TCOM 515 IP Routing

Lab5: BGP(Border Gateway Protocol) Routing

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Router: DALLAS

Team Members: None

1. Introduction

In order for packets to be routed throughout the network, each router must generate a routing table. This routing table serves as a map to direct which interface the packet needs to be sent at. There are three ways the routing table is created.

1. Directly connected interfaces. (C-connected)
2. Static routes. (S-static)
3. Dynamic routing protocols. (O-OSPF/R-RIP/B-BGP/D-EIGRP)

In this lab, BGP(Border Gateway Protocol), specifically iBGP(Interior) and eBGP(Exterior) will be explored to generate a routing table.

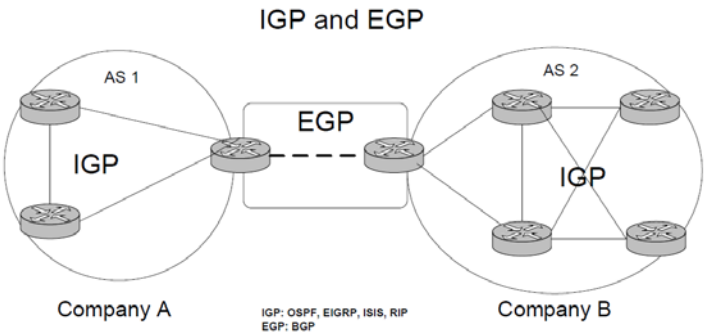
- BGP is primarily used as an EGP(Exterior Gateway Protocol) for determining routes between ASs. Another words, it is an Inter-AS routing protocol.
- BGP uses a Path Vector algorithm which uses Bellman-Ford Algorithm. In the Bellman-Ford Algorithm, each node does not know the information about the entire network topology.
- BGP carries routing information that includes a next hop and a set of AS numbers, describing a "AS path" that the route has traversed.
- BGP uses TCP to transport its packets. (TCP port number 179)
- BGPv4 was introduced for classless routing.

Terminology:

- **IGP (Interior Gateway Protocol) – Routing within AS**
- **EGP (Exterior Gateway Protocol) – Routing Between AS**
- **Non-Transit AS – Traffic that stays within an AS**
- **Transit AS – Traffic that crosses different AS**
- **BGP Message Types:**
  - **OPEN**
  - **NOTIFICATION**
  - **UPDATE**
  - **KeepAlive**
- **BGP Updates:**
  - **Prefix (subnet) – BGP Update**
  - **BGP Attributes –used to describe the prefix**
- **BGP Peers – BGP neighbor(identified by NeighborAS#, IPAddress)**
- **BGP Prefix – Network Address and mask ex: 192.168.5.0/24**
- **BGP Attributes – Parameters to define the preference of the routes**
  - **Origin**
  - **AS-Path**
  - **Next-Hop**
  - **MED (Multi-Exit Discriminator)**
  - **Local Pref**
  - **Community**
  - **Atomic-Aggregate**
  - **Aggregate**
- **BGP RIBs (Routing Information Base) – Routing Table for BGP**

AS-Autonomous System – A set of routers having a single routing policy under a single set of "technical administrators".

- Single IGP(Interior Gateway Protocol) domain or collection of IGP Domains
- Necessary when connecting to another group of routers (AS to AS connections)
- Range of AS Numbers: 1-65535 (2Bytes)
- 64512-65534 designated for private use
- **Non-Transit AS** – Only traffic originating or destined for the Local AS
- **Transit AS** – Traffic originating from another AS and destined for yet a third AS may also transit through the local AS, additionally.



BGP Operation

- BGP involves two routers forming a BGP session after establishing neighbor relationship (peering).
- The router then passes routing info
- Each router send 31 **BGP updates** about the states of their BGP routes containing:
    - **BGP Prefix (subnet)**
        - 10.10.0.0/16
        - 192.168.1.0/26
        - BGP prefixes can be advertised
            - 1. Local AS (Network Command)
            - 2. Route aggregation
            - 3. Forwarded from other AS
    - **BGP Attributes** are used to describe the prefix

BGP Neighbors

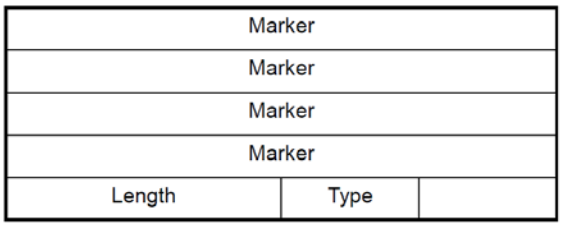
- BGP Peers-BGP neighbors
- A Peer is defined by NeighborAS and IP Address
- ISPs peer with each other to exchange routes on the internet.
- Peering can be private or public
- 2 types of Peers:
    - 1. **Internal Peer** – a neighbor with your own AS
    - 2. **External Peer** – a neighbor outside your own AS
- Both neighbors must identify the other as a neighbor to establish peering
- Once both sides are configured, neighbor establishment begins

BGP Neighbor States

- **Idle** - before the neighbors attempt TCP connection
- **Connect** - one of the neighbor attempting to establish TCP connection
- **Active** - Attempt for TCP connection timed out, will periodically try to re-connect
- **OpenSent** - Identification packet sent to neighbor
- **OpenConfirm -** OpenSent message is received from neighbor, neighbor will decide to accept/refuse BGP session.
- **Established** - BGP session fully active, peers start exchanging update packets with peer

BGP Header

Note: this will sit under the TCP header



- Marker – used for sync and security. Based on message type and options
- Length – length of entire BGP message including header
- Message Type:
    - Type1-Open
    - Type2-Update
    - Type3-Notification

- Type4-KeepAlive

BGP Message Types

1. **Open Message** – first sent message. Used for ID and agreement of protocol parameters
   - Message Fields:
     - **BGP Version**
     - **ASN(AS#)** – AS# of the sending router, compared to BGP neighbor configured AS
     - **HoldTime** – time(sec) that the sender proposes to use as a holdTimer. This is maxTime it will wait for keep alive from neighbor. Once exceeded, neighbor is marked dead, negotiated to lower of the two neighbors
     - **BGP Identifier** – value chosen by sender to ID the BGP speaker
2. **Notification Message** – used to identify an error in the underlying TCP connection before it closes the connection
   - Used for trouble shooting
   - Message Fields:
     - **Error Code** – identifies the type of error that occurred
       - 1. Message Header Error
       - 2. Open Message Error (Bad Peer AS or Identifier)
       - 3. Update Message Error (Invalid Next_Hop, Invalid Origin)
       - 4. Hold timer Error
       - 5. Finite State Machine Error
       - 6. Cease- no other code applies
     - **Error Subcode** – narrows down more specific type of error (Applicable to codes1-3)
     - **Data** – only present for specific error code and error subcode combinations
3. **Update Message** – used for most communications between two BGP peers. Used to advertise or withdraw a prefix.
   a. Message Fields:
      i. **NLRI(Network Layer Reachability Information)** – list of prefixes advertised and associated with the Path Attributes. All prefixes are described by all path attributes.
      ii. **Path Attributes** – List of BGP attributes that describe the prefixes in the next field – Attribute type, length, value for each attribute.
      iii. **Withdrawn Routes** – List of IP prefixes for which the sender no longer wishes to forward packets
4. **KeepAlive Message** – notifies neighbors that the route is still up.
   a. The hold timer is negotiated at the beginning of the session and used to determine the maximum amount of time between KeepAlives before a neighbor is considered dead.
   b. Recommended KeepAlive interval = 1/3 HoldTimer.
   c. Either keep alive message or Update message will reset the hold timer.
   d. A KeepAlive message has only the BGP header with no other data contained within it.

BGP RIBs (Routing Information Base) = Routing Table

- RIB – Routing Information Base – BGP-4's Term for routing table.
- There are a few types of RIBs:
  - **Adj-RIB-In** – the location where prefixes from specific neighbors are stored. Each peer has an Adj-RIB-In
    - **All the routes that are learned from all neighbors**
  - **Loc-RIB** – All the prefixes in the different Adj-RIB-In are processed. The chose paths for each individual prefix is stored in the Loc-RIB. Each system has one Loc_RIB
    - **All the best routes**
  - **Adj-RIB-Out** – the location where the prefix to be advertised to a specific peer are stored. Each peer has its own Adj-RIB-Out.
    - **All the routes that will be advertised**

BGP Attributes

- BGP uses Path Attributes in update packets to give information about the prefixes advertised.
- Attributes belong to the following categories,
  1. **WELL KNOWN MANDATORY**
     - WELL KNOWN = Must be supported by all BGP software implementation.
     - MANDATORY = Must appear in every UPDATE message. If WELL KNOWN MANDATORY attribute is missing from an UPDATE message, a NOTIFICATION message must be sent to the peer.

