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Study of Dynamic Routing Protocols

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Abstract

Today the technology is rapidly entering into the lives of humans. The people nowadays, depend on these technologies for most of their work to be done. To make our lives more private & secure, we need some rules regarding our use of technologies. These rules are known in the technical world as protocols. They are of great importance to us in the current era & the years to come. These protocols change according to the demands, day-by – day. Routing is a process of finding of finding the best path in a network. The 2 types of routing are static routing protocol and dynamic routing protocol. The dynamic routing protocol is more robust than static routing protocol.

1 Introduction

Talking about the dynamic routing protocols, below is a figure (Figure1) that shows the evolution of Dynamic Protocols over time.

Interior Gateway Protocols

- Open Shortest Path First (OSPF)
- Routing Information Protocol (RIP) & RIPv2
- Intermediate System to Intermediate System (IS-IS)
- Enhanced Interior Gateway Routing Protocol (EIGRP)
- IGRP Interior Gateway Routing Protocol (IGRP)

Exterior Gateway Protocols

- Exterior Gateway Protocol (EGP)
- Border Gateway Protocol (BGP)

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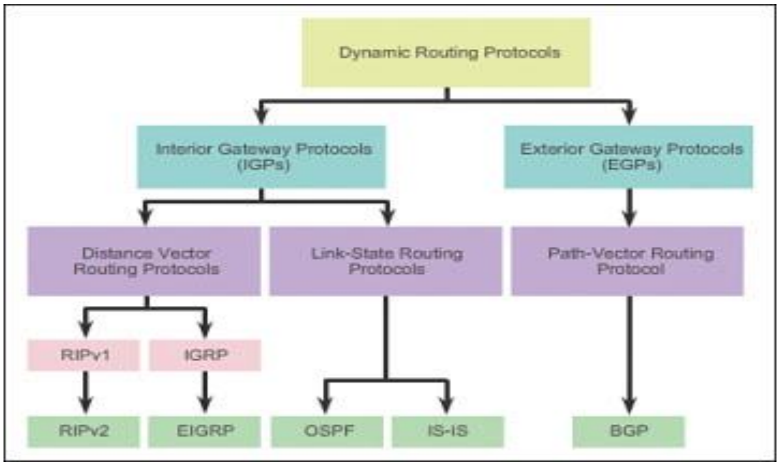
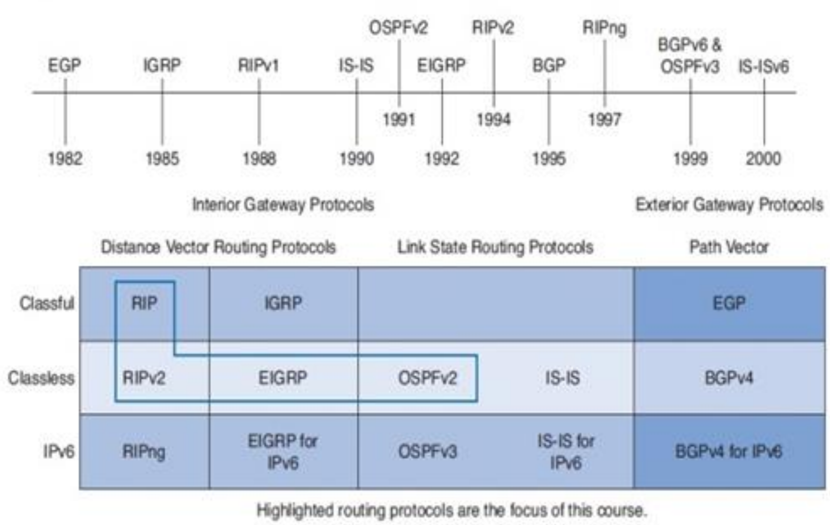
Figure 1



Evolution

The use of the dynamic routing protocols have started from the early 1980s. First version of RIP released in 1982, but some of the basic algorithms within the protocol were used on the ARPANET as early as 1969. The enhancement and evolving of networks also led them to become more complex; new routing protocols too have emerged since. Figure 2 shows the classification of routing protocols and a timeline of IP routing protocols.

