COMPARATIVE STUDY OF OSPFV3, IS-IS AND OSPFV3_IS-IS PROTOCOLS USING OPNET

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Abstract: As IPV6 is becoming popular day by day; due to its wide range of applications; and great hierarchy of IPs. But selecting the best protocol among available is found to be critical task. This paper includes Intermediate System To intermediate System (IS-IS) and Open Shortest Path First V3(OSPFV3) Protocol and mentioned IPv6 network's performance evaluation on the basis of Video End to End Delay, End to End Delay in Voice,Jitter. In this paper, to get the results, three different scenarios are desigined, in first scenario Intermediate System To intermediate System (IS-IS) has to be implemented. In second scenario, Open Shortest Path First V3 (OSPFV3) protocol has to be implemented. In third scenario, combination of both protocol need to be implemented in one network. To analyse the performance of both routing protocol, we use the OPNET simulator.

Keywords: OPNET, IPV6, LINK STATE ROUTING, OSPFV3, IS-IS.

1. INTRODUCTION

Internet has become integral part of our life. We are using many services like video streaming, email and file transfer. These are all based on packet data and routing protocol has important role to deliver packet across the internet. There are many protocols existing in IP network. We take Open Shortest Path First V3 (OSPFV3) and Intermediate System to intermediate System (IS-IS) .Both protocols comes from link state. The router has prior knowledge about the adjacent networks which can assist in selecting the routes between two nodes. There are different types of routing protocols in the IP networks. Three classes are common on IP networks as follows:

- Interior gateway routing over link state routing protocols, such as IS-IS and OSPF.
- Interior gateway routing over distance vector Protocols, such as RIP, IGRP and EIGRP.
- Exterior gateway routing, such as BGP v4 routing protocol.

2. ROUTING PROTOCOLS

In IP networks, the main job of a routing protocol is to transmit packets forwarded from one node to another. In a network, routing can be defined as transmitting information from a source to a destination by hopping one-hop or multi hop. Routing protocols should provide at least two facilities: selecting routes for different pairs of source/destination nodes and, successfully transmitting data to a given destination.Routing protocols are used to explainhow routers communicate to each other, learn available routes build routing tables, make routing decisions and share information among neighbours. Routers are used to connect multiplenetworks and to provide packet forwarding for different types of networks.The main objective of routing protocols is to determine the best path from a source to a destination. A routing algorithm uses different metrics based on a single or on several properties of the path in order to determine the best way to reach a given network. Conventional routing protocols used in interior gateway networks are classified as Link State Routing Protocols and Distance Vector Routing Protocols.Routing protocols can be classified as:

- Static and dynamic routing protocols.
- Classful and Classless routing protocols.
- Distance Vector and Link State routing protocols.

3. LINK STATE ROUTING

Link State Routing (LSR) protocols are also known as Shortest Path First (SPF) protocol where each router determines the shortest path to each

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network. In LSR, each router maintains a database which is known as link state database. This database describes the topology of the AS. Exchange of routing information among the nodes is done through the Link State Advertisements (LSA). Each LSA of a node contain information of its neighbours and any change (failure or addition of link) in the link of the neighbours of a node is communicated in the AS through LSAs by flooding. When LSAs are received, nodes make a note of the change and the routes are recomputed accordingly and resend through LSAs to its neighbours. Therefore, all nodes have an identical database describing the topology of the networks. These databases contain informationregarding the cost of each link in the network from which a routing tableis derived. This routing table describes the destinations a node can forward packets to indicating the cost and the set of paths. Hence, the paths described in the routing table are used to forward all the traffic to the destination.

Dijkstra's algorithm is used to calculate the cost and path for each link. The price of each link can also be represented as the weight or length of that link and is set by the network operator. By suitably assigning link costs, it is possible to achieve load balancing. If this is accomplished, congested links and inefficient usage of the network resources can be avoided. Hence, for a network operator to change the routing the only way is to modify the link cost. Generally the weights are left to the default values and it is recommended to assign the weight of a link as the inverse of the link's capacity. Since there is no simple method to modify the link weights so as to optimize the routing in the network, finding the link weights is known to be NP-hard. LSR protocols offer greater flexibility but are complex compared to DV protocols. A better decision about routing is made by link state protocols and it also reduces overall broadcast traffic. The most common types of LSR protocols are OSPF and IS-IS. OSPF uses the link weight to determine the shortest path between nodes.