     Ex: - AS_path

- ORIGIN
- NEXT_HOP

2. **WELL-KNOWN DISCRETIONARY**
   - WELL KNOWN = Must be supported by all BGP software implementation.
   - DISCRETIONARY = Does not have to be included in updates

   Ex: - LOCAL_PREF
   - ATOMIC_AGGREGATE
3. **OPTIONAL TRANSITIVE**
   - OPTIONAL = Attribute not required to be supported
   - TRANSITIVE = Will be passed to other BGP speakers. If it is sent in an UPDATE message, but not recognized by the receiver, it should be passed to the next AS.

   Ex: - The Aggregator of the Route (AGGREGATOR)
   - Community String (COMMUNITY)
4. **OPTONAL NON-TRANSITIVE**
   - OPTIONAL = Attribute not required to be supported
   - NON-TRANSITIVE = Will NOT be passed to other BGP speakers.

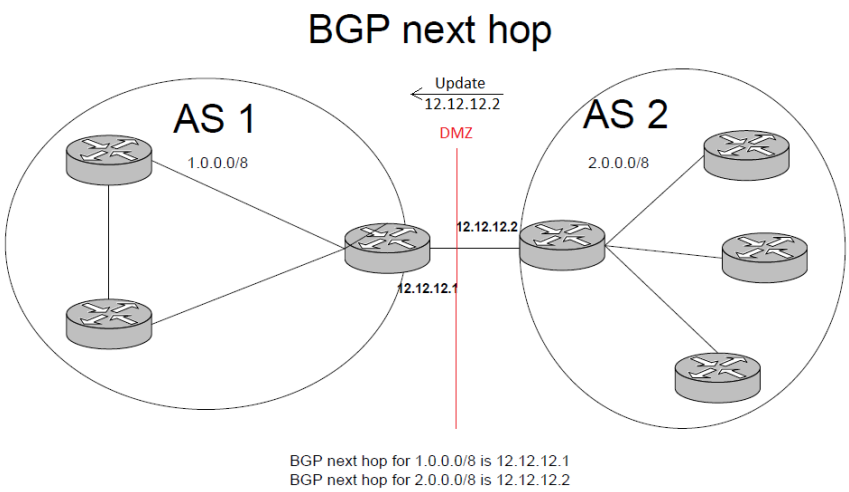
   Ex: - Multi-Exit Discriminator (MULTI_EXIT_DISC)
   - Route Originator ID (ORIGINATOR_ID)
   - Route Cluster List (ClusterList)

- **Important Attributes:**
  - **BGP Origin – (WELL KNOWN MANDATORY)**
    - Origin Attribute shows how the advertised prefix came into BGP table at the originating AS
    - The prefix can come from directly attached interfaces, static routes, or other routing protocols.
      - **Possible values of the attribute are:**
        1. **IGP** – prefix learned from IGP
        2. **EGP** – prefix learned from EGP
        3. **Incomplete** – prefix learned through method other than IGP or EGP, most often redistribution.

  - **BGP AS-Path – (WELL KNOWN MANDATORY)**
    - **Contains AS#** for each AS that the announcement for the prefix pass through.
    - The first AS in this attribute is the originating AS, with each subsequent AS appending their numbers as it leaves the AS
    - Used to detect and **prevent routing loops**

  - **BGP Next-Hop – (WELL KNOWN MANDATORY)**
    - The BGP Next-Hop attribute tells the receiver of the advertisement the node to send packets to in order to reach the advertised prefix destination
    - Next-Hop maybe a BGP speaker from the advertising system but it does not have to be
    - Next-Hop is used in building the routing table for BGP
    - Next-Hop is encoded as an IP address

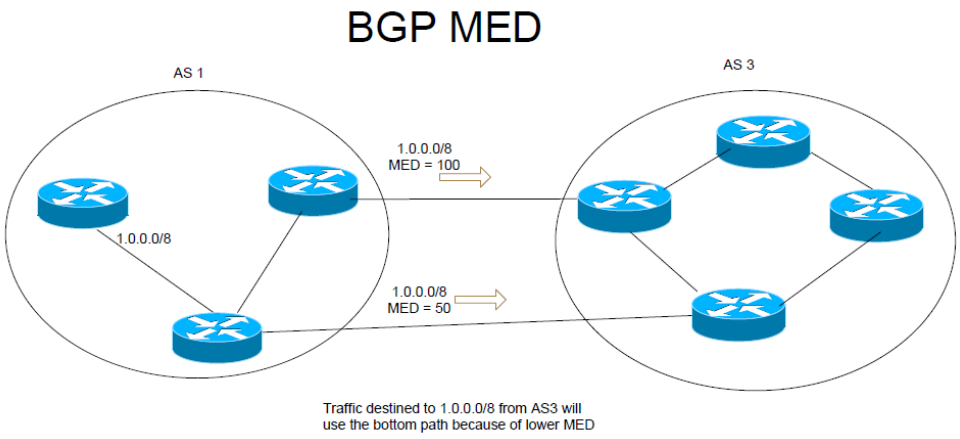
    - BGP Next-Hop Reachability issues:



- BGP Next-Hop have to be reachable In order for the BGP route to be added to the BGP table.
- The following **method can be used to ensure BGP next hop reachability**:
  1. Static route to Next-Hop
  2. BGP Next-Hop self – this changes the default next hop from your peering IP address to your own IP address.
  3. Advertise Next-Hop into IGP
     - **Passive interface** – link that connects next hop will be in IGP, but no neighbor relationship will be formed, therefore preventing routing information from being leaked out.
       No adjacencies. No hellos. No OSPF
     - **Redistribution of connected interface** – link that connects next hop will be in IGP, but no neighbors will form on this link

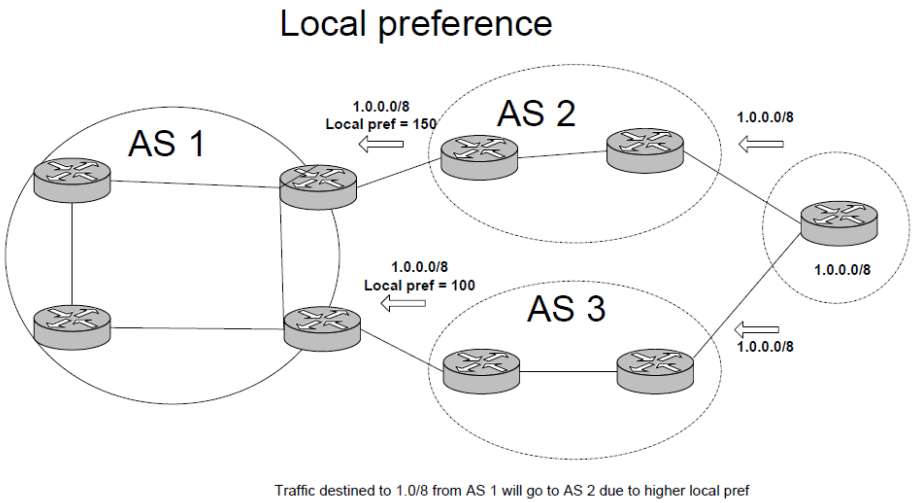
o **BGP MED (Multi-Exit Discriminator) – (OPTIONAL NON-TRANSITIVE, Lower=better)**

- When there are two or more paths to one AS, MED attribute carries a value expressing preferred path
- The sender of MED is informing the peer AS on which link it would prefer to receive traffic from the receiving AS.
- MED is configured by Network Admin
- Only apply to AS that has dual peering(has multiple paths) with other AS



o **BGP Local-Pref – (WELL KNOWN DISCRETIONARY, higher=better)**

- Local-Pref goes beyond MED for use by ISPs with multiple connections and paths to other AS.
- Local-Pref is configured for local AS and is assigned based on the advertising AS. The remote AS does not assign the value
- Local-Pref is configured by Network Admin



