Volume 6, Issue 3, March 2016 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

A Survey of Various Routing Protocols

Yashpreet Kaur, Mandeep Kaur
Shri Guru Granth Sahib World University, Fatehgarh Sahib,
Punjab, India

***Abstract**— In a network topology for forwarding packets various routing protocols are being used. Routers maintain a routing table for successful delivery of the packets from the source node to the correct destined node. The extent of information stored by a router about the network depends on the algorithm it follows. Most of the popular routing algorithms used are RIP, OSPF, IGRP and EIGRP. Here in this paper we are analyzing the performance of these very algorithms on the basis of the cost of delivery, amount of overhead on each router, number of updates needed, failure recovery, delay encountered and resultant throughput of the system. We are trying to find out which protocol suits the best for the network and through a thorough analysis we have tried to find the pros and cons of each protocol.*

***Keywords**— TCP/IP, BGP, IGP,*

I. INTRODUCTION

Internet protocol suite is used for communication for the internet and similar networks. TCP/IP [1-4] provides end to end connectivity and also specifies how data should be formatted, addressed, transmitted, routed and received at the destination. It basically has four abstraction layers namely link layer, internet layer, transport layer and application layers. Each layer has its own functions as Link Layer contains communication technologies for a local network; Internet Layer connects local networks and establishes internetwork communication; Transport layer handles host to host communication and Application layer contains protocols specific for data communication services on process to process level.

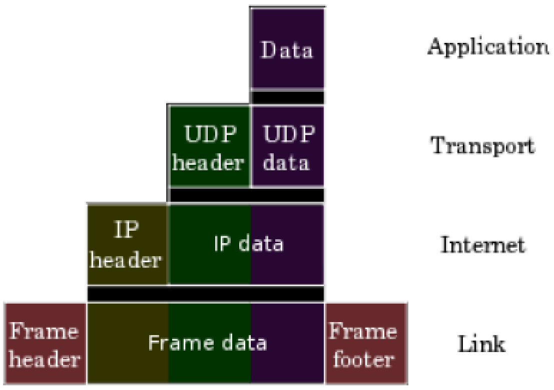

Fig 1: Data encapsulation in TCP/IP suit

Dynamic routing protocols have been used in N/Ws since early 1980.As N/W have evolved so become more complex new routing protocols have emerged [1]. Dynamic routing use Routing Protocol that dynamically discover N/W destinations. Dynamic routing protocols have big impact on network resource utilization [9]. If router on the route goes down then dynamic routing allow routing tables in routers to change.

There are mainly three classes which are used on IP networks.

1. Interior Gateway Routing via link state routing protocols- IGP exchange routing information within a single administration. Link state routing protocol use sophisticated algorithms. that maintain a data base of internetwork topology [6] ..e.g. OSPF and IS-IS.
2. Interior gateway routing via distance vector routing protocols- It uses simple algorithm that calculates a cumulative distance value between routers based on hop count.
3. Exterior gateway routing- Border gateway protocol (BGP) is the routing protocol used on internet for exchange traffic between autonomous systems.

In this paper various Interior Gateway Routing Protocols are compared.

In link state routing, each node build a roadmap of connectivity to the network, showing which node are connected to which other nodes [10]. Each node then independently calculates the next best logical path from it to every possible destination in the network. The collection of best path will then form the routing table. In LSP the only information passed between nodes is connectivity related. Link State Routing Protocols converge more quickly and they are less prone to routing loops. Convergence is when all routers to share information calculate best path and update the routing table. Faster the convergence better is the routing protocol.

Link State Routing Protocol work best in situation where:

1. Network Design is Hierarchical
2. Administrator has a good knowledge of implementation
3. Fast convergence of network is crucial.

II. ROUTING PROTOCOLS

Open Shortest Path First: OSPF [5] [7] [9] is a routing protocol which was defined as version 2 in RFC 2328; used to allow routers to dynamically learn routes from other routes and to advertise routes to other routes; advertisements containing routes are referred to as link state advertisements; keeps the track of all the various links between itself and a n/w it is trying to send data to; summarizes the route information ,reduces the number advertised routes and reduces the n/w load, uses a designated router to reduce the quantity and frequency of link state advertisements; it has a router, processor, memory more than other routing protocols; selects the best routes of finding the lowest cost paths to a destination; Protocol suite: TCP/IP; Protocol type: Transport layer interior link state routing protocol; Interior Gateway Protocol: Routing Information in an autonomous system; Link State based Algorithm: The state of the interface or link is used to decide the path on which the information is routed; Multiple links with same state is possible. Demand to a destination can be routed on multiple paths.

