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Comparative Analysis of IPV6 Based IS-IS and OSPF-V3 Protocols

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Abstract

This paper deals with the critical issues of OSPF V3 & IS-IS in IPV6. 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. Therefore this proposed work focuses on evaluating the shortcomings of IPV6 based protocol in various applications like data base, video, voice E-mail and HTTP servers. It has been found that the performance of OSPF V3 and IS-IS has been neglected by the most of existing researchers. Most of the researchers did work on IPv4 that means the characteristics of IPv6 have been ignored. The effect of scalability in the network has been neglected by most of the existing researchers. In near future we will simulate the given IPV6 based protocols in OPNET tool.

Keywords: OPNET, IPV6, LINK STATE ROUTING, OSPF V3, IS-IS.

Introduction

Today internet [1] has become integral part of our life. We are using many services like video steaming, email and file transfer. These are all based on packet data and routing protocol has important role to transport packet across the internet. There are many protocols existing in IP network. We have taken OSPF3 and IS-IS .We will do analysis which would be a better for IP network. With respective application like video, e-mail, Database and Http. Routing protocols specify how routers communicate with each other by disseminating information. 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:

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

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, successsfully transmitting data to a given destination. Routing protocols are used to explain how routers communicate to each other, learn available routes build routing tables, make routing decisions and share information among neighbours. Routers are used to connect multiple networks 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.

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 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

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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 information regarding the cost of each link in the network from which a routing table is 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.

A. Methods of routing

Every router will accomplish the following process [1].

i. Every router learns about directly connected networks to it and its own links.
ii. Every router must meet its directly connected neighbour networks. This can be done through HELLO packet exchanges.
iii. Every router needs to send link state packets containing the state of the links connected to it.
iv. Every router stores the copy of link state packet received from its neighbours.
v. Every router has a common view of the network topology and independently determines the best path for that topology.

B. Advantages and Disadvantages of LSR

In LSR protocols [4], routers compute routes independently and are not dependent on the computation of intermediate routers. The main advantages of link state routing protocols are:

i. React very fast to changes in connectivity.
ii. The packet size sent in the network is very small. The main problems of link state routing are:
iii. Large amounts of memory requirements.
iv. Much more complex.

C. Properties of routing protocols

To present efficient and reliable routing, several desirable properties are required from the routing protocols:

i. Distributed Operation

The protocol should not depend on any centralized node for routing, i.e., distributed operation. The main advantage of this approach is that in such a network a link may not succeed anytime.

ii. Loop Free

The routes provided by the routing protocol should guarantee a loop free route. The advantage of loop free routes is that in the some cases the available bandwidth can be used efficiently.

iii. Convergence

The protocol should converge very fast, i.e., the time taken for all the routers in the network to know about routing specific information should be small.

iv. Demand Based Operation

The protocol should be reactive, i.e., the protocol should provide routing only when the node demands saving thus valuable network resources.

v. Security

The protocol should ensure that data will be transmitted securely to a given destination.

vi. Multiple Routes

The routing protocol should maintain multiple routes. If a link fails or congestion occurs then the routing can be done through the multiple routes available in the routing table saving thus valuable time for discovering a new route.

1. OSPF

Open Shortest Path first (OSPF) is a link state routing protocol that was firstly developed in 1987 by Internet Engineering Task Force (IETF) working group of OSPF. In RFC1131, the OSPFv1 specification was published in 1989.These conversion

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of OSPF was released in 1998 and published in RFC2328. The third version of OSPF was published in1999 and mainly aimed to support IPv6.

2. IS-IS

The IS-IS (Intermediate System - Intermediate System) protocol is one of a relatives of IP Routing protocols, and is an Interior Gateway Protocol (IGP) for the Internet, used to allocate 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 filled 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.

A. Comparison with OSPF

Both IS-IS and OSPF are link state protocols, and both make use of the same Dijkstra algorithm for computing the best path through the network. As a result, they are conceptually alike. Both sustain variable length subnet masks, can use multicast to find out neighbouring routers using hello packets, and can support authentication of routing updates.

As OSPF is 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 transmit 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 run with IPv6 networks, the OSPF protocol was rewritten in OSPF v3 (as specified in RFC 2740).

IS-IS differs from OSPF in the way that "areas" are defined and routed between. IS-IS routers are elected 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 relations 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 through the network. However, the basic concepts are similar.

OSPF has a larger set of extensions and possible features specific in the protocol standards. However IS-IS is more easy to enlarge: 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.