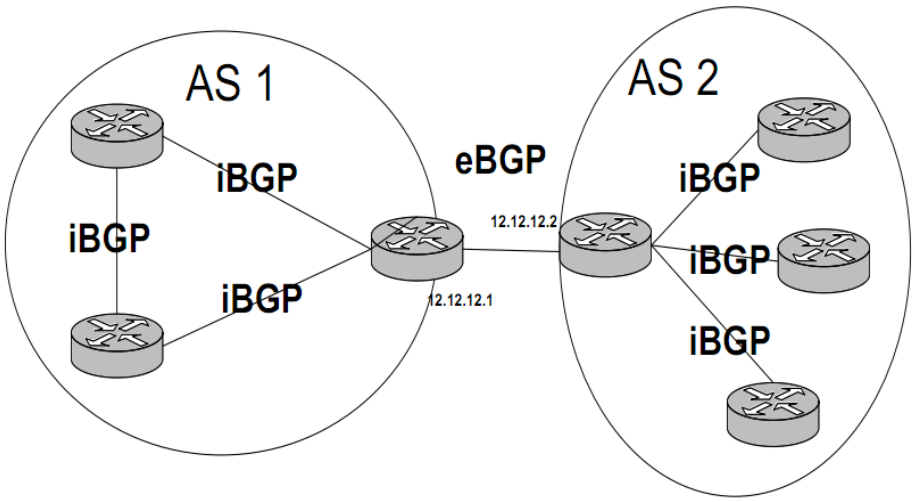
- **Atomic-Aggregate – (WELL KNOWN DISCRETIONARY)**
  - Indicates loss of information due to aggregation
- **Aggregator – (OPTIONAL TRANSITIVE)**
  - Identifies AS and BGP speaker that performed aggregation of some of the routes
- **BGP Community (OPTIONAL TRANSITIVE)**
  - Community is used to simplify configuration of routing policies for BGP.
  - Community allows for network admin to define policies for types of neighbors rather than for each. A route is identified as being within a certain category
  - Community values are 32 bit field
  - Community values are only significant within an AS
  - Each route can have multiple Community values
  - Well-known Community Values:
    - 0xFFFFFF01 – No-Export
    - 0xFFFFFF02 – No-Advertise
    - 0xFFFFFF03 – No-Export-Subconfederation

iBGP vs eBGP

- **eBGP (External BGP)** – between routers in two separate AS **(Admin dist = 20)**
- **iBGP (Internal BGP) –** between routers within a single AS **(Admin dist = 200)**
- eBGP most often has an IGP as a source of its routes. Some prefer to use iBGP because of the common attributes and metrics. Importing other IGPs such as OSPF or IS-IS there can lead to loss of metrics used to make routing decisions.
- Most networks running eBGP do not use iBGP as their primary IGP, but use instead either OSPF, IS-IS or EIGRP

- Four Main Differences between iBGP and eBGP
  1. Routes learned via iBGP Peers are not advertised to other iBGP Peers to prevent routing loops
  2. iBGP path attributes are not manipulated to affect path selection
  3. AS Path is not changed when advertising to iBGP Peer. i.e., the local AS is not added
  4. BGP NextHop is not changed on the route learned from an iBGP Peer

eBGP and iBGP



iBGP Scaling

- iBGP routers have to be fully meshed. This means a lot of BGP sessions in AS with a lot of iBGP routers
- **Route Reflection**
  - Route reflector is a router that can re-advertise a route learned from an iBGP neighbor
  - Route reflector client is a router that receives that reflected routes from a route reflector
- **Confederations**
  - Divide an confederation into smaller sub-AS

BGP Path Selection

- BGP has a very specific process for choosing a route from overlapping routes
- Multiple routes to the same prefix mean that the prefix must be of exactly the same subnet length to be considered the same. Routes with more specific subnet or longer subnet lengths are preferred over less specific.
- BGP uses Attributes as a tie breaker on preferred path
- Paths are compared in pairs, the better path is compared to the next possible path until 1 path is determined as Best.
- Important consideration in Route Selection is that a Network Admin should predict or choose the route that will be preferred
- <Summary: preferred route among multiple routes with equal prefix are tie broken via BGP Attributes>

BGP Route Selection Hierarchy

1. Highest Local-Pref
2. Shortest AS-Path
3. Lowest ORIGIN code
   IGP < EGP < incomplete
4. Lowest MED (Multi-Exit Discriminator)
5. eBGP vs iBGP (eBGP preferred)
6. Lowest IGP metric to the BGP NextHop preferred
7. BGP neighbor with the lowest BGP identifier preferred
8. Neighbor with lowest IP Address preferred

BGP Decision List (Cisco)

1 Only consider paths with reachable NEXT_HOPs
2 Do not consider iBGP path if not synchronized
3 Highest WEIGHT
4 Highest LOCAL_PREF
5 Prefer locally originated route
6 Shortest AS_PATH
7 Lowest ORIGIN code
IGP < EGP < incomplete
8 Lowest Multi-Exit Discriminator (MED)
8a IF bgp deterministic-med, order the paths before comparing
8b IF bgp always-compare-med, then compare it for all paths
8c Considered only if paths are from the same neighbor AS
9 Prefer an *External* path over an *Internal* one
10 Lowest IGP metric to the NEXT_HOP
11 IF multipath is enabled, the router may install up to N parallel paths in the routing table
12 For eBGP paths, select the "oldest"
To minimize route-flap
13 Lowest Router-ID
Originator-ID is considered for reflected routes
14 Shortest Cluster-List
Client must be aware of RR attributes!
15 Lowest neighbor IP address

2. Purpose

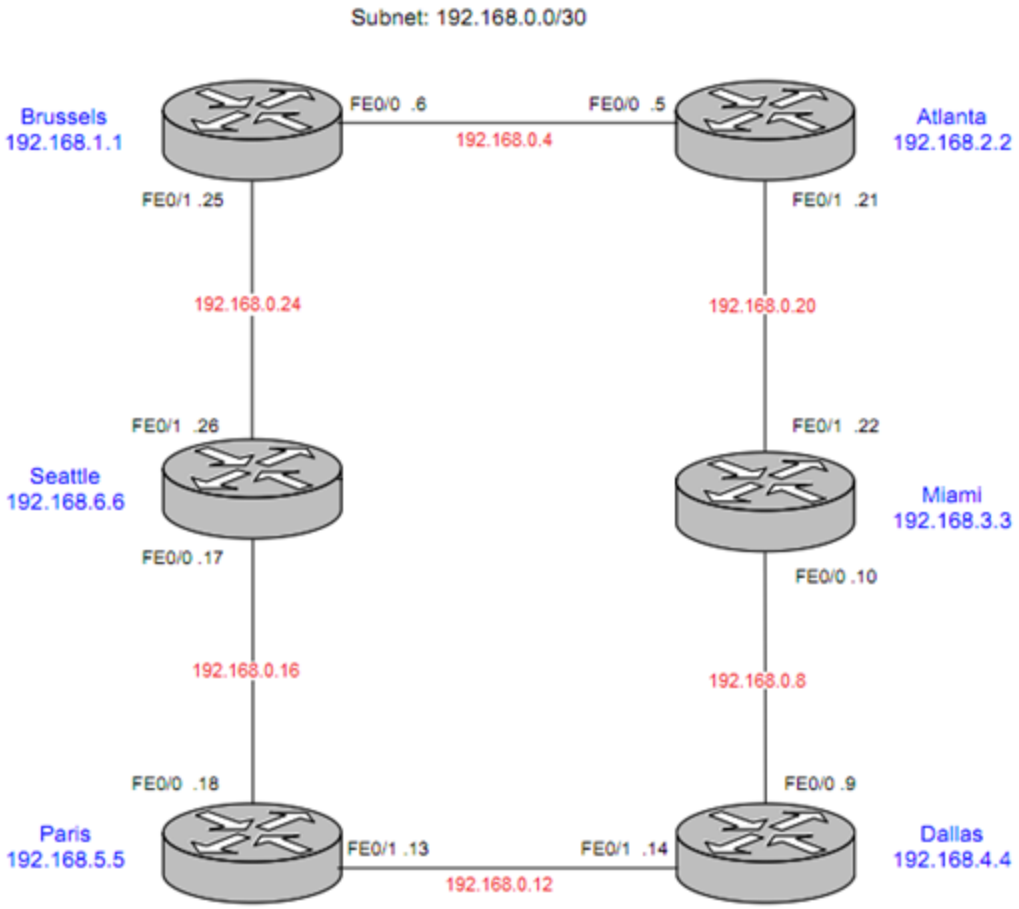
The purpose of this lab is to understand how to setup/configure routers for iBGP, eBGP network. Understand the routing characteristic unique to BGP routing protocol.

