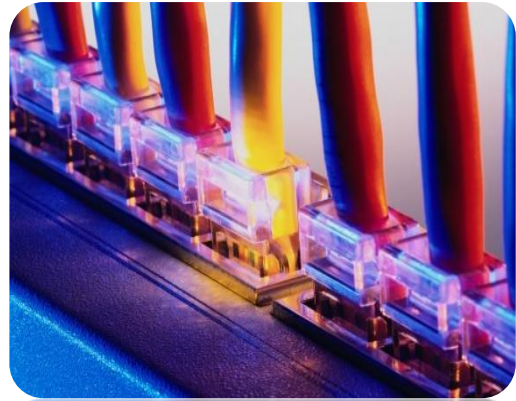


# *IP Routing -3*

## *L2 Switching*



### EIGRP Features and Operation

Enhanced IGRP (EIGRP) is a classless, **enhanced distance-vector** protocol. EIGRP is a Cisco proprietary protocol.

EIGRP **includes the subnet mask** in its route updates. And as you now know, the advertisement of subnet information allows us to use Variable Length Subnet Masks (VLSMs) when designing our networks!

EIGRP is sometimes referred to as a hybrid routing protocol because it has characteristics of both distance-vector and link-state protocols. For example, **EIGRP doesn't send link-state packets as OSPF does**; instead, **it sends traditional distance-vector updates** containing information about networks plus the cost of reaching them from the perspective of the advertising router.

And EIGRP has **link-state characteristics as well—it synchronizes routing tables between neighbors** at startup and then sends specific updates only when topology changes occur.

This makes EIGRP suitable for very large networks. EIGRP has a maximum hop count of 255 (the default is set to 100).

## Neighbor Discovery

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Before EIGRP routers are willing to exchange routes with each other, **they must become neighbors**. There are three conditions that must be met for neighborship establishment:

- Hello or ACK received
- AS numbers match
- Identical metrics (K values)

**The only time EIGRP advertises its entire routing table is when it discovers a new neighbor** and forms an adjacency with it through the exchange of Hello packets.

When this happens, both neighbors advertise their entire routing tables to one another.

Let's define some terms before we move on:

### Reported/advertised distance

This is the metric of a remote network, as reported by a neighbor.

### Feasible distance

The metric of a feasible distance is the metric reported by the neighbor (called reported or advertised distance) plus the metric to the neighbor reporting the route.

### Successor

A successor route is the best route to a remote network. A successor route is used by EIGRP to forward traffic to a destination and is stored in the routing table.

### Feasible successor

A feasible successor is a path whose reported distance is less than the feasible distance, and it is considered a backup route. EIGRP will keep up to six feasible successors in the topology table.

### Neighbor table

Each router keeps state information about adjacent neighbors in this table.

### Topology table

The topology table is populated by the protocol-dependent modules and acted upon by the Diffusing Update Algorithm (DUAL). It contains all destinations advertised by neighboring routers.

### Diffusing Update Algorithm (DUAL)

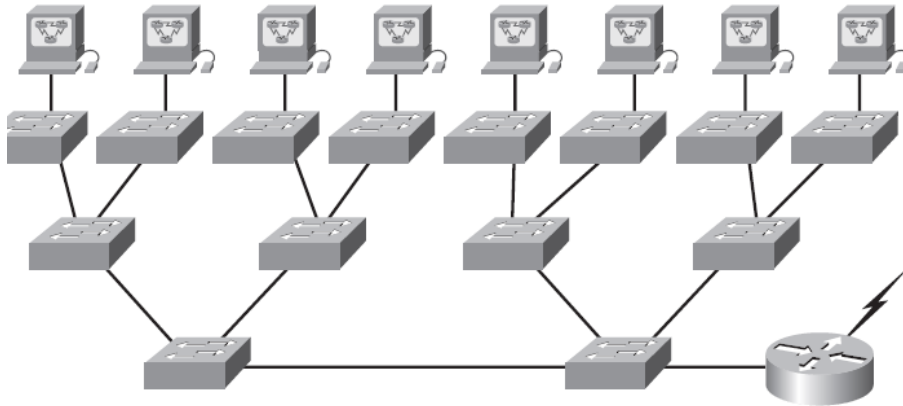
EIGRP uses Diffusing Update Algorithm (DUAL) for selecting and maintaining the best path to each remote network. DUAL also used to obtain backup paths

