

Routing Protocols Explained

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Preface:

In this paper I will explain many different routing protocols and give some basic details and features about them. This paper in no way should be considered a source of full detail about any of the listed protocols. For detailed information about routing protocols I would suggest looking into the Request For Comments (RFC) for that protocol, goggling them, or maybe visiting different vendor's websites such as Cisco, Juniper, or Bay networks. Most vendors' web sites have detailed explanations about all the Protocols there equipments support features. Before you can understand routing protocol you will have to have a basic understanding or IP networks, Variable Length Subnet Masks (VLSM), Network Topologies (bus, star, Hub, ect..), and the OSI model. If you are not familiar with any of the above subjects you may want to read up and learn about them before moving into routing protocols. Routing protocols are what makes the internet work by moving traffic from network to network. With out routing protocols the internet could not work because networks would just be separate LANs with no connection to others LANs. The internet in basic terms is just a lot of LANs wired together to make a huge WAN.

Protocol types:

Distance Vector: distance vector routing is a type of routing protocol that discovers routes on interconnected networks. The Distance Vector routing algorithm is based on the Bellman-Ford algorithm. Examples of distance-vector routing protocols include RIP (Routing Information Protocol), Cisco's IGRP (Internet Gateway Routing Protocol) try Google to see all the different protocols in the Distance Vector family. Distance Vector protocols are suitable for smaller networks as many of the protocols in this family aren't scaleable in larger complex networks as they are limited. The main limit to Distance Vector Protocols is there method that requires each router simply inform its neighbors of its routing table. This routing table update to other members is bandwidth intensive to larger networks.

RIP (Routing Information Protocol):

Routing Information Protocol (RIP) is one of the first protocols to be used in networking and is classified as a distance vector routing protocol. RIP uses broadcast User Datagram Protocol (UDP) data packets to exchange routing information. There are two versions RIP V1 & V2. RIP Version 1 is the original version and has many limitations. The metric that RIP uses to rate the value of different routes is hop count. The hop count metric works by assigning static routes with a value of 0 and all other routers values are set by the number of hops (up to 15) that the data must travel though to get to an end point. RIP Version 2 supports plain text and MD5 authentication, route summarization, classless inter-domain routing (CIDR), variable-length subnet masks (VLSMs), Multicast support. Some vendors support other non-standard features for RIP but be careful as many vendor centric features are not compatible in a mixed vendor network.

IGRP (Inter Gateway Routing Protocol):

Interior Gateway Routing Protocol (IGRP) is a distance vector routing protocol which is a proprietary and invented by Cisco. It is used by routers to exchange routing data within an autonomous system (AS). IGRP supports multiple metrics for routes, including bandwidth, load,

delay and MTU. This improves reliability over RIP because IGRP uses advanced metrics to compare two routes into a combined route. The two routes together are combined into a single metric, using a formula which can be adjusted via command line. The maximum hop count of IGRP is 255 which is an improvement over RIP's 15 hop max. Keep in mind that IGRP is a Cisco proprietary protocol and can not be used in a mixed vendor network.

Link State: Link State routing protocol requires each router (peer) to maintain at least a partial map of the network. When a network link changes state (up to down, or vice versa), a notification, called a link state advertisement (LSA) is flooded throughout the network. All the routers note the change, and recompute their routes accordingly. This method is more reliable, easier to debug and less bandwidth-intensive than Distance-Vector. It is also more complex and more compute- and memory-intensive. Link state routing protocols are found in many larger networks and provide Scalable solutions for more complex networks.

OSPF (Open Shortest Path First)

Open shortest path first (OSPF) is a link-state routing protocol that calls for the sending of link-state advertisements (LSAs) to all other routers within the same hierarchical area or autonomous system (AS). An AS can be divided into a number of areas, which are groups of contiguous networks and attached hosts. Information on attached interfaces, metrics used, and other variables are included in OSPF LSAs. As OSPF routers accumulate link-state information, they use the SPF algorithm to calculate the shortest path to each node.

(IS-IS) Intermediate System-to-Intermediate System

Intermediate System-to-Intermediate System (IS-IS) is a routing protocol developed by the ISO and is natively an ISO Connectionless Network Service or CLNS protocol so it does not use IP to carry routing information messages. It uses OSI protocols to deliver its packets and establish its adjacencies. IS-IS has been enhanced to carry IP (Internet Protocol) and this is called Integrated IS-IS. Integrated IS-IS supports VLSM and converges rapidly. It is also scalable to support very large networks and is the key protocol in many larger ISP's.

Hybrid: Hybrid routing Protocols are a combination of both Distance Vector and Link state protocols and only one protocol fits into this field. EIGRP is Cisco Systems Proprietary protocol based on their original IGRP. For more information on Hybrid Protocols look below to the section on "EIGRP".

EIGRP (Enhanced Inter Gateway Routing Protocol)

Enhanced Inter Gateway Routing Protocol (EIGRP) is Cisco Systems Proprietary protocol based on their original IGRP. EIGRP is a balanced hybrid IP routing protocol, with optimizations to minimize both the routing instability incurred after topology changes, as well as the use of bandwidth and processing power in the router. EIGRP has Protocol-Dependent Modules that can deal with AppleTalk and IPX as well as IP. The advantage with this is that only one routing process need run instead of a routing process for each of the protocols. EIGRP provides loop-free operation and almost instant simultaneous synchronization of routers.

Inter-Autonomous System: Inter-Autonomous System routing protocols are designed to connect larger networks or Autonomous Systems (AS) together and allow for multiple Autonomous Systems to network. One example for the need of an inter-autonomous system protocol is to connect two or more Internet Service Providers (ISP) together so their customer can connect to each other. Without getting in too much detail both "Link State & Distance Vector" protocols are considered intra-autonomous system

protocols as they are designed to just route traffic in a single AS. Inter-Autonomous System protocols main goal is to propagate the intra-autonomous system information between different autonomous systems.

BGP4 (Border Gateway Protocol Version 4)

Border Gateway Protocol is the backbone routing protocol for most of the internet and allows for peering and carrier networks to connect. BGP is explained as a path vector protocol. With BGP the policy or attributes for making the actual route selections among the interconnected autonomous systems is based on Weight, Local preference, Multi-exit discriminator, Origin, AS path, Next hop, & Community. BGP information is propagated through the network by exchanges of BGP messages (4 types: Open, Update, Notification, & Keep Alive) between peers. Another key feature to BGP is that it supports Classless Inter Domain Routing (CIDR) with the support of CIDR BGP can reduce the size of the Internet routing tables. BGP neighbors exchange full routing information when the TCP (port 179) connection between neighbors is first established. When changes to the routing table accrue, the BGP routers send to their neighbors only those routes that have changed. BGP routers do not send periodic routing updates and advertise only the optimal paths to a destination.