3. Procedure

Make Physical Connectivity Between Devices

The six Cisco 2811 ISRs were set up in the topology shown in figure below. The router that I configured was DALLAS (192.168.4.4 – loopback address) and made connection as follows:

- DALLAS FE0/0.9 ←→ Miami FE0/0.10
- DALLAS FE0/0.14 ←→ Paris FE0/1.13



The management network of the routers were connected through the Cisco 2511 (terminal server) and connected to the PC workstations.

NOTE: The following is the color scheme for this lab report:

- Input into the command prompt
- Output of the command prompt
- Comment or syntax of the command

Login to the router.

```
login: student
Password:
% Please answer 'yes' or 'no'.
Would you like to enter the initial configuration dialog? [yes/no]: n
```

Going from:

"USER MODE" `Router>`
"enable MODE" `Router#`
"Global Config MODE" `Router(config)#`

```
Router>enable
Router#conf t
Router(config)#
```

Changing Host name of the router to "DALLAS":

```
Router(config)#hostname DALLAS
DALLAS(config)#
```

Disabling the DNS lookup for our lab purposes. This prevents long waits for ping wait time as it is not expecting a response from the DNS server:

```
DALLAS(config)#no ip domain lookup
```

Entering the router's "Global Line Configure Mode":

```
DALLAS(config)#line console 0
DALLAS(config-line)#logging synchronous
```

Configure from the terminal:

```
DALLAS#conf
Configuring from terminal, memory, or network [terminal]? t
```

2. Configure the Router

Configuring the physical interfaces. Based on the below table the connections were made as such:

- DALLAS 192.168.0.9/30 ←→ Miami 192.168.0.10/30
- DALLAS 192.168.0.14/30 ←→ Paris 192.168.0.13/30

Router Name	Loopback0	FastEthernet Interface 0/0 and mask	FastEthernet Interface 0/1 and mask	AS number
Brussels	192.168.1.1/32	192.168.0.6/30	192.168.0.25/30	1
Atlanta	192.168.2.2/32	192.168.0.5/30	192.168.0.21/30	2
Miami	192.168.3.3/32	192.168.0.10/30	192.168.0.22/30	3
Dallas	192.168.4.4/32	192.168.0.9/30	192.168.0.14/30	4
Paris	192.168.5.5/32	192.168.0.18/30	192.168.0.13/30	5
Seattle	192.168.6.6/32	192.168.0.17/30	192.168.0.26/30	6

(Configuring FE0/0 DALLAS←→Miami Interface)

```
DALLAS#conf t
DALLAS(config)#interface fastEthernet 0/0
DALLAS(config-if)#description (DALLAS)<-->(Miami)
DALLAS(config-if)#ip address 192.168.0.9 255.255.255.252
DALLAS(config-if)#no shut
DALLAS(config-if)#exit
DALLAS(config)#exit
DALLAS#
```

(Configuring FE0/1 DALLAS←→Paris Interface)

```
DALLAS(config)#interface fastEthernet 0/1
DALLAS(config-if)#description  (DALLAS)<-->(Paris)
DALLAS(config-if)#ip address 192.168.0.14 255.255.255.252
DALLAS(config-if)#no shut
DALLAS(config-if)#exit
DALLAS(config)#
DALLAS(config)#exit
DALLAS#
```

(Configuring Loopback Interface)

Loopback is a logical interface. To configure, type:

```
DALLAS#conf t
DALLAS(config)#interface loopback 0
DALLAS(config-if)#
DALLAS(config-if)#ip address 192.168.4.4 255.255.255.255
DALLAS(config-if)#no shut
```

3.1 The interfaces, FastE0/0, FastE0/1 and Loopback0, which were configured, are up.

```
DALLAS#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            192.168.0.9     YES manual up                    up
FastEthernet0/1            192.168.0.14    YES manual up                    up
FastEthernet0/0/0          unassigned      YES unset  up                    down
FastEthernet0/0/1          unassigned      YES unset  up                    down
FastEthernet0/0/2          unassigned      YES unset  up                    down
FastEthernet0/0/3          unassigned      YES unset  up                    down
Serial0/1/0                unassigned      YES unset  administratively down down
Serial0/1/1                unassigned      YES unset  administratively down down
Vlan1                      unassigned      YES unset  up                    down
SSLVPN-VIF0                unassigned      NO  unset  up                    up
Loopback0                  192.168.4.4     YES manual up                    up
```

Pinging my neighbors:

Pinging Connected Interface (Miami):

```
DALLAS#ping 192.168.0.10
```

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.0.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

Pinging Connected Interface (Paris):

```
DALLAS#ping 192.168.0.13
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.0.13, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

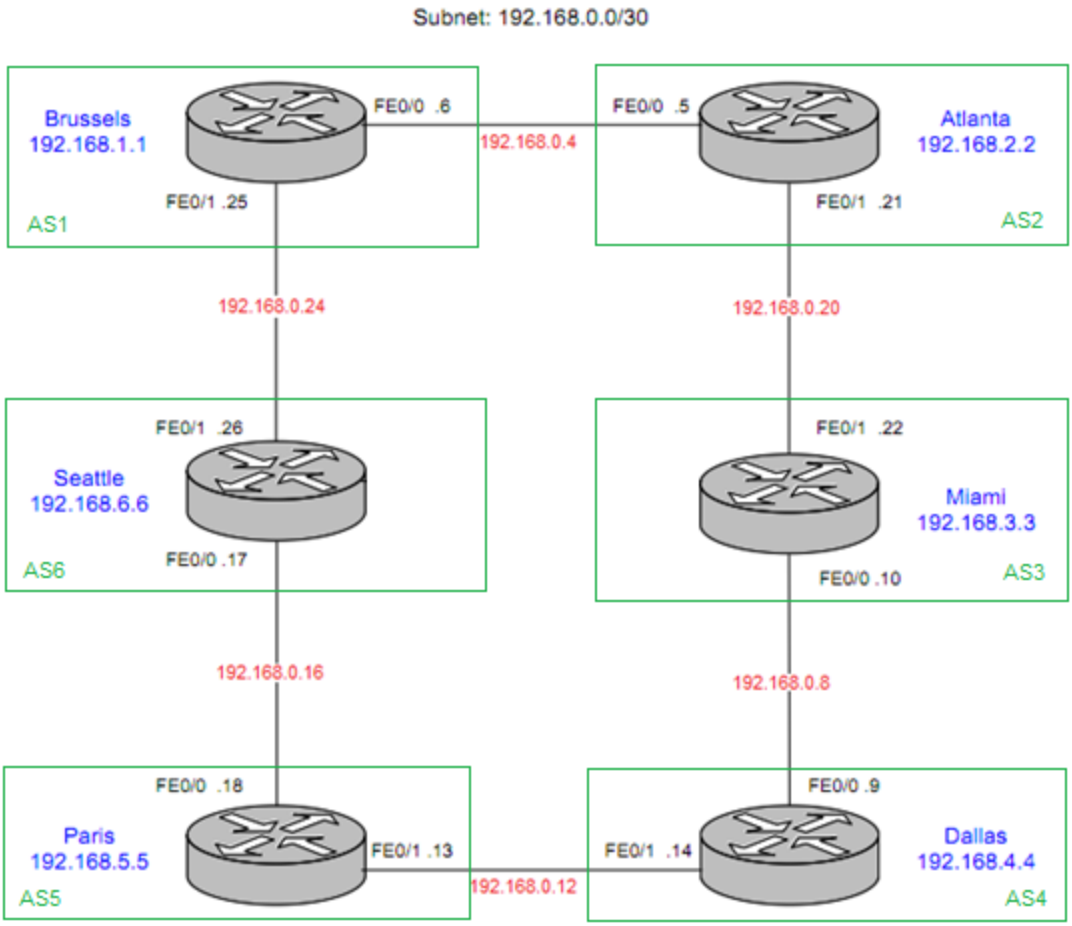
3.2 What does the route table look like?