Figure 2: Evolution of dynamic routing protocols

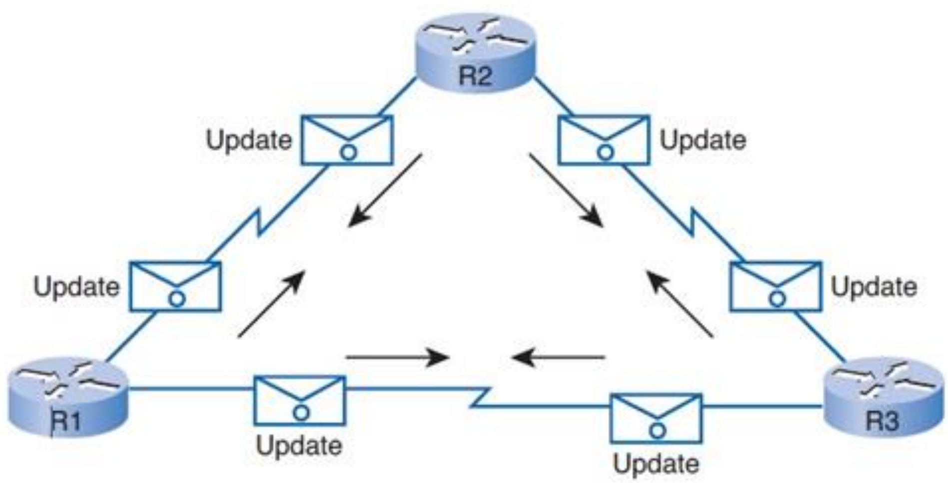


RIP is the earliest protocol and has evolved into a newer version: RIPv2. However, the newer version of RIP still does not scale to larger network implementations. To address the needs of larger networks, two advanced routing protocols were developed—OSPF and IS-IS.
Cisco introduced us to Interior Gateway Routing Protocol (IGRP) and Enhanced IGRP (EIGRP). EIGRP scales well in larger network implementations.
Additionally, there was the need to interconnect different internetworks and provide routing among them. Border Gateway Protocol (BGP) is now used between Internet service providers (ISP) as well as between ISPs and their larger private clients to exchange routing information. With the advent of numerous consumer devices using IP, the IPv4 addressing space is nearly exhausted. To get over this limitation of IPv4, IPv6 emerged. To support the communication based on IPv6, newer versions of the IP routing protocols have been developed (see the IPv6 row in Figure 2).

2 Role of Dynamic Routing Protocol

Routing protocols are used to facilitate the exchange of routing information between routers. Routing protocols allow routers to dynamically learn information about remote networks and automatically add this information to their own routing tables, as shown in Figure 3.[12]

Figure 3: Routers Dynamically Pass Updates



In the routing table, the best path to each network is added. If changes in the topology are done, the routers exchange information so they can change their tables. This is a great advantage of dynamic routing protocol, as the changes in the topology are frequent in today's world. The exchange of information allows routers to automatically learn about new networks and also, find new and alternate paths if there is a link failure to a current network. Compared to static routing, dynamic routing protocols require less administrative overhead. However, the expense of using dynamic routing protocols is dedicating part of a router's resources for protocol operation, including CPU time and network link bandwidth. Despite the benefits of dynamic routing, static routing still has its place. There are times when static routing is more appropriate and other times when dynamic routing is the better choice. To make the network less complicated, the use of both protocols could be seen.

3 Purpose of Dynamic Routing Protocols

A routing protocol is a set of processes, algorithms, and messages. These exchange routing information and populate the routing table with the routing protocol's choice of best paths. The purpose of a routing protocol includes:

- Discovering remote networks
- Maintaining up-to-date routing information
- Choosing the best path to destination networks
- Having the ability to find a new best path if the current path is no longer available

The components that a routing protocol possesses are:

- Data structures: Some routing protocols use tables or databases for their operations. This information is kept in RAM.
- Algorithm: An algorithm is a finite list of steps used in accomplishing a task. Routing protocols use algorithms for processing routing information and for best-path determination.
- Routing protocol messages: Routing protocols use various types of messages to discover neighboring routers, exchange routing information, and do other tasks to learn and maintain accurate information about the network.