Routing Using OSPF

Routers maintain database with link state information, weights computed using link state, IP address etc. This database in each router is updated by transmitting Link State Advertisements throughout the autonomous system. A shortest path tree is constructed by each router with itself as the root node and based on weights in the database.

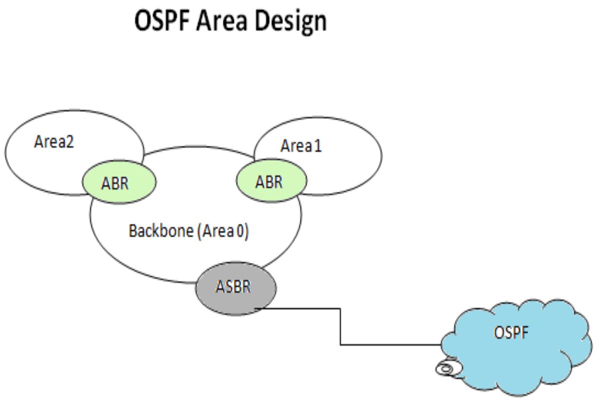

Fig 2: Area Design of OSPF Routing Protocol

A. OSPF Terminology

1) Link: It is the network or interface assigned to any given network. In OSPF a link will have state information associated with it

2) Router ID : It is an IP address used to identify router.

3) Neighbour: These are two or more router, that have an interface on a common network

4) Adjacency: It is a relationship between two OSPF routers, that permit direct exchange of route updates.

5) Hello protocol: It provides dynamic neighbour discovery and maintain relationships hello packets are address to 224.0.0.5. [2]

6) Neighbourship Database: A variety of details including router ID and state are maintained on each router in this database.

7) Topological Database: It contains the information from all of link state advertisement packets that have been received from an area.

8) Link state advertisement: LSA is an OSPF data packet containing link state and routing information , that shared among OSPF routers

9) OSPF areas : It is a grouping of contiguous networks and routers . area also play a role in establishing hierarchical network.

10) Designated Router (DR) : It is elected whenever OSPF routers are connected to same multi-access network.

11) Backup Designated Router (BDR) : BDR is a hot stand by DR on multi-access links. The BDR receives all updates from OSPF adjacent routers.

B. OSPF Tables

In OSPF there are different tables for storing different information regarding network

1) Neighbour Table: It contains the information of connected OSPF routers in this table the information of neighbour status router ID are stored.

2) Topology Table: Each router has full road map of its entire area
3) Routing Table: Routing table has best route for reaching different network. OSPF uses this SPF for calculate best path in OSPF process.

C. Packet Types

Hello Packet, DBD, LSR, LSU, LSA are the name of the packets used in OSPF. Hello packet is used to discover or maintained neighbor. DBD (data base description) is used to summarized the content of database .LSR (link state request) is used to download the database .LSU (link state update) are used to make updating in the database , LSA (link state acknowledgment) are used for flooding the acknowledgment.

D. Neighbour Relationship

1) Determine router ID. each router has its unique ID.
2) Add interfaces to link state database.
3) Send hello message on the chosen interface this state is called “Down State”.
4) When the router received hello then this state is called “Init State”. This state check the area ID , net mask , hello/dead interval of the router.
5) After checking the ID the router send reply hello i.e. it sends the reply hello to neighbours this state is called”2-way State”.the router send that Am I listed as a neighbour in your hello packet?. If the reply is yes then it reset the dead timer. if the reply is no, add as new neighbour .If the routers are new neighbours than it goes to next step .
6) Master-slave relationship determined: this state is called “Exstart State”. Master sends DBD packet. DBD is the summary of link state database.
7) DBD are acknowledged and reviewed : this state is called “Loading State” if DBD have some new network information that slave did not have in its routing table , it sends LSR to master then the master sends LSU updates.
8) Neighbours are synchronised: this state is called” Full State”.
OSPF uses a metric referred as Cost. Cost is associated with every outgoing interface included in SPF Tree. The formula for calculating cost in OSPF is as follows:
Cost = More the bandwidth of OSPF less is the cost [2] .The Dijkstra algorithm is used to calculate shortest path.