```
DALLAS#
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.0.0/30 is subnetted, 2 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
```

There are only 2 physically connected 1 loopback entries. All three addresses are logically connected, hence we see 3 connected on the on the route table.

4. Configure External BGP
(Turning on EBGP)

Router Name	Loopback0	AS number
Brussels	192.168.1.1	1
Atlanta	192.168.2.2	2
Miami	192.168.3.3	3
Dallas	192.168.4.4	4
Paris	192.168.5.5	5
Seattle	192.168.6.6	6




```
Format:
DALLAS(config-router)#router bgp <AS#>
DALLAS(config-router)#network <loopback> mask 255.255.255.255.255
DALLAS(config-router)#network <Ethernet network address> mask 255.255.255.255.252
DALLAS(config-router)#neighbor <neighbor interface IP add> remote-as <neighbor AS#>
DALLAS(config-router)#no auto-summary

DALLAS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
DALLAS(config)#router bgp 4
DALLAS(config-router)#network 192.168.4.4 mask 255.255.255.255
DALLAS(config-router)#network 192.168.0.8 mask 255.255.255.252
DALLAS(config-router)#network 192.168.0.12 mask 255.255.255.252
DALLAS(config-router)#neighbor 192.168.0.10 remote-as 3
DALLAS(config-router)#neighbor 192.168.0.13 remote-as 5
DALLAS(config-router)#no auto-summary
*Apr 19 22:52:43.911: %BGP-5-ADJCHANGE: neighbor 192.168.0.10 Up
*Apr 19 22:52:47.299: %BGP-5-ADJCHANGE: neighbor 192.168.0.13 Up
*Apr 19 22:53:16.275: %SYS-5-CONFIG_I: Configured from console by console
```

4.1 How many entries are now visible in the IP route table?

There are 3-connected and there should be 9 BGP routes. However, there are 8 new BGP routes available. Examining closely at the lab output, Atlanta's loopback of 192.168.2.2 which should have been configured for BGP was not on the routing table. This did not effect the lab as we didn't have to ping the loopback of Atlanta.

Is there a route entry to every IP subnet? Yes, there is a route entry for each subnet.

```
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
```

```
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:25:43
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:25:43
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [20/0] via 192.168.0.13, 00:10:58
B       192.168.0.24 [20/0] via 192.168.0.13, 00:25:45
B       192.168.0.16 [20/0] via 192.168.0.13, 00:25:45
B       192.168.0.20 [20/0] via 192.168.0.10, 00:25:59
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [20/0] via 192.168.0.13, 00:10:59
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [20/0] via 192.168.0.10, 00:25:59
DALLAS#show ip protocols
Routing Protocol is "bgp 4"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  IGP synchronization is disabled
  Automatic route summarization is disabled
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.0.10
    192.168.0.13
  Maximum path: 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.10         20      00:25:02
    192.168.0.13         20      00:11:04
  Distance: external 20 internal 200 local 200
```

4.2 Below.

4.3 How many entries in the BGP table?
BGP Table contains 11 entries, 5 with multiple paths.

Which entry has the longest AS-path?
192.168.0.4/30 and 192.168.1.1/32 both have to pass through 3 AS.

Any route entry with more than one possible path?
Following five routes have redundant paths:

- 192.168.0.4/30
- 192.168.0.8/30
- 192.168.0.12/30
- 192.168.0.24/30
- 192.168.1.1/32

```
DALLAS#
DALLAS#show ip bgp
BGP table version is 16, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 1 i
*  192.168.0.8/30   192.168.0.10             0             0 3 i
*>                  0.0.0.0                  0         32768 i
*  192.168.0.12/30  192.168.0.13             0             0 5 i
*>                  0.0.0.0                  0         32768 i
*> 192.168.0.16/30  192.168.0.13             0             0 5 i
*> 192.168.0.20/30  192.168.0.10             0             0 3 i
*  192.168.0.24/30  192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 i
*  192.168.1.1/32   192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 1 i
*> 192.168.3.3/32   192.168.0.10             0             0 3 i
*> 192.168.4.4/32   0.0.0.0                  0         32768 i
*> 192.168.5.5/32   192.168.0.13             0             0 5 i
*> 192.168.6.6/32   192.168.0.13                           0 5 6 i
DALLAS#
DALLAS#show ip bgp summary
```

```
BGP router identifier 192.168.4.4, local AS number 4
BGP table version is 16, main routing table version 16
11 network entries using 1452 bytes of memory
16 path entries using 832 bytes of memory
7/5 BGP path/bestpath attribute entries using 1036 bytes of memory
5 BGP AS-PATH entries using 120 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 2) using 32 bytes of memory
BGP using 3472 total bytes of memory
BGP activity 12/1 prefixes, 20/4 paths, scan interval 60 secs
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.0.10    4     3      36      35       16    0    0 00:27:24        6
192.168.0.13    4     5      34      35       16    0    0 00:27:21        7
```

4.2 Who are your BGP neighbors?

My BGP neighbors are:

- MIAMI's interface 192.168.0.10 with AS3
- Paris's interface 192.168.0.13 with AS5

How many prefixes have you received from each neighbor?

- Received 6 current and 10 total prefixes from Miami
- Received 7 current and 7 total prefixes from Paris

```
DALLAS#
DALLAS#show ip bgp neighbors
BGP neighbor is 192.168.0.10,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:27:41
  Last read 00:00:49, last write 00:00:42, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8         10
    Keepalives:            26         25
    Route Refresh:          0          0
    Total:                 35         36
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                                 Sent       Rcvd
  Prefix activity:               ----       ----
    Prefixes Current:              11          6 (Consumes 312 bytes)
    Prefixes Total:                14         10
    Implicit Withdraw:              2          0
    Explicit Withdraw:              1          4
    Used as bestpath:             n/a          2
    Used as multipath:            n/a          0
                                   Outbound    Inbound
  Local Policy Denied Prefixes:    --------    -------
    AS_PATH loop:                       n/a          9
    Total:                                0          9
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.9, Local port: 42948
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x372D74):
Timer          Starts    Wakeups            Next
Retrans            31          0             0x0
TimeWait            0          0             0x0
AckHold            31         28             0x0
```

```
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         2546       2545        0x372E13
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 1257119701  snduna: 1257120657  sndnxt: 1257120657     sndwnd:  15429
irs: 2910584306  rcvnxt: 2910585372  rcvwnd:      15319  delrcvwnd:   1065

SRTT: 295 ms, RTTO: 335 ms, RTV: 40 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 48 (out of order: 0), with data: 32, total data bytes: 1065
Sent: 61 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 31, total data bytes: 955
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 192.168.0.13,  remote AS 5, external link
  BGP version 4, remote router ID 192.168.5.5
  BGP state = Established, up for 00:27:45
  Last read 00:00:50, last write 00:00:49, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8          7
    Keepalives:            26         26
    Route Refresh:          0          0
    Total:                 35         34
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            11          7 (Consumes 364 bytes)
    Prefixes Total:              14          7
    Implicit Withdraw:            2          0
    Explicit Withdraw:            1          0
    Used as bestpath:           n/a          6
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    AS_PATH loop:                     n/a          6
    Total:                              0          6
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.13
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.14, Local port: 15940
Foreign host: 192.168.0.13, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x374930):
Timer          Starts    Wakeups            Next
Retrans            31          0             0x0
TimeWait            0          0             0x0
AckHold            30         29             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         2562       2561        0x374A6F
DeadWait            0          0             0x0
```

```
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 2170312586  snduna: 2170313542  sndnxt: 2170313542     sndwnd:  15429
irs:  846919556  rcvnxt:  846920460  rcvwnd:      15481  delrcvwnd:    903

SRTT: 295 ms, RTTO: 335 ms, RTV: 40 ms, KRTT: 0 ms
minRTT: 4 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 60 (out of order: 0), with data: 31, total data bytes: 903
Sent: 62 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 31, total data bytes: 955
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

DALLAS#
DALLAS#show ip bgp 192.168.0.8
BGP routing table entry for 192.168.0.8/30, version 3
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, metric 0, localpref 100, valid, external
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin IGP, metric 0, localpref 100, weight 32768, valid, sourced, local,
best
DALLAS#
DALLAS#show ip bgp 192.168.0.20
BGP routing table entry for 192.168.0.20/30, version 5
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, metric 0, localpref 100, valid, external, best
DALLAS#
DALLAS#show ip bgp 192.168.0.4
BGP routing table entry for 192.168.0.4/30, version 16
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3 2 1
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, localpref 100, valid, external
  5 6 1
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, localpref 100, valid, external, best
DALLAS#
DALLAS#show ip bgp 192.168.0.24
BGP routing table entry for 192.168.0.24/30, version 12
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3 2 1
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, localpref 100, valid, external
  5 6
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, localpref 100, valid, external, best
DALLAS#
DALLAS#show ip bgp 192.168.0.16
BGP routing table entry for 192.168.0.16/30, version 9
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  5
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, metric 0, localpref 100, valid, external, best
DALLAS#
DALLAS#show ip bgp 192.168.0.12
BGP routing table entry for 192.168.0.12/30, version 4
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  5
```