TABLE 1: COMPARISON AMONG IS-IS AND OSPF PROTOCOLS

IS-IS Terminology	**OSPF Terminology**
Area	Stub Area
Area ID	Area ID
Backbone Area	Backbone Area
DIS(Designated Intermediate System)	Designated Router
Domain	Network
ES(End System)	Host
ES-IS	ARP(Address Resolution Protocol)
IS(Intermediate system)	Router
ISO Routing Domain	Autonomous System
Level 1	Internal Non backbone Stub Area
Level 1-2	Area Border Router
Level 2	Backbone Router

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LSP(Link state Packet)	LSA(Link State Advertisement)
PDU(Protocol Data Unit)	Packet
NET(Network Entity Title)	IP Destination Address
NSAP(Network Service Access Point)	IP Destination Address + IP Protocol Number
Subnet=Data Link	Subnet=IP Network
System ID	Router ID

Literature survey

The use of real-time multimedia [1] or mission-critical applications over IP networks puts strong pressure on service providers to run disruption-free networks. However, after any topological change, link-state Interior Gateway Protocols (IGPs), such as IS-IS or OSPF, enter a convergence phase during which transient forwarding loops may occur. Such loops increase the network latency and cause packet losses. In this paper, we propose and evaluate an efficient algorithm aimed at avoiding such traffic disruptions without modifying these IGPs. In case of an intentional modification of the weight of a link (e.g., to shut it down for maintenance operations or to perform traffic engineering), our algorithm iteratively changes this weight, splitting the modification into a sequence of loop-free transitions. The number of weight increments that need to be applied on the link to reach its target state is minimized in order to remain usable in existing networks.Routing protocol [1] is taking a vital role in the modern internet era. A routing protocol determines how the routers communicate with each other to forward the packets by taking the optimal path to travel from a source node to a destination node. In this paper we have explored two eminent protocols namely, Enhanced Interior Gateway Routing Protocol (EIGRP) and Open Shortest Path First (OSPF) protocols. Evaluation of these routing protocols is performed based on the quantitative metrics such as Convergence Time, Jitter, End-to-End delay, Throughput and Packet Loss through the simulated network models. The evaluation results show that EIGRP routing protocol provides a better performance than OSPF routing protocol for real time applications. Through network simulations we have proved that EIGRP is more CPU intensive than OSPF and hence uses a lot of system power. Therefore EIGRP is a greener routing protocol and provides for greener Internetworking.A method [2] to find an alternate path has been suggested, after a link failure, from a source node to a destination node, before the Interior Gateway Protocol (e.g., OSPF or IS-IS) has had a chance to re converge in response to the failure. The target application is a small (up to tens of nodes) regional access sub network of a service provider's network, which is a typical access scale encountered in practice. We illustrate the method and prove that it will find a path if one exists. Current intra-domain routing protocols like OSPF and IS-IS use link-state routing algorithms with hop-by-hop forwarding that sacrifice traffic engineering performance for ease of implementation and management. Though optimal traffic engineering algorithms exist, they tend to be either not link-state algorithms or to require source routing - characteristics that make them difficult to implement. As the focus of this paper, we introduce HALO, the first optimal link-state routing algorithm with hop-by-hop forwarding, where link weights can be calculated locally. Furthermore, our solution can adapt to changing traffic patterns automatically. The optimality of the algorithm is proved theoretically and also verified numerically. Link-state based routing [4] protocols are dominant in Shortest Path Bridges (IEEE 802.1aq) and also at TRILL (IETF) R bridges. Both standards propose a hybrid of switch and router adding a link state routing protocol in layer two that computes shortest paths between bridges. Surprisingly, path exploration mechanisms have not yet been considered at standardization bodies, in spite of some outstanding advantages: simplicity, instantaneous path adaptation to traffic load with load adaptive routing and low latency. We have developed All-path, a family of protocols based on simple path exploration mechanisms based on full flooding of a single frame, as an alternative to the "beaten trail" of path computation. Path exploration (either instantaneous or periodical, proactive or reactive) is an efficient alternative to path computation for bridged networks because the processing cost of address learning at bridges from broadcast frames is very low and Ethernet links provide very high link capacity so that the extra packet broadcasts do not impact load significantly. Standardization groups should consider the application of path exploration (instantaneous or periodical, proactive or reactive) mechanisms in Audio Video Bridges and in generic bridging networks like campus and data centers to find redundant paths, low latency and load distribution in simple ways instead of complex multiple path computations.