4. OSPFV3

Open Shortest Path First (OSPF) is a routing protocol for Internet Protocol (IP) networks. It uses a link state routing algorithm and falls into the group of interior routing protocols, operating within a single autonomous system (AS). It is defined as OSPF Version 2 in RFC 2328 (1998) for IPv4. The updates for IPv6 are specified as OSPF Version 3 in RFC 5340 (2008). OSPF is perhaps the most widely used interior gateway protocol (IGP) in large enterprise networks. OSPF is an interior gateway protocol (IGP) for routing Internet Protocol (IP) packets solely within a single routing domain, such as an autonomous system. It gathers link state information from available routers and constructs a topology map of the network. The topology is presented as a routing table to the Internet Layer which routes datagram based solely on the destination IP address found in IP packets. OSPFV3 supports Internet Protocol Version 4 (IPv4) and Internet Protocol Version 6 (IPv6) networks and features variable-length subnet masking (VLSM) and Classless Inter-Domain Routing (CIDR) addressing models. OSPFv3, running on IPv6, no longer supports protocol-internal authentication. Instead, it relies on IPv6 protocol security (IPsec). OSPF version 3 introduces modifications to the IPv4 implementation of the protocol. Except for virtual links, all neighbour exchanges use IPv6 link-local addressing exclusively. The IPv6 protocol runs per link, rather than based on the subnet. All IP prefix information has been removed from the link-state advertisements and from the Hello discovery packet making OSPFv3 essentially protocol-independent. Despite the expanded IP addressing to 128-bits in IPv6, area and router Identifications are still based on 32-bit values.

5. IS-IS

Intermediate System to Intermediate System (IS-IS) is a routing protocol designed to move information efficiently within a computer network, a group of physically connected computers or similar devices. It accomplishes this by determining the best route for datagrams through a packet-switched network. The protocol was defined in ISO/IEC 10589:2002 as an international standard within the Open Systems Interconnection (OSI) reference design. Though originally an ISO standard, the IETF republished the protocol as an Internet Standard in RFC 1142. IS-IS has been called "the de facto standard for large service provider network backbones.

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The IS-IS (Intermediate System - Intermediate System) protocol is one of a family of IP Routing protocols, and is an Interior Gateway Protocol (IGP) for the Internet, used to distribute IP routing information throughout a single Autonomous System (AS) in an IP network.IS-IS is a link-state routing protocol, which means that the routers exchange topology information with their nearest neighbours. The topology information is flooded throughout the AS, so that every router within the AS has a complete picture of the topology of the AS. This picture is then used to calculate end-to-end paths through the AS, normally using a variant of the Dijkstra's algorithm. Therefore, in a link-state routing protocol, the next hop address to which data is forwarded is determined by choosing the best end-to-end path to the eventual destination. The IS-IS protocol was developed by Digital Equipment corporation as part of DEC net Phase V. It was standardized by the ISO in 1992 as ISO 10589 for communication between network devices which are termed Intermediate Systems (as opposed to end systems or hosts) by the ISO. The purpose of IS-IS was to make possible the routing of datagram's using the ISO-developed OSIprotocol stack called CLNS.

6. COMPARISON OF OSPFV3 AND IS-IS

- Both IS-IS and OSPF are link state protocols, and both use the same Dijkstra algorithm for computing the best path through the network. As a result, they are conceptually similar. Both support variable length subnet masks, can use multicast to discover neighboring routers using hello packets, and can support authentication of routing updates.
- While OSPF natively built to route IP and is itself a Layer 3 protocol that runs on top of IP, IS-IS is natively an OSI network layer protocol (it is at the same layer as CLNS). The widespread adoption of IP worldwide may have contributed to OSPF's popularity. IS-IS does not use IP to carry routing information messages. IS-IS is neutral regarding the type of network addresses for which it can route. OSPF, on the other hand, was designed for IPv4. This allowed IS-IS to be easily used to support IPv6. To operate with IPv6 networks, the OSPF protocol was rewritten in OSPF v3 (as specified in RFC 2740).
- IS-IS routers build a topological representation of the network. This map indicates the subnets which each IS-IS router can reach, and the lowest-cost (shortest) path to a subnet is used to forward traffic.
- IS-IS differs from OSPF in the way that "areas" are defined and routed between. IS-IS routers are designated as being: Level 1 (intra-area); Level 2 (inter area); or Level 1-2 (both). Level 2 routers are inter area routers that can only form relationships with other Level 2 routers. Routing information is exchanged between Level 1 routers and other Level 1 routers, and Level 2 routers only exchange information with other Level 2 routers. Level 1-2 routers exchange information with both levels and are used to connect the inter area routers with the intra area routers.
- In OSPF, areas are delineated on the interface such that an area border router (ABR) is actually in two or more areas at once, effectively creating the borders between areas inside the ABR, whereas in IS-IS area borders are in between routers, designated as Level 2 or Level 1-2. The result is that an IS-IS router is only ever a part of a single area.
- IS-IS also does not require Area 0 (Area Zero) to be the backbone area through which all inter-area traffic must pass. The logical view is that OSPF creates something of a spider web or star topology of many areas all attached directly to Area Zero and IS-IS by contrast creates a logical topology of a backbone of Level 2 routers with branches of Level 1-2 and Level 1 routers forming the individual areas.
- IS-IS also differs from OSPF in the methods by which it reliably floods topology and topology change information

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through the network. However, the basic concepts are similar.