3.1 Dynamic Routing Protocol Operation

To learn about remote networks and, to quickly adapt whenever there is a change in the topology, are the basic purposes of all the routing protocols. The method that a routing protocol uses to accomplish this depends on the algorithm it uses and the operational characteristics of that protocol. The operations of a dynamic routing protocol vary depending on the type of routing protocol and the specific operations of that routing protocol. The operations of a dynamic routing protocol can be described as follows:

- The router sends and receives routing messages on its interfaces.
- The router shares routing messages and routing information with other routers that are using the same routing protocol.
- Routers exchange routing information to learn about remote networks.
- When a router detects a topology change, the routing protocol can advertise this change to other routers.

3.2 Dynamic Routing Protocol Advantages

In many cases, the complexity of the network topology, the number of networks, and the need for the network to automatically adjust to changes require the use of a dynamic routing protocol. Before examining the benefits of dynamic routing protocols, we need to consider the reasons why we use static routing. Dynamic routing certainly has several advantages over static routing; however, static routing is still used in networks today. In fact, networks typically use a combination of both static and dynamic routing. Figure 4 compares dynamic and static routing features. From this comparison, we listed the advantages of each routing method. The advantages of one method are the disadvantages of the other.

Figure 4: Dynamic versus Static Routing

Feature	Dynamic Routing	Static Routing
Configuration complexity	Generally independent of the network size	Increases with network size
Required administrator knowledge	Advanced knowledge required	No extra knowledge required
Topology changes	Automatically adapts to topology changes	Administrator intervention required
Scaling	Suitable for simple and complex topologies	Suitable for simple topologies
Security	Less secure	More secure
Resource usage	Uses CPU, memory, and link bandwidth	No extra resources needed
Predictability	Route depends on the current topology	Route to destination is always the same

Classification of routing protocols on basis of their characteristics:

- IGP or EGP
- Distance vector or link-state
- Classful or classless

Commonly used routing protocols:

- **RIP:** A distance vector interior routing protocol
- **IGRP:** The distance vector interior routing protocol developed by Cisco (deprecated from Cisco IOS Release 12.2 and later)
- **OSPF:** A link-state interior routing protocol
- **IS-IS:** A link-state interior routing protocol
- **EIGRP:** The advanced distance vector interior routing protocol developed by Cisco
- **BGP:** A path vector exterior routing protocol

4 Security and Performance Issues

Certain features of DSR hurt its performance or make it vulnerable to security attacks [3-9]. No Expiration of Routes: Without an effective mechanism to remove excessively old (stale) entries, route caches may contain broken or non-minimum hop routes. Using stale routes causes loss of data packets (low delivery rate) and wastes network bandwidth. Route replies from intermediate nodes and snooping data packets exacerbate this problem by polluting caches with stale routes [5-7]. Intermediate-Node (IN) Replies:

Intermediate-node replies make the route learning process faster because all route requests do not need to travel all the way to the destination. Without route freshness indication, however, it results in polluting caches with stale routes when node mobility is high and data transmissions are infrequent [5,6]. When a source receives the bad route reply, it tries to send the waiting data packet along the route. Upon failure of one of the links along the route, a route error packet is propagated back to the source, which then issues a new route request, starting the process all over again.

Data Salvaging: Data Salvage can be useful in relatively static networks, in which routes remain stable for relatively long periods of time. However, in a MANET, it is likely that the route in the intermediate node's cache was older, and hence, also invalid. Trying to salvage a data packet by using another bad route would result in a waste of time and bandwidth. Also, a malicious node may misroute data packets without risking its detection under the guise of data salvaging.

Gratuitous Replies: Like data salvaging, gratuitous replies can be of limited benefit when the routes are fresh and nodes are not malicious. Otherwise, this feature degrades performance, security, or both.

