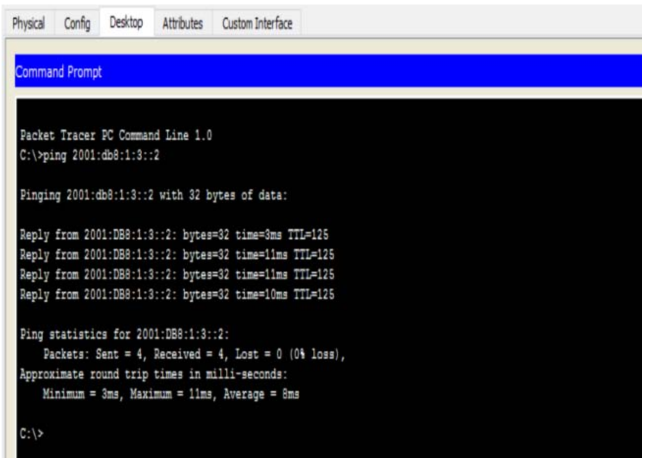



*Fig. 11:* Checking result using 'ping' command.

## VIII. Data Collection

Ping command is used to check the configuration results in different routing protocols. Fig. 2 shows the small network model design for OSPFv3 in IPv6 protocol and packet transfer calculated for the time taken by it to travel from sender to receiver node. These data obtained by ping command and the traffic generator using the simulation for auto/capture/play button. It mainly shows the time to travel and reach the packets from source to destination nodes. Now Fig. 12 shows the simulation mode of cisco packet tracer environment for OSPFv3 in IPv6 protocol.

*Fig. 12:* Simulation environment for data collection of OSPFv3 in IPv6 network

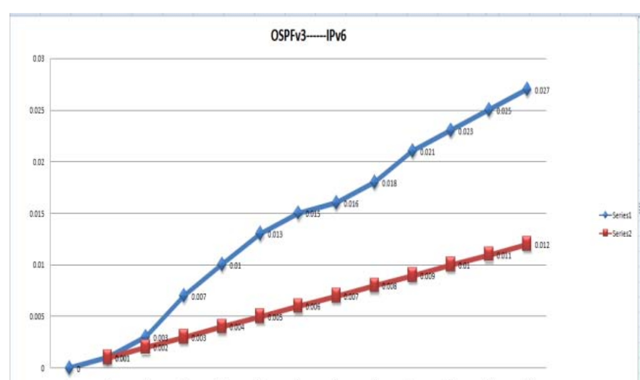
Data notes down which mainly indicates that the packet takes the destination shown below:

*Table 1:* pc0 to pc1 while taken to travel OSPFv3 in IPv6 routing protocol and reference message with no constant delay that is ICMPv6

| Time(sec) | Last Device | At Device | Type |
|---|---|---|---|
| 0.001 | PC 0 | Switch 0 | ICMPv6 |
| 0.003 | Switch 0 | Router 0 | ICMPv6 |
| 0.007 | Router 0 | Router 1 | ICMPv6 |
| 0.010 | Router 1 | Router 2 | ICMPv6 |
| 0.013 | Router 2 | Switch 1 | ICMPv6 |
| 0.015 | Switch 1 | PC 1 | ICMPv6 |
| 0.016 | PC 1 | Switch 1 | ICMPv6 |
| 0.018 | Switch 1 | Router 2 | ICMPv6 |
| 0.021 | Router 2 | Router 1 | ICMPv6 |
| 0.023 | Router 1 | Router 0 | ICMPv6 |
| 0.025 | Router 0 | Switch 0 | ICMPv6 |
| 0.027 | Switch 0 | PC 0 | ICMPv6 |

*Table 2:* pc0 to pc1 while taken to travel OSPFv3 in IPv6 routing protocol and reference message with the constant delay that is ICMPv6

| Time(sec) | Last Device | At Device | Type |
|---|---|---|---|
| 0.001 | PC 0 | Switch 0 | ICMPv6 |
| 0.002 | Switch 0 | Router 0 | ICMPv6 |
| 0.003 | Router 0 | Router 1 | ICMPv6 |
| 0.004 | Router 1 | Router 2 | ICMPv6 |
| 0.005 | Router 2 | Switch 1 | ICMPv6 |
| 0.006 | Switch 1 | PC 1 | ICMPv6 |
| 0.007 | PC 1 | Switch 1 | ICMPv6 |
| 0.008 | Switch 1 | Router 2 | ICMPv6 |
| 0.009 | Router 2 | Router 1 | ICMPv6 |
| 0.010 | Router 1 | Router 0 | ICMPv6 |
| 0.011 | Router 0 | Switch 0 | ICMPv6 |
| 0.012 | Switch 0 | PC 0 | ICMPv6 |




*Graph 1:* Comparison figure of the OSPFv3 routing protocol in IPv6 with time zone (from table 1, 2) and travels the stations during packet transfer with constant delay and without constant delay

## IX. Data Analysis

The simulation process which indicates the impact of the traffic sent and received in the network. It generates through a ping command method from pc0 to pc1 which shows the connectivity, justification, testing, and transfer of the packet from source to destination. It also verified the simulation and packet transfer time with the observed parameters is checked from pc0 and pc1 with constant delay and without constant delay which constructed from the simulation time. The graph shows the simulation time vary from node to node when a packet travels through the network and finally the IPv6 network finds out the performance of the routing protocol OSPFv3.

## X. Conclusion

This paper demonstrated that Cisco tracer could be used by network planners to select and to design various networks and optimal routing topology. In a network, routing is used to trace the path. In this paper, we used cisco packet tracer for implementing a routing protocol. We use OSPFv3 routing protocol in IPv6 network due to the usage and area of necessity though there are many different types of routing techniques. OSPFv3 are used for small and large enterprises and other business organization for IPv6 network environment. The time zone (second) in each station mainly packet take to travel one station to another, check the destination address to plot these generated time zone to show how fast data packet flows through a network of OSPFv3 in IPv6 environment with and without constant delay. It used for security, unlimited hop count, low overload, authentication. OSPFv3 uses area concepts which mainly eases management, route and packet traffic control.

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