- OSPF has a larger set of extensions and optional features specified in the protocol standards. However IS-IS is more easy to expand: its use of type-length-value data allows engineers to implement support for new techniques without redesigning the protocol. For example, in order to support IPv6, the IS-IS protocol was extended to support a few additional TLVs, whereas OSPF required a new protocol draft (OSPFv3). In addition to that, IS-IS is less "chatty" and can scale to support larger networks. Given the same set of resources, IS-IS can support more routers in an area than OSPF. This has contributed to IS-IS as an ISP-scale protocol.

7. SIMULATOR

In this paper, network simulator, Optimized Network Engineering Tools (OPNET) modeler 14.5 has been used as a simulation environment. OPNET is a simulator built on top of discrete event system (DES) and it simulates the system behaviour by modelling each event in the system and processes it through user defined processes. OPNET is very powerful software to simulate heterogeneous network with various protocols. The protocols used in this thesis are OSPFV3 and IS-IS routing protocol. The proposed routing protocols and its combination are compared and evaluated based on some quantitative metrics such as End to End Delay in Voice , End to End Delay in Video, Jitter.In this paper, three scenarios are created. The network topology composed of the following network devices and configuration utilities:

- Routers
- Ethernet Server
- Switch
- PPP_DS3 Duplex Link
- PPP_DS1 Duplex Link
- Ethernet 100 Base T Duplex Link
- Ethernet Workstation
- Application Configuration
- Profile Configuration

The network topology design is based on the geographical layout of Punjab Districts. We considered Twelve Routers in accordance with the name of districts of Punjab those are interconnected to each other.

(a) IS-IS Scenario: In this scenario, IS-IS routing protocol is enabled first for all routers on the network. After configuring routing protocols, individual DES statistics was chosen to select performance metrics and to measure the behaviour of this routing protocol. Then simulation run time was set to 5 minutes.

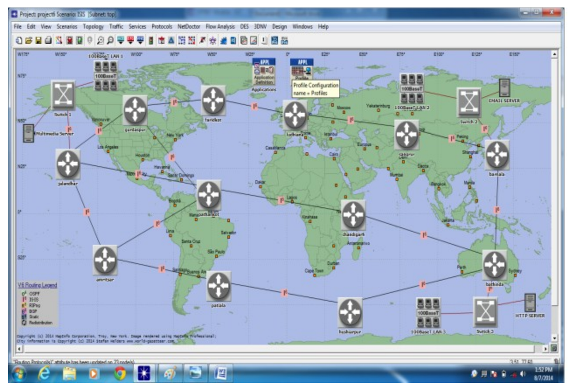

Fig 1: IS-IS Scenario

(b) OSPFV3 Scenario: In this scenario, OSPFV3 routing protocol is enabled first for all routers on the network. After configuring routing protocols, individual DES statistics was chosen to select performance metrics and to measure the behavior of this routing protocol. Then simulation run time was set to 5 minutes.

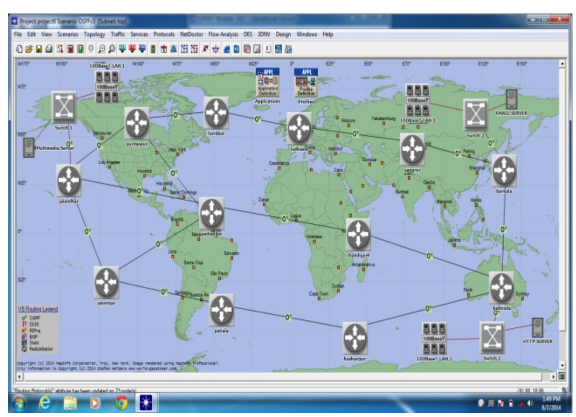

Fig 2: OSPFV3 Scenario

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(3) OSPFV3_IS-IS Scenario: A key issue of this scenario is to analyze the performance of the network where both IS-IS and OSPFV3 are running concurrently. This scenario is different from other two scenarios. In this Scenario half network is configured with IS-IS and rest of the part of this scenario is configured with OSPFV3.