Routing Information Protocol:

The Routing Information Protocol (RIP) [5][8][10][11] is a distance-vector protocol that uses hop count as its metric. The Routing Information Protocol (RIP) provides the standard IGP protocol for local area networks, and provides great network stability, guaranteeing that if one network connection goes down the network can quickly adapt to send packets through another connection. It is widely used for routing traffic in the global Internet and is an interior gateway protocol (IGP), which means that it performs routing within a single autonomous system. RIP itself evolved as an Internet routing protocol, and other protocol suites use modified versions of RIP. IP RIP is formally defined in two documents: Request For Comments (RFC) 1058 and 1723. RFC 1058 (1988) describes the first implementation of RIP, while RFC 1723 (1994) updates RFC 1058. RFC 1058 enables RIP messages to carry more information and security features.

RIP Updates

RIP sends routing-update messages at regular intervals and when the network topology changes. When a router receives a routing update that includes changes to an entry, it updates its routing table to reflect the new route. The metric value for the path is increased by one, and the sender is indicated as the next hop. RIP routers maintain only the best route (the route with the lowest metric value) to a destination. After updating its routing table, the router immediately begins transmitting routing updates to inform other network routers of the change. These updates are sent independently of the regularly scheduled updates that RIP routers send. The algorithm that enables each router to update its database with the fastest route communicated from neighboring routers:
Database each RIP router on a given network keeps a database that stores the following information for every computer in that network:

- IP Address. The Internet Protocol address of the computer.
- Gateway. The best gateway to send a message addressed to that IP address.
- Distance: The number of routers between this router and the router that can send the message directly to that IP address.
- Route change flag. A flag that indicates that this information has changed, used by other routers to update their own databases.
- Timers. Various timers. The RIP algorithm works like this
- Update. At regular intervals each router sends an update message describing its routing database to all the other routers that it is directly connected to. Some routers will send this message as often as every 30 seconds, so that the network will always have up-to-date information to quickly adapt to changes as computers and routers come on and off the network.
- Propagation. When a router X finds that a router Y has a shorter and faster path to a router Z, then it will update its own routing database to indicate that fact. Any faster path is quickly propagated to neighboring routers through the update process, until it is spread across the entire RIP network.

Each hop in a path from source to destination is assigned a hop-count value, which is typically 1. When a router receives a routing update that contains a new or changed destination-network entry, the router adds one to the metric value indicated in the update and enters the network in the routing table. The IP address of the sender is used as the next hop.

Interior Gateway Routing Protocol:
The Interior Gateway Routing Protocol (IGRP)[5-8] [10-11] is a routing protocol to provide routing within an autonomous system (AS). Distance-vector routing protocols calls for each router to send all or a portion of its routing table in a routing-update message at regular intervals to each of its neighboring routers. As routing information proliferates through the network, routers can calculate distances to all nodes within the internetwork. IGRP adheres to the following Distance-Vector characteristics: sends out periodic routing updates (every 90 seconds); sends out the full routing table every periodic update; uses a form of distance as its metric; uses the Bellman-Ford Distance Vector algorithm to determine the best "path" to a particular destination; supports only IP routing; utilizes IP protocol 9; routes have an administrative distance of 100; by default, supports a maximum of 100 hops. This value can be adjusted to a maximum of 255 hops; is a classful routing protocol; uses Bandwidth and Delay of the Line, by default, to calculate its distance metric. Reliability, Load, and MTU are optional attributes that can be used to calculate the distance metric; requires that you include an Autonomous System (AS) number in its configuration. Only routers in the same Autonomous system will send updates between each other.

Enhanced Interior Routing Protocol:
Enhanced Interior Gateway Routing Protocol (EIGRP) or Enhanced IGRP [5-11] is a Cisco proprietary routing protocol utilizing the Diffusing Update Algorithm (DUAL). EIGRP is a hybrid protocol as it incorporates features of a Distance Vector routing protocol and features of a Link State routing protocol. Enhanced Interior Gateway Routing Protocol (EIGRP) is an enhanced version of IGRP. used in TCP/IP and OSI internets. It is regarded as an interior gateway protocol (IGP) but has also been used extensively as an exterior gateway protocol for inter-domain routing. Key capabilities that distinguish Enhanced IGRP (EIGRP) from other routing protocols include fast convergence, support for variable-length subnet mask, support for partial updates, and support for multiple network layer protocols. A router running EIGRP stores all its neighbors' routing tables so that it can quickly adapt to alternate routes. If no appropriate route exists, EIGRP queries its neighbors to discover an alternate route. These queries propagate until an alternate route is found.
The support of EIGRP for variable-length subnet masks permits routes to be automatically summarized on a network number boundary. In addition, EIGRP can be configured to summarize on any bit boundary at any interface.