```
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, metric 0, localpref 100, valid, external
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin IGP, metric 0, localpref 100, weight 32768, valid, sourced, local, best

DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.10 routes
BGP table version is 16, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.10                           0 3 2 1 i
*  192.168.0.8/30   192.168.0.10             0             0 3 i
*> 192.168.0.20/30  192.168.0.10             0             0 3 i
*  192.168.0.24/30  192.168.0.10                           0 3 2 1 i
*  192.168.1.1/32   192.168.0.10                           0 3 2 1 i
*> 192.168.3.3/32   192.168.0.10             0             0 3 i
Total number of prefixes 6
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.13 routes
BGP table version is 16, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*> 192.168.0.4/30   192.168.0.13                           0 5 6 1 i
*  192.168.0.12/30  192.168.0.13             0             0 5 i
*> 192.168.0.16/30  192.168.0.13             0             0 5 i
*> 192.168.0.24/30  192.168.0.13                           0 5 6 i
*> 192.168.1.1/32   192.168.0.13                           0 5 6 1 i
*> 192.168.5.5/32   192.168.0.13             0             0 5 i
*> 192.168.6.6/32   192.168.0.13                           0 5 6 i
Total number of prefixes 7
```

4.4 Take one BGP route entry from the IP routing table and decipher each part of it.

```
DALLAS#show ip route
BGP  DestinationIP [AdminCost/0] via NextHopIP,      TimeStamp
B    192.168.0.4   [20/0]        via 192.168.0.13,   00:10:58

DALLAS#
DALLAS#show ip bgp
BGP table version is 16, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
DestinationNetworkIP NextHopIP        Metric(Always Zero)    Weight  AS-Path        OriginCode
   Network           Next Hop         Metric         LocPrf  Weight  Path
*  192.168.0.4/30    192.168.0.10                            0       3 2 1          i (i=IGP)
*>                   192.168.0.13                            0       5 6 1          i
```

(Traceroute Seattle Loopback 192.168.6.6)

```
DALLAS#
DALLAS#traceroute 192.168.6.6
Type escape sequence to abort.
Tracing the route to 192.168.6.6
  1 192.168.0.13 0 msec 4 msec 0 msec
  2 192.168.0.17 [AS 5] 0 msec *  0 msec
```

4.5 What are the attributes of the above destination? Please list all of these attributes.

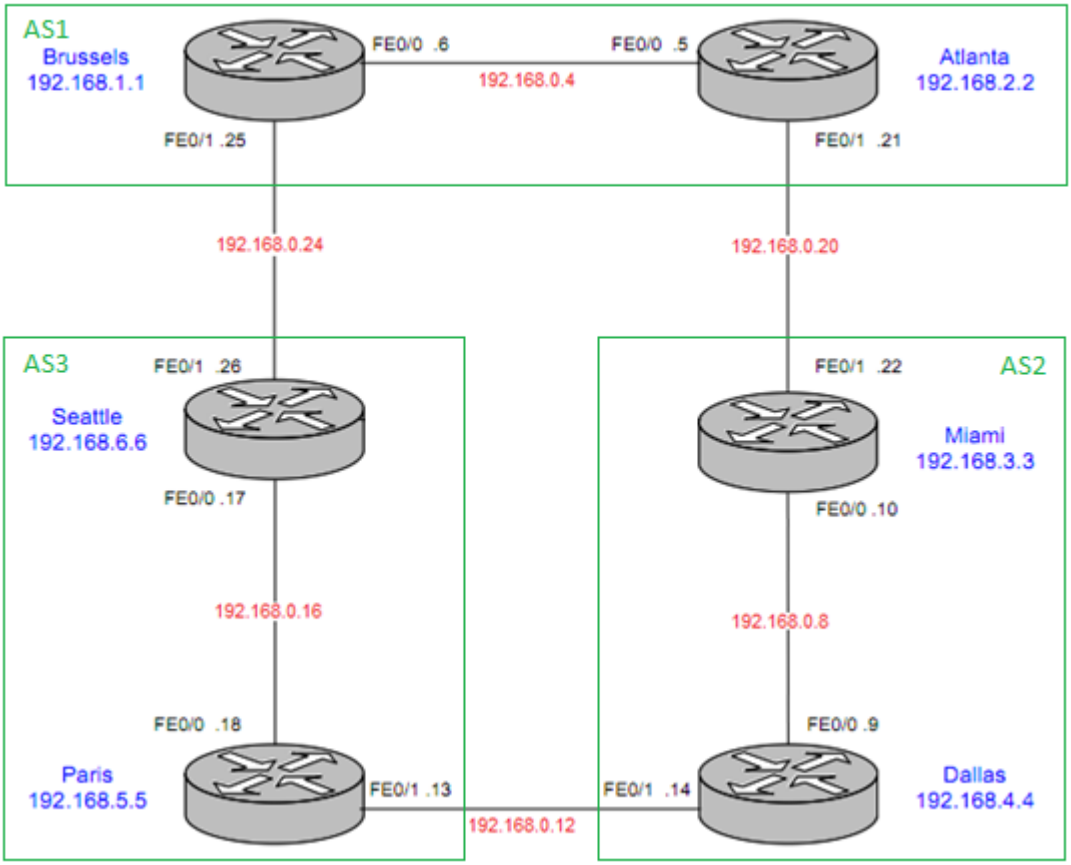
- Weight: 0
- Local Pref: 100 (default)
- AS Path: 5→6
- Origin: Internal
- MED: 0

Which attribute was used as the tiebreaker in choosing the best path?
AS Path.

5. Configure Internal BGP
(Turning on iBGP)

Router Name	Loopback0	AS number
Brussels	192.168.1.1	1
Atlanta	192.168.2.2	1
Miami	192.168.3.3	2
Dallas	192.168.4.4	2
Paris	192.168.5.5	3
Seattle	192.168.6.6	3

Subnet: 192.168.0.0/30



(Remove BGP AS4 as IBGP)

```
DALLAS(config)##  took off BGP AS#
DALLAS(config)#no router bgp 4
```

(Reconfigure as BGP AS2 for EBGP)

```
Format:
DALLAS(config-router)#router bgp <AS#>
DALLAS(config-router)#no synchronization
DALLAS(config-router)#redistribute connected
DALLAS(config-router)#neighbor <neighbor interface IP add> remote-as <neighbor AS#>
DALLAS(config-router)#neighbor <neighbor interface IP add> remote-as <neighbor AS#>
DALLAS(config-router)#no auto-summary

DALLAS(config)#router bgp 2
DALLAS(config-router)#no synchronization
DALLAS(config-router)#redistribute connected
DALLAS(config-router)#neighbor 192.168.0.10 remote-as 2
DALLAS(config-router)#neighbor 192.168.0.13 remote-as 3
DALLAS(config-router)#no auto-summary
*Apr 19 23:27:23.883: %BGP-5-ADJCHANGE: neighbor 192.168.0.10 Up
*Apr 19 23:27:32.371: %BGP-5-ADJCHANGE: neighbor 192.168.0.13 Up
```

Make sure all routers have BGP configured and all networks are reachable; use the following show commands on your router to answer the questions:

- *show IP route*
- *show IP BGP*
- *show IP protocols*
- *show IP BGP summary*
- *show IP BGP neighbor*
- *show IP BGP <network address>*
- *show IP BGP neighbor <neighbor address> routes*

5.1 How has the IP route table changed from section 4?

There are 3-connected and 9-BGP routes.

Some of the BGP routes now have adminDist=200 representing iBGP routes. Having high adminDist is undesired, hence eBGP routes will be chosen over iBGP routes. Another words, BGP default is set so that the packets are treated as “hot potatoes”, where they are expelled out of the current AS as soon as possible.

```
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:40:00
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:39:29
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [200/0] via 192.168.0.21, 00:40:38
B       192.168.0.24 [20/0] via 192.168.0.13, 00:39:30
B       192.168.0.16 [20/0] via 192.168.0.13, 00:40:01
B       192.168.0.20 [200/0] via 192.168.0.10, 00:40:43
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [200/0] via 192.168.0.21, 00:40:29
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [200/0] via 192.168.0.21, 00:40:39
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [200/0] via 192.168.0.10, 00:40:44
```

5.2 Below.

5.3 How has the BGP table changed from section 4?

There are i-internal routes now available. Some of the path priorities have changed also as iBGP paths are less desired as eBGP paths. Also default LocalPref of 100 is shown for iBGP routes.