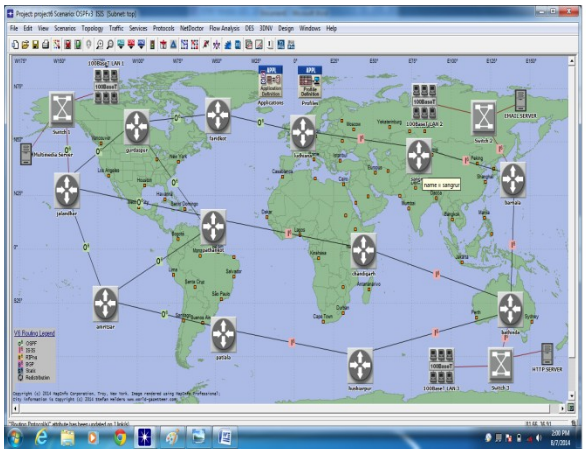

Fig 3: OSPFV3_IS-IS Scenario

8. METRICS

(a) JITTER: Jitter is defined as a variation in the delay of received packets. At the sending sides, packets are sent in a continuous stream with the packets spaced evenly apart. Due to network congestion, improper queuing or configuration errors, this steady stream can be lumpy or the delay between each packet can vary instead of remaining constant.

(b) END TO END DELAY: End-to-end delay refers to the time taken for a packet to be transmitted across a network from source to destination. End-to-end delay has a critical importance when a packet arrives too late at the receiver as a consequence, the packet can be effectively lost. Lost packets due to delay have a negative effects on the received quality for both video and voice traffic.

9. RESULTS

(a) JITTER: In Jitter, OSPFV3's performance is better than IS-IS and OSPFV3_IS-IS.

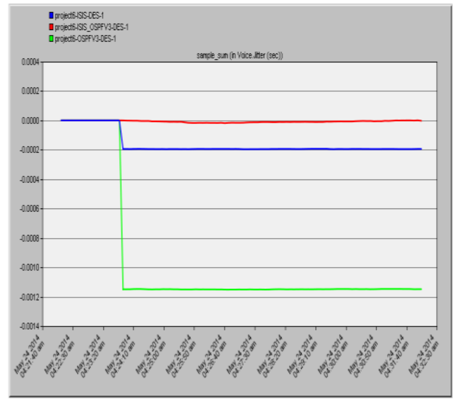

Fig 4: Jitter

(b) VIDEO END TO END DELAY: In the performance metrics of VIDEO End To End Delay, Response time of IS-IS protocol is better than the OSPFV3 and OSPFV3_ISIS.

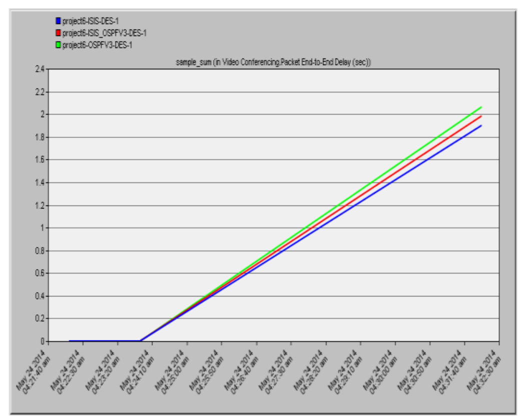

Fig 5: Video End to End Delay

(c) VOICE END TO END DELAY: In the performance metrics of Voice End to End Delay, Response time of OSPFV3_IS-IS is better than others.

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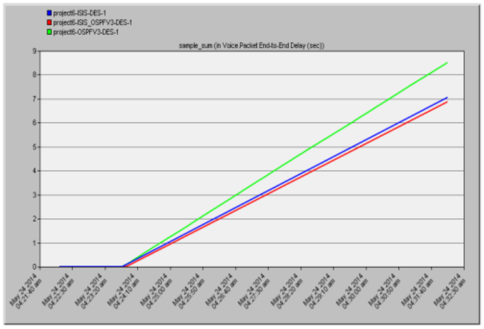

Fig 6: Voice End to End Delay

10. CONCLUSION AND FUTURE SCOPE

In this paper, we have presented a comparative studyof selected routing protocols such as IS-IS, OSPFV3 and the combination of IS-IS and OSPFV3. The comparative analysis has been done in the same network with different protocols for real time applications. Performance has been measured on the basis of some parameters that aimed to figure out the effects of routing protocols. In our paper work, the simulation result has shown that In Video End to End Delay, IS-IS Protocol is better than two others. .In Jitter, OSPFV3 has much better than others two. In Voice End to End Delay,IS-IS_OSPFV3 is better. In future, a research work can be done on the explicit features of both OSPFV3 and IS-IS protocols in the IPv6 environment with other server like Remote Login. Telnet, Data Base Query Response Time and Security analysis for both OSPFV3 and IS-IS can be done.

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