## Configuration

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```
R2(config)#router eigrp 1
R2(config-router)#network 172.16.0.0
%DUAL-5-NBRCHANGE: IP-EIGRP 1: Neighbor 172.16.3.1 (Serial0/0/0) is up: new adjacency
R2(config-router)#network 192.168.10.8 0.0.0.3
```

# *L2 Switching*



## Switching Services

Layer 2 switches and bridges are faster than routers because they don't take up time looking at the Network layer header information. Instead, they look at the frame's hardware addresses before deciding to either forward, flood or drop the frame.

### Layer 2 switching provides the following:

- Hardware-based bridging (ASIC)
- Wire speed.
- Low latency.
- Low cost.

## Three Switch Functions at Layer 2

There are three distinct functions of layer 2 switching (you need to remember these!):

**Address learning , forward/filter decisions , and loop avoidance**

## Address learning

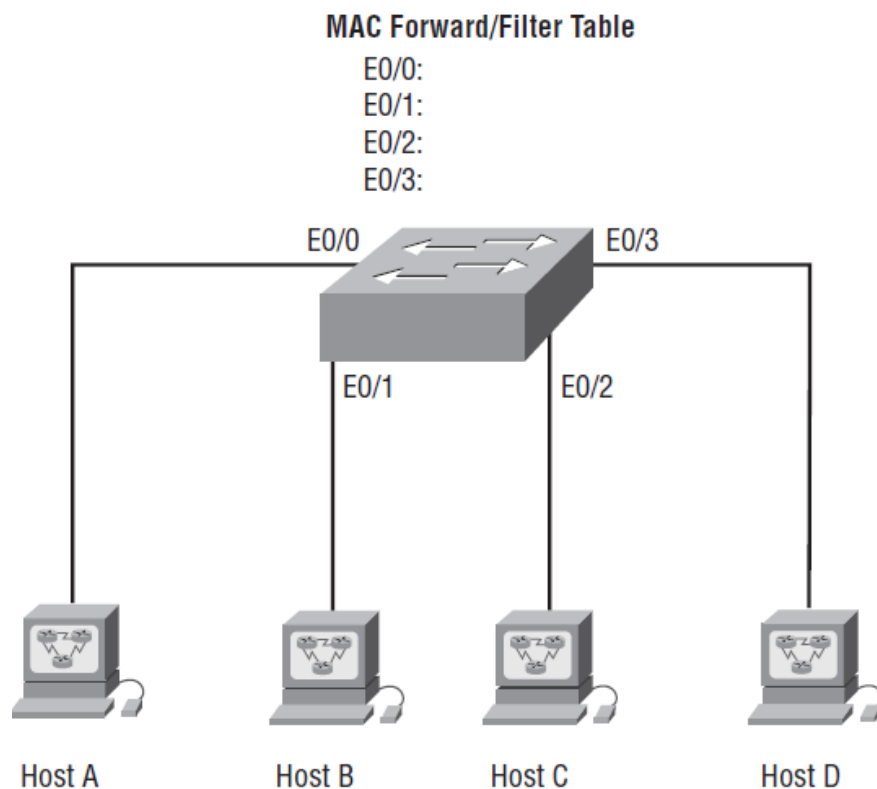
Layer 2 switches and bridges remember the **source hardware address** of each frame received on an interface, and they enter this information into a MAC database called a forward/filter table.

## Forward/filter decisions

When a frame is received on an interface, the switch looks at the destination hardware address and finds the exit interface in the MAC database. The frame is only forwarded out the specified destination port.

## Loop avoidance

If multiple connections between switches are created for redundancy purposes, network loops can occur. Spanning Tree Protocol (STP) is used to stop network loops while still permitting redundancy.



## Spanning Tree Protocol (STP)

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STP's main task is to stop network loops from occurring on your layer 2 network (bridges or switches). It vigilantly monitors the network to find all links, making sure that no loops occur by shutting down any redundant links. STP uses the spanning-tree algorithm (STA) to first create a topology database and then search out and destroy redundant links. With STP running, frames will be forwarded only on the premium, STP-picked links.

## Spanning Tree Terms

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### Root bridge

The root bridge is the bridge with the **lowest bridge ID**. With STP, the key is for all the switches in the network to elect a root bridge that becomes the focal point in the network. All other decisions in the network—such as which port is to be blocked and which port is to be put in forwarding mode—are made from the perspective of this root bridge.

### Bridge Protocol Data Unit (BPDU)

All the switches exchange information to use in the selection of the root switch as well as in subsequent configuration of the network, and this is done by exchanging BPDUs.

### Bridge ID

The bridge ID is how STP keeps track of all the switches in the network. It is determined by a **combination of the bridge priority** (32,768 by default on all Cisco switches) **and the base MAC address**. The bridge with the lowest bridge ID becomes the root bridge in the network.

### Root port

The root port is always the link directly connected to the root bridge, or the shortest path to the root bridge.

### Designated port

A designated port is one that has been determined as having the best (lowest) cost. A designated port will be marked as a forwarding port.

### Nondesignated port

A nondesignated port is one with a higher cost than the designated port. Nondesignated ports are put in blocking mode—they are not forwarding ports.

### Forwarding port

A forwarding port forwards frames.

