EIGRP (Enhanced Interior Gateway Routing Protocol)

Important points about EIGRP

- EIGRP is a Cisco proprietary protocol which means it will work only on Cisco routers.
- EIGRP is also called advanced distance vector or Hybrid routing protocol.
- Multicast or unicast is used for exchange of information.
- Multiple network layer protocols are supported.
- 100% loop-free.
- By default,EIGRP will limit itself to use no more than 50% of the interface bandwidth
- Maximum Hop-Count is 255[100 by default]
- EIGRP is classless protocol
- EIGRP supports VLSM and authentication
- EIGRP uses Diffusing Update Algorithm (DUAL) to determine the best path among all "feasible" paths. DUAL also helps ensure a loop-free routing environment.
- EIGRP will form neighbor relationships with adjacent routers in the same Autonomous System (AS)
- EIGRP uses RTP (Reliable Transport Protocol) and its function is to deliver EIGRP packets between neighbors in a reliable and ordered way.
- All EIGRP routing information are exchanged between neighbors via multicast using the address **224.0.0.10**
- EIGRP routers do not send periodic, full-table routing updates. Updates are sent when a change occurs, and include only the change
- K-Values are used for calculating metric. By default EIGRP consider k1 and k3 only
- EIGRP having internal Administrative distance as 90 and external AD as 170
- EIGRP summary route AD value is 5
- In EIGRP Summarization is enabled by default."**No auto-summary**" command is needed because by default EIGRP will behave like a classfull routing protocol which means it won't advertise the subnet mask along the routing information. For example 1.1.1.0/24 and 2.2.2.0/24 will be advertised as 1.0.0.0/8 and 2.0.0.0/8. Disabling auto-summary will ensure EIGRP sends the subnet mask along.
- EIGRP converges rapidly after link failure
- EIGRP can load balance on both equal and unequal cost paths."*Variance*" command is used to configure load balancing
- EIGRP supports up to 6 loop-free paths with a metric lowers than the product of variance and the best metric

- Manual summarization can be enabled at any interface
- If a packet is not acknowledged,EIGRP re transmit the packet to the non responding neighbor as a unicast.No other traffic is sent to this neighbor until it responds.After 16 unacknowledged re-transmissions,the neighbor is removed from the neighbor table
- The process of neighbor discovery and route exchange between two EIGRP router is as follows
    o Router A sends out a hello
    o Router B sends back a hello and an update.The update contains routing information
    o Router A acknowledges the update
    o Router A sends its update
    o Router B acknowledges
- A neighbor is considered as lost if no hello is relieved within 3 hello periods

Why do we call EIGRP an advanced distance vector or hybrid routing protocol?
Because it shares features of both distance vector and link state protocols. For example EIGRP advertise routes to directly connected neighbors like a distance vector protocols and it uses a series of tables like link state protocols

Advantages of EIGRP

- EIGRP uses AS (Autonomous system) number ranging from 1-65535 to identify collection of routers that share same information.
- EIGRP have less convergent time and is more efficient
- EIGRP supports both auto and manual route summarization
- Supports multiple routed protocols like IP ,IPX and apple talks
- EIGRP converges rapidly in the event of link failure
- EIGRP can load balance equal and unequal cost path.By default EIGRP supports 4 load balancing path.It can be extended to 6 paths

EIGRP Packet types
There are 5 packet types

1. **Hello Packet** – In normal scenarios Hello packets are send in 5 seconds .Hello packets are send between directly connected neighbors. Hello packets are send as Multicast
2. **Update** – Update packet are used to send triggered updates. EIGRP won't send periodic updates like distance vector protocols. They send triggered updates only when a chance is occurred .Update packets are send as Multicast or unicast

3. **Query** – Query packets are send when the successor path is failed and there is no feasible successor (back up path).Query packets are send as multicast
4. **Reply** – Reply for query packets. Reply packets are send as unicast
5. **ACK** – Ack packets are send as Acknowledgement for update and Reply packet. Send as Unicast

 NOTE : Hello packets don't have to be acknowledged since EIGRP uses a holddown time. If a
router doesn't receive hello packets in an X amount of time it will drop the neighbor adjacency.

Stuck in Active: When a route (current successor) goes down, the router first checks its topology table for a feasible successor. If backup path(feasible successor) is not present, it goes active(actively checking to find new route) on the that route to find a new successor by sending queries out to its neighbors requesting a path to the lost route. Such state of router while waiting for a reply for a query packet is called **Stuck in Active**. In normal working condition router running EIGRP protocols is in passive state(P).If there is a failure in successor path and there is no back up path, then router will be in Active state(A).

Conditions to form EIGRP neighbors
Must receive HELLO PACKET from neighbor router
AS number must be same
Must have identical K-values or Metric
Adjacencies will not form unless the primary IP addresses on connecting interfaces are on the same subnet.