A wireless based mesh network [5] has been considered as a viable option to provide coverage for a vast area. Interference due to multi hop transmission and potential isolated nodes are the

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major obstacles to achieve high performance. In order to avoid problem related to multi hop transmission we adopt a heterogeneous Wi-Fi mesh network which can provide more efficiency by implementing Open Shortest Path (OSPF) protocol standard to it. Here in this paper a Wi-Fi router of later version which works on Ad-Hoc On Demand Vector (AODV) protocol standard is first studied and our newly emphasized network architecture with OSPF implementation has been compared. The change in efficiency standard and link quality performance of our newly designed Wi-Fi architecture is analyzed with Qualnet 5.02 simulator. Link state routing protocol [6] has been widely employed in wired network applications. When network topology change occurs, a Link State Advertisement (LSA) is generated and flooded into the rest of the devices of the network. In our approach, we propose an efficient flooding way to reduce LSA overhead in link state routing protocols such as OSPF and IS-IS. The proposed algorithm is an efficient method for large scale networks and wireless environments in that the problem of the LSA overhead and router CPU utilization. The proposed method has been validated through both performance analysis and computer simulation. An open question [7] with a positive answer: Optimal traffic engineering (or optimal multi commodity flow) can be realized using just link-state routing protocols with hop-by-hop forwarding. Today's typical versions of these protocols, OSPF and IS-IS, split traffic evenly over shortest paths based on link weights. However, optimizing the link weights for OSPF/IS-IS to the offered traffic is a well-known NP-hard problem, and even the best setting of the weights can turn significantly from an optimal distribution of the traffic. In this paper, we propose a new link-state routing protocol, PEFT, that splits traffic over multiple paths with an exponential penalty on longer paths. Unlike its predecessor, DEFT, our new protocol provably achieves optimal traffic engineering while retaining the simplicity of hop-by-hop forwarding. The new protocol also leads to a major reduction in the time needed to compute the best link weights. Both the protocol and the computational methods are developed in a conceptual framework, called Network Entropy Maximization that is used to identify the traffic distributions that are not only optimal, but also realizable by link-state routing. With the explosive growth [8] of the Internet and the incredible development of network applications, the variation in traffic volume has become one of the most important problems faced by network operators. Designing a network using a single ``busy hour" traffic matrix strains credibility due to the high volatility of traffic patterns. Thus, there is a need for efficient dynamic reconfiguration methods allowing to adapt resource utilization to prevailing traffic. In this paper, we focus on the problem of link weight optimization in IP networks where the traffic is routed along shortest paths according to the link metrics (OSPF and IS-IS-based networks). We propose an online approach to handle time-varying traffic matrices that relies on online traffic monitoring and updates link weights, and thus the routing paths, adaptively as some changes are observed. OSPF and EIGRP [9]are routing protocol which is a member of IGP (Interior Gateway Protocol). OSPF and EIGRP will distribute routing information between routers in the same autonomous system. This research will find how routing protocol works and compare those dynamic routing protocols in IPv4 and IPv6 network. This research will simulate some network topology and shows that EIGRP are much better than OSPF in many different topologies. With the development of IPv6 [10], the research on Internet core technologies-routing technology based on IPv6 become more and more important. OSPF for IPv6, also referred to as OSPFv3, has been widely researched and implemented by many manufacturers in various devices such as routers and operation systems. In this paper we firstly introduce the knowledge of IPv6 and then analyse the mechanism of OSPF routing protocol. After research the improvements of OSPFv3, we use Dynamips simulator to model the main features of this complex protocol. Extensions for OSPF [11] in a mobile ad-hoc environment have been developed by the OSPF IETF working group. These extensions are emerging as effective routing solutions for tactical edge networks. However, these extensions have been designed and implemented for IPv6 routing, namely OSPFv3, so OSPFv3 is not directly applicable to IPv4 networks. Fortunately, the OSPF working group has also proposed an address family extension which allows OSPFv3 to operate in IPv4 networks. The address family extension assumes that the physical interface supports both IPv4 and IPv6 natively. Nevertheless, this assumption is not valid for the security tunneling interfaces across some IP encryptors. In this paper, we propose a novel solution which enables OSPFv3 MANET extensions to operate over various IP encryptors. Our approach is a modular approach and leverages widely deployed automatic tunneling mechanism, i.e., ISATAP (intra-site automatic tunnel addressing protocol). We demonstrate that our approach can provide a unified routing solution for both IPv4 and IPv6 across

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Limitations of earlier work

The major shortcomings of existing research work are:-

1. The performance of OSPF V3 and IS-IS has been neglected by the most of existing researchers.
2. Most of the researchers did work on IPv4, we are going to work on IPv6.
3. The effect of scalability in the network has been neglected by most of the existing researchers.

Conclusion and future work

This paper deals with the critical issues of OSPF V3 & IS-IS in IPV6. 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. Therefore this work focuses on evaluating the shortcomings of IPV6 based protocol in various applications like data base, video, voice E-mail and HTTP servers. It has been found that the performance of OSPF V3 and IS-IS has been neglected by the most of existing researchers. Most of the researchers did work on IPv4 that means the characteristics of IPv6 have been ignored. The effect of scalability in the network has been neglected by most of the existing researchers. In near future we will simulate the given IPV6 based protocols in OPNET tool.

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