### Blocked port

A blocked port is the port that, in order to prevent loops, will not forward frames. However, a blocked port will always listen to frames.

## Spanning Tree Operations

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### Selecting the Root Bridge

To determine the root bridge, you combine the priority of each bridge with its MAC address. If two switches or bridges happen to have the same priority value, the MAC address becomes the tiebreaker for figuring out which one has the lowest (best) ID.

Changing the default priority is the best way to choose a root bridge. This is important because you want the core switch (the one closest to the center of your network) to be the root bridge in your network so STP will converge quickly.

Switch B(config)#**spanning-tree vlan 1 priority ?**

<0-61440> bridge priority in increments of 4096

Switch B(config)#**spanning-tree vlan 1 priority 4096**

## Elect Root Ports

Every switch in a spanning-tree topology, except for the root bridge, has a single root port defined. The root port is the switch port with the lowest path cost to the root bridge.

when two or more ports on the same switch have the same path cost to the root use the configurable port priority value.

Link Speed	Cost (Revised IEEE Specification)	Cost (Previous IEEE Specification)
10 Gb/s	2	1
1 Gb/s	4	1
100 Mb/s	19	10
10 Mb/s	100	100

## Electing Designated Ports and Non-Designated Ports

After a switch determines which of its ports is the root port, the remaining ports must be configured as either a designated port (DP) or a non-designated port (non-DP) to finish creating the logical loop-free spanning tree.

**Each segment in a switched network can have only one designated port.** When two non-root port switch ports are connected on the same LAN segment, a competition for port roles occurs. The two switches exchange BPDUs to sort out which switch port is designated and which one is non-designated.

Generally, when a switch port is configured as a designated port, it is based on the BID. **However, keep in mind that the first priority is the lowest path cost to the root bridge** and that only if the port costs are equal, is the BID of the sender.

- First step is to select the switch on the segment. The switch on the network segment with the lowest accumulated path cost to the Root Bridge will be selected.



- If there is a tie in accumulated path costs between the two switches in the network segment, then the switch with the lowest Switch ID will be selected

## Spanning-Tree Port States

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The ports on a bridge or switch running STP can transition through five different states:

### Blocking

A blocked port won't forward frames; it just listens to BPDUs. The purpose of the blocking state is to prevent the use of looped paths. All ports are in blocking state by default when the switch is powered up.

### Listening

The port listens to BPDUs to make sure no loops occur on the network before passing data frames. A port in listening state prepares to forward data frames without populating the MAC address table.

### Learning

The switch port listens to BPDUs and learns all the paths in the switched network.

### Forwarding

The port sends and receives all data frames on the bridged port. If the port is still a designated or root port at the end of the learning state, it enters the forwarding state.

### Disabled

A port in the disabled state (administratively) does not participate in the frame forwarding or STP. A port in the disabled state is virtually nonoperational.