EIGRP maintain 3 tables
• Neighbor table – list of all neighboring routers. Neighbors must belong to the same Autonomous System
• Topology table – list of all routes in the Autonomous System
• Routing table – contains the best route for each known network

EIGRP Neighbors
EIGRP forms neighbor relationships, called adjacencies, with other routers in the same AS by exchanging Hello packets. Routers share routing information after forming adjacencies. Hello packets are sent as
multicasts to address 224.0.0.10. By default, EIGRP Hellos are sent every 5 seconds. On slower connections, EIGRP Hellos are sent every 60 seconds by default.

The EIGRP Hello timer can be adjusted on a per interface basis:

Router(config)#Interface fa 0/1
Router(config-if)# ip hello-interval eigrp 20 15
The above command allows us to change the hello timer to 15 seconds for
Autonomous System 20.

In addition to the Hello timer, EIGRP neighbors have a Hold timer. The Hold timer
indicates how long a router should wait before marking a neighbor inactive, if it
stops receiving hello packets from that neighbor.

By default, the Hold timer is three times the Hello timer. On high-speed links the
timer is set to 15 seconds, and on slower links the timer is set to 180 seconds.

The Hold timer can also be adjusted on a per interface basis:
Router(config)#Interface fa 0/1
Router(config-if)# ip hold-interval eigrp 20 21
The above command allows us to change the hold timer to 21 seconds for
Autonomous System 20.

Changing the Hello timer does not automatically change the Hold timer.
Additionally, Hello and Hold timers do not need to match between routers for an
EIGRP neighbor relationship to form.

Successor Path and Feasible Successor path
EIGRP enabled routers will send HELLO Packets to each other and become
neighbors. EIGRP neighbors will exchange routing information which will be
saved in the topology table. The best path from the topology table will be copied in
the routing table. Such path are called Successor. Metric of the successor path is
called Feasible distance.

After finding the successor path ,EIGRP will find another path as a back up path to
successor to give redundancy is called Feasible successor. The metric used to
find feasible successor is called Advertised distance (AD) or Reported distance
(RD).This Advertised distance (AD) is the distance between neighbor of the source
and destination .
In short,
Advertised distance: How far the destination is away for your neighbor.
Feasible distance: The total distance to the destination.
successor : The best path to the destination

Condition for choosing Feasible successor
Advertised distance (AD) must be less than the metric of successor path
Advertised distance of feasible successor < Feasible distance of successor.

Note : While calculation best paths, one thing you must keep in mind is Split horizon rule which states *"whatever you learn on an interface you don't advertise back out of the same interface."*

Feasible Successors provide EIGRP with redundancy, without forcing routers to re-converge when a topology change occurs. If no Feasible Successor exists and a link fails, a route will enter an Active (converging) state until an alternate route is found.

EIGRP Route States
An EIGRP route can exist in one of two states, in the topology table:
• Active state
• Passive State

A Passive state indicates that a route is reachable, and that EIGRP is fully converged. A stable EIGRP network will have all routes in a Passive state.

A route is placed in an Active state when the Successor and any Feasible Successors fail, forcing the EIGRP to send out Query packets and re-converge. Multiple routes in an Active state indicate an unstable EIGRP network. If a Feasible Successor exists, a route should never enter an Active state.

You can check the status of states by using
Router# show ip eigrp topology
To view only active routes in the topology table:
Router# show ip eigrp topology active
EIGRP Metrics
EIGRP can utilize 5 separate metrics to determine the best route to a destination:

1. Bandwidth (K1)
2. Load (K2
3. Delay of the Line (K3
4. Reliability (K4)
5. MTU (K5)

By default, only Bandwidth and Delay of the Line are used
K1 = 1, K2 = 0, K3 = 1, K4 = 0, K5 = 0

Graceful Shutdown

When an EIGRP process is shut down, the router sends out "goodbye" messages to its neighbors (in the form of hello packets).   The neighbors can then immediately begin recalculating paths to destinations that went through the shutdown router without having to wait for the hold timer to expire.

GNS3 Labs:

- [EIGRP Beginner](#)
- [EIGRP intermediate](#)

Interview Questions
What is EIGRP?
What are the different tables in EIGRP?
Why EIGRP is called hybrid protocol
What are the different packets in EIGRP?
What are the advantages of EIGRP other routing protocol ?
What type of Authentication is supported by EIGRP ?
What is the use of "variance" Command in EIGRP?
Internal and external Administrative distance in EIGRP ?
What is Feasible successor ?
What is Advertised distance ?
What is successor ?
What is the muticast address used by EIGRP to send Hello packets ?
What is "Stuck in Active" ?
what is "Graceful shutdown" ?
what is "Goodbye" message recieved in EIGRP ?
Maximum path load balanced by EIGRP ?
How EIGRP support unequal load balancing ?
What happen when we enable passive interface in EIGRP ?
Conditions for EIGRP neigbours
what is meant by active and passive states in EIGRP ?
What are the different K-values used in EIGRP ?