4.2 Solutions for the issues

New Techniques to Improve DSR Performance .The throughput achieved by Base DSR at a load of 50 Kbps for the example network configuration is about 32 Kbps (64% delivery rate), whereas, the throughput achieved by AODV for this network is close to 40 Kbps (80% delivery rate). So, to improve the performance of DSR further, we evaluate three simple, intuitive routing modifications based on our observations of other protocols.

4.3 Performance Analysis of Proposed techniques

Figure 5 gives delivery rates of 'Base DSR' (original DSR with IN replies, DS and gratuitous replies turned off) and combinations of the three proposed techniques applied to the base DSR. (LR indicates limited replies, FR routes sorted by timestamps, and 1R one route per destination.) Applying all three proposed techniques, denoted 'Base + LR + FR + 1R' in the graph, achieves the best performance until the network starts to saturate for high loads (>250 Kbps). At these high loads, most routes are congested. In such a scenario, congested links could be wrongly identified as 'broken', resulting in route errors and route requests propagating throughout the network. Keeping only 1 route increases the routing overhead (Figure 6), and hurts the performance for high loads. At lower loads, there is enough network bandwidth to absorb the additional control traffic caused by 1R option. It is noteworthy that the average ages of routes used (Figure 7) with the proposed techniques are also reduced significantly compared to the base DSR. Compared to the original DSR, the combination of base DSR with LR, FR and 1R options reduces route age by a factor of 15 and improves delivery rates by a factor of 2 to 4.

Figure 5: Delivery rates of base DSR and proposed modifications

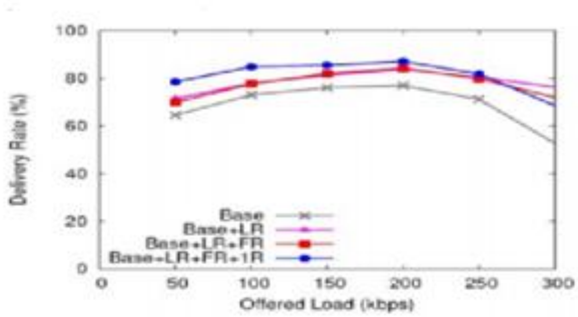


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Figure 6: Control Overhead for various forms of DSR

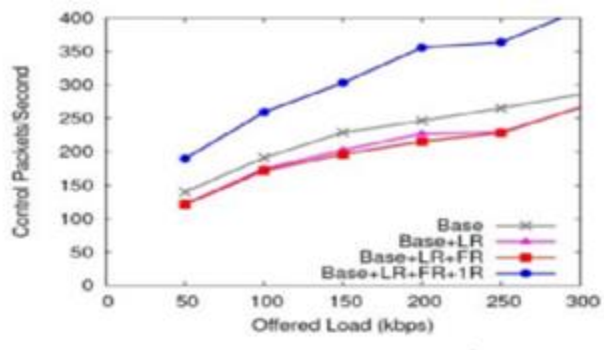
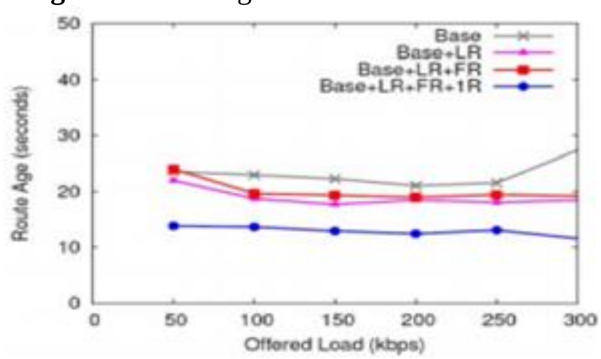


Figure 7: Route ages for various forms of DSR



5 Conclusions

We have studied the available dynamic routing protocols that are available and have studied their efficiency with respect to some factors. Then we have looked into their purposes, advantages and security issues and performance analysis for the same on the bases of DSR rates. The respective performance charts have been mentioned above.

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