Working
2.4.1.1 Neighbor Table
Each router keeps state information about adjacent neighbors. When newly discovered neighbors are learned, the address and interface of the neighbor is recorded. This information is stored in the neighbor data structure. The neighbor table holds these entries. There is one neighbor table for each protocol dependent module. When a neighbor sends a hello, it advertises a HoldTime. The HoldTime is the amount of time a router treats a neighbor as reachable and operational. In other words, if a hello packet isn't heard within the HoldTime, then the HoldTime expires. When the HoldTime expires, DUAL is informed of the topology change.
The neighbor table entry also includes information required by the reliable transport mechanism. Sequence numbers are employed to match acknowledgments with data packets. The last sequence number received from the neighbor is recorded so out of order packets can be detected. A transmission list is used to queue packets for possible retransmission on a per neighbor basis. Round trip timers are kept in the neighbor data structure to estimate an optimal retransmission interval.

Topology Table
The Topology Table is populated by the protocol dependent modules and acted upon by the DUAL finite state machine. It contains all destinations advertised by neighboring routers. Associated with each entry is the destination address and a list of neighbors that have advertised the destination. For each neighbor, the advertised metric is recorded. This is the metric that the neighbor stores in its routing table. If the neighbor is advertising this destination, it must be using the route to forward packets. This is an important rule that distance vector protocols must follow. Also associated with the destination is the metric that the router uses to reach the destination. This is the sum of the best advertised metric from all neighbors plus the link cost to the best neighbor. This is the metric that the router uses in the routing table and to advertise to other routers.

Feasible Successors
A destination entry is moved from the topology table to the routing table when there is a feasible successor. All minimum cost paths to the destination form a set. From this set, the neighbors that have an advertised metric less than the current routing table metric are considered feasible successors. Feasible successors are viewed by a router as neighbors that are downstream with respect to the destination. These neighbors and the associated metrics are placed in the forwarding table. When a neighbor changes the metric it has been advertising or a topology change occurs in the network, the set of feasible successors may have to be re-evaluated. However, this is not categorized as a route recomputation. When a link

to a neighbor that is the only feasible successor goes down, all routes through that neighbor commence a route recomputation and enter the Active state

III. CONCLUSION

On analyzing the result of the performance of various routing protocols naming RIP, OSPF, IGRP and EIGRP over a scenario for cost of transmission, router overhead, throughput, link utilization and queuing delay we can say that OSPF has best performance overall as it has the least cost of transmission, lower router overhead after RIP and maximum throughput amongst all routing protocol and queuing delay of it is second lowest after EIGRP and it also has second highest link utilization after EIGRP. Then EIGRP performs good as it has cost of transmission just above OSPF and has optimum router over head and overall performance in terms of throughput, Queuing delay and link utilization.

So for best effort service that is transmission of data packets OSPF performs better than other protocols for throughput, queuing delay, utilization and overhead.

REFERENCES

[1] Understanding the protocols underlying dynamic Routing, CNET Networks, and Retrieved 2008-10-17.

[2] Rick Graziani and Allan Jonson,2008, Routing Protocols and Concepts, CCNA exploration companion guide, Pearson Education.

[3] Wu, Bing, “Simulation Based Performance Analyses on RIP, EIGRP and OSPF Using OPNET"

[4] Vishal sharma, Rajneesh Narula and Sameer khullar “Performance Analysis of IEEE 802.3 using IGRP and EIGRP Routing Protocols” International Journal of Computer Applications (0975 – 8887)Volume 44– No13, April 2012

[5] Ittiphon krinpayorm and Suwat Pattaramalai,"Link Recovery Comparison Between OSPF & EIGRP ", International Conference on Information and Computer Networks (ICICN 2012) IPCSIT vol. 27 (2012) IACSIT Press, Singapore

[6] Mr. R. M. Pethe, Miss S. R .Burnase TECHNICAL ERA LANGUAGE OF THE NETWORKING - EIGRP International Journal of Engineering Science and Technology (IJEST) NCICT Special Issue Feb 2011

[7] Mehboob Nazim Shehzad, Najam-Ul-Sahar, "Simulation of OSPF Routing Protocol Using OPNET Module"(A Routing Protocol Based on the Link-State Algorithm)

[8] Bernard Fortz,Jennifer Rexford and Mikkel Thorup., Traffic Engineering With Traditional IP Routing Protocols." IEEE Communications Magazine. October 2002, pp. 118-124.

[9] Ahmad Karim, Minhaj Ahmad Khan "Behaviour of Routing Protocols for Medium to Large Scale Networks", Australian Journal of Basic and Applied Sciences, 5(6): 1605-1613, 2011