```
DALLAS#
DALLAS#show ip bgp
BGP table version is 15, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.13                           0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
* i192.168.0.8/30   192.168.0.10             0    100      0 ?
*>                  0.0.0.0                  0         32768 ?
*  192.168.0.12/30  192.168.0.13             0             0 3 ?
*>                  0.0.0.0                  0         32768 ?
*> 192.168.0.16/30  192.168.0.13             0             0 3 ?
*>i192.168.0.20/30  192.168.0.10             0    100      0 ?
*> 192.168.0.24/30  192.168.0.13                           0 3 ?
* i                 192.168.0.21             0    100      0 1 ?
*  192.168.1.1/32   192.168.0.13                           0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
*  192.168.2.2/32   192.168.0.13                           0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
*>i192.168.3.3/32   192.168.0.10             0    100      0 ?
*> 192.168.4.4/32   0.0.0.0                  0         32768 ?
*> 192.168.5.5/32   192.168.0.13             0             0 3 ?
*> 192.168.6.6/32   192.168.0.13                           0 3 ?
DALLAS#
DALLAS#show ip protocols
Routing Protocol is "bgp 2"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  IGP synchronization is disabled
  Automatic route summarization is disabled
  Redistributing: connected
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.0.10
    192.168.0.13
  Maximum path: 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.10         200      00:40:12
    192.168.0.13          20      00:39:44
  Distance: external 20 internal 200 local 200
DALLAS#
DALLAS#show ip bgp summary
BGP router identifier 192.168.4.4, local AS number 2
BGP table version is 15, main routing table version 15
12 network entries using 1584 bytes of memory
18 path entries using 936 bytes of memory
7/5 BGP path/bestpath attribute entries using 1036 bytes of memory
3 BGP AS-PATH entries using 72 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 3 (at peak 3) using 96 bytes of memory
BGP using 3724 total bytes of memory
BGP activity 12/0 prefixes, 19/1 paths, scan interval 60 secs
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.0.10    4     2      47      45       15    0    0 00:41:08        7
192.168.0.13    4     3      45      48       15    0    0 00:41:00        8
```

5.2 Who are your neighbors and what kind of neighbors are they?

BGP neighbors are:

- 192.168.0.10 remote AS2 which is an internal link.
- 192.168.0.13, remote AS3 which is an external link.

```
DALLAS#
DALLAS#show ip bgp neighbor
BGP neighbor is 192.168.0.10,  remote AS 2, internal link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:41:22
  Last read 00:00:51, last write 00:00:52, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
```

```
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                3          5
    Keepalives:            41         41
    Route Refresh:          0          0
    Total:                 45         47
  Default minimum time between advertisement runs is 0 seconds
 For address family: IPv4 Unicast
  BGP table version 15, neighbor version 15/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                                  Sent       Rcvd
  Prefix activity:                ----       ----
    Prefixes Current:                7          7 (Consumes 364 bytes)
    Prefixes Total:                  7          8
    Implicit Withdraw:               0          0
    Explicit Withdraw:               0          1
    Used as bestpath:              n/a          5
    Used as multipath:             n/a          0
                                   Outbound    Inbound
  Local Policy Denied Prefixes:    --------    -------
    Bestpath from this peer:                7        n/a
    Total:                                  7          0
  Number of NLRIs in the update sent: max 3, min 2
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 255
Local host: 192.168.0.9, Local port: 39155
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x636D24):
Timer          Starts    Wakeups            Next
Retrans            45          0             0x0
TimeWait            0          0             0x0
AckHold            44         43             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         5190       5189        0x636DEA
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 3459572822  snduna: 3459573843  sndnxt: 3459573843     sndwnd:  15364
irs:  401391493  rcvnxt:  401392604  rcvwnd:      15274  delrcvwnd:   1110

SRTT: 299 ms, RTTO: 306 ms, RTV: 7 ms, KRTT: 0 ms
minRTT: 4 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 88 (out of order: 0), with data: 46, total data bytes: 1110
Sent: 90 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 45, total data bytes: 1020
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 192.168.0.13,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.5.5
  BGP state = Established, up for 00:41:20
  Last read 00:00:58, last write 00:00:33, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
```

```
    Updates:                6          3
    Keepalives:            41         41
    Route Refresh:          0          0
    Total:                 48         45
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 15, neighbor version 15/0
  Output queue size : 0
  Index 2, Offset 0, Mask 0x4
  2 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:             8          8 (Consumes 416 bytes)
    Prefixes Total:              10          8
    Implicit Withdraw:            0          0
    Explicit Withdraw:            2          0
    Used as bestpath:           n/a          4
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    Bestpath from this peer:              4        n/a
    Total:                                4          0
  Number of NLRIs in the update sent: max 3, min 1
  Address tracking is enabled, the RIB does have a route to 192.168.0.13
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.14, Local port: 179
Foreign host: 192.168.0.13, Foreign port: 38535
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x6386B8):
Timer          Starts    Wakeups            Next
Retrans            45          0             0x0
TimeWait            0          0             0x0
AckHold            44         42             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger            0          0             0x0
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss:  405233408  snduna:  405234536  sndnxt:  405234536     sndwnd:  15257
irs: 3799927971  rcvnxt: 3799928987  rcvwnd:      15369  delrcvwnd:   1015

SRTT: 299 ms, RTTO: 306 ms, RTV: 7 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: passive open, gen tcbs
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 90 (out of order: 0), with data: 45, total data bytes: 1015
Sent: 89 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 46, total data bytes: 1127
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.8
BGP routing table entry for 192.168.0.8/30, version 3
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1    2
  Local
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin incomplete, metric 0, localpref 100, valid, internal
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin incomplete, metric 0, localpref 100, weight 32768, valid, sourced, best
DALLAS#
DALLAS#show ip bgp 192.168.0.20
BGP routing table entry for 192.168.0.20/30, version 5
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        2
```

```
  Local
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
DALLAS#
DALLAS#show ip bgp 192.168.0.4
BGP routing table entry for 192.168.0.4/30, version 7
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        2
  3 1
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin incomplete, localpref 100, valid, external
  1
    192.168.0.21 from 192.168.0.10 (192.168.3.3)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
DALLAS#
DALLAS#show ip bgp 192.168.0.24
BGP routing table entry for 192.168.0.24/30, version 15
Paths: (2 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin incomplete, localpref 100, valid, external, best
  1
    192.168.0.21 from 192.168.0.10 (192.168.3.3)
      Origin incomplete, metric 0, localpref 100, valid, internal
DALLAS#
DALLAS#show ip bgp 192.168.0.16
BGP routing table entry for 192.168.0.16/30, version 11
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin incomplete, metric 0, localpref 100, valid, external, best
DALLAS#
DALLAS#show ip bgp 192.168.0.12
BGP routing table entry for 192.168.0.12/30, version 4
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1    2
  3
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin incomplete, metric 0, localpref 100, valid, external
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin incomplete, metric 0, localpref 100, weight 32768, valid, sourced, best

DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.10 routes
BGP table version is 15, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*>i192.168.0.4/30   192.168.0.21             0    100      0 1 ?
* i192.168.0.8/30   192.168.0.10             0    100      0 ?
*>i192.168.0.20/30  192.168.0.10             0    100      0 ?
* i192.168.0.24/30  192.168.0.21             0    100      0 1 ?
*>i192.168.1.1/32   192.168.0.21             0    100      0 1 ?
*>i192.168.2.2/32   192.168.0.21             0    100      0 1 ?
*>i192.168.3.3/32   192.168.0.10             0    100      0 ?
Total number of prefixes 7
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.13 routes
BGP table version is 15, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.13                           0 3 1 ?
*  192.168.0.12/30  192.168.0.13             0             0 3 ?
*> 192.168.0.16/30  192.168.0.13             0             0 3 ?
*> 192.168.0.24/30  192.168.0.13                           0 3 ?
*  192.168.1.1/32   192.168.0.13                           0 3 1 ?
*  192.168.2.2/32   192.168.0.13                           0 3 1 ?
*> 192.168.5.5/32   192.168.0.13             0             0 3 ?
*> 192.168.6.6/32   192.168.0.13                           0 3 ?
```

```
Total number of prefixes 8
DALLAS#
```

Now if you are on Paris, Seattle or Brussels, traceroute to Miami's loopback. If you are on Dallas, Miami or Atlanta, traceroute to Seattle's loopback. Save the output.

5.4 Has this changed from section 4? If so, how?
No the path remains the same.
NextHop interface of Miami would put me on a path of going through crossing both AS1 and AS2 to reach Seattle.
NextHop Interface of Paris would put me on a path of going through crossing only to AS2 to reach Seattle, hence is more desired.

```
DALLAS#traceroute 192.168.6.6
Type escape sequence to abort.
Tracing the route to 192.168.6.6
  1 192.168.0.13 0 msec 0 msec 4 msec
  2 192.168.0.17 [AS 3] 0 msec *  0 msec
```

Additional Lab Questions:

1. What was the most important piece of knowledge you took away from this lab?
   BGP has both iBGP and eBGP. In default BGP scheme, iBGP is less desired than eBGP. The packets are treated in "hot potato" scheme where each packet is expelled from each AS as soon as possible.

2. What new command did you find most useful and why?

   (Configure iBGP)

```
Format:
DALLAS(config-router)#router bgp <AS#>
DALLAS(config-router)#network <loopback> mask 255.255.255.255
DALLAS(config-router)#network <Ethernet network address> mask 255.255.255.252
DALLAS(config-router)#neighbor <neighbor interface IP add> remote-as <neighbor AS#>
DALLAS(config-router)#no auto-summary

DALLAS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
DALLAS(config)#router bgp 4
DALLAS(config-router)#network 192.168.4.4 mask 255.255.255.255
DALLAS(config-router)#network 192.168.0.8 mask 255.255.255.252
DALLAS(config-router)#network 192.168.0.12 mask 255.255.255.252
DALLAS(config-router)#neighbor 192.168.0.10 remote-as 3
DALLAS(config-router)#neighbor 192.168.0.13 remote-as 5
DALLAS(config-router)#no auto-summary
```

   (Remove BGP AS4 as iBGP)

```
DALLAS(config)##  took off BGP AS#
DALLAS(config)#no router bgp 4
```

   (Reconfigure as BGP AS2 for eBGP)

```
Format:
DALLAS(config-router)#router bgp <AS#>
DALLAS(config-router)#no synchronization
DALLAS(config-router)#redistribute connected
DALLAS(config-router)#neighbor <neighbor interface IP add> remote-as <neighbor AS#>
DALLAS(config-router)#neighbor <neighbor interface IP add> remote-as <neighbor AS#>
DALLAS(config-router)#no auto-summary

DALLAS(config)#router bgp 2
DALLAS(config-router)#no synchronization
DALLAS(config-router)#redistribute connected
DALLAS(config-router)#neighbor 192.168.0.10 remote-as 2
DALLAS(config-router)#neighbor 192.168.0.13 remote-as 3
DALLAS(config-router)#no auto-summary
```

   (How to check your BGP parameters)

```
DALLAS#show ip protocols
DALLAS#show ip bgp
DALLAS#show ip bgp summary
DALLAS#show ip bgp neighbors
DALLAS#show ip bgp <networkIP>
DALLAS#show ip bgp 192.168.0.8
DALLAS#show ip bgp neighbor <nextHopIP> routes
```

```
DALLAS#show ip bgp neighbor 192.168.0.10 routes
```

3. Identify at least one problem you experienced in this lab. How did you figure out the problem? How did you resolve it?
   When configuring interfaces, one of the interfaces would not come up after being configured. After a bit of trouble shooting, we figured out that I accidently plugged in a straight through Ethernet cable instead of the Cross over.

The lab included eBGP and iBGP. Explain in your own words the differences between eBGP and iBGP.
eBGP routes are preferred routes as AdminDist = 20 vs. iBGP routes with AdminDist = 200. This makes it so that each packet is designed to escape the current AS as soon as possible. This was explained to me that from the Network Operator's point of view, it is to preserve the resources of my AS. I'm not totally convinced with this explanation. I'd like to think that the routing is designed to push packets out of the current AS because the probability that the destination exists inside the current AS is less than it is within the current AS. I would appreciate any comments on this.

We turned off BGP synchronization for section 5. Explain in your own words what BGP synchronization is.

```
DALLAS(config-router)#router bgp <AS#>
DALLAS(config-router)#no synchronization
```

BGP Synchronization will not allow BGP routes to propagate through multiple AS's until the route is learned via IGP by all routers in the AS. Only when the route is learned via IGP propagation does it start to advertise to external peers.

What is synchronization, and how does it influence BGP routes installed in the IP routing table?

A. If your AS passes traffic from another AS to a third AS, BGP should not advertise a route before all routers in your AS learn about the route via IGP. BGP waits until IGP propagates the route within the AS and then advertises it to external peers. A BGP router with synchronization enabled does not install iBGP learned routes into its routing table if it is not able to validate those routes in its IGP. Issue the **no synchronization**command under **router bgp** in order to disable synchronization. This prevents BGP from validating iBGP routes in IGP. Refer to BGP Case Studies: Synchronization for a more detailed explanation.
<Ref: http://www.cisco.com/en/US/tech/tk365/technologies_q_and_a_item09186a00800949e8.shtml#nineteen>

iOS Command Prompt Script:

```
login: student
Password:
% Please answer 'yes' or 'no'.
Would you like to enter the initial configuration dialog? [yes/no]: n
Press RETURN to get started!
*Apr 19 22:20:29.663: %ESWMRVL_FLTMG-5-NOTICE: Notice: FPGA Rev 0x71
*Apr 19 22:20:48.579: %VPN_HW-6-INFO_LOC: Crypto engine: onboard 0  State changed to: Initialized
*Apr 19 22:20:48.583: %VPN_HW-6-INFO_LOC: Crypto engine: onboard 0  State changed to: Enabled
*Apr 19 22:20:50.435: %LINEPROTO-5-UPDOWN: Line protocol on Interface VoIP-Null0, changed state to up
*Apr 19 22:20:50.435: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Apr 19 22:20:50.435: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Apr 19 22:20:50.439: %LINK-3-UPDOWN: Interface Serial0/1/0, changed state to down
*Apr 19 22:20:50.439: %LINK-3-UPDOWN: Interface Serial0/1/1, changed state to down
*Apr 19 22:20:50.439: %LINEPROTO-5-UPDOWN: Line protocol on Interface SSLVPN-VIF0, changed state to up
*Apr 19 22:20:50.923: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to down
*Apr 19 22:20:51.979: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEtherne
Router>
Routet0/0, changed state to down
*Apr 19 22:20:51.979: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
*Apr 19 22:20:51.979: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to down
*Apr 19 22:20:51.979: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/1, changed state to down
*Apr 19 22:23:51.275: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
*Apr 19 22:24:09.567: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
*Apr 19 22:24:44.007: %SYS-5-RESTART: System restarted --
Cisco IOS Software, 2800 Software (C2800NM-ADVIPSERVICESK9-M), Version 12.4(20)T, RELEASE SOFTWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Thu 10-Jul-08 22:00 by prod_rel_team
*Apr 19 22:24:44.015: %SNMP-5-COLDSTART: SNMP agent on host Router is undergoing a cold start
*Apr 19 22:24:44.247: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is OFF
*Apr 19 22:24:44.247: %CRYPTO-6-GDOI_ON_OFF: GDOI is OFF
*Apr 19 22:24:44.247: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is OFF
*Apr 19 22:24:44.247: %CRYPTO-6-GDOI_ON_OFF: GDOI is OFF
*Apr 19 22:24:44.759: %LINK-5-CHANGED: Interface FastEthernet0/0, changed state to administratively down
*Apr 19 22:24:44.759: %LINK-5-CHANGED: Interface FastEthernet0/1, changed state to administratively down
*Apr 19 22:24:44.759: %LINK-5-CHANGED: Interface Serial0/1/0, changed state to administratively down
*Apr 19 22:24:44.759: %LINK-5-CHANGED: Interface Serial0/1/1, changed state to administratively down
*Apr 19 22:24:44.987: %LINK-3-UPDOWN: Interface FastEthernet0/0/3, changed state to up
*Apr 19 22:24:44.987: %LINK-3-UPDOWN: Interface FastEthernet0/0/2, changed state to up
*Apr 19 22:24:44.987: %LINK-3-UPDOWN: Interface FastEthernet0/0/1, changed state to up
*Apr 19 22:24:44.987: %LINK-3-UPDOWN: Interface FastEthernet0/0/0, changed state to up
*Apr 19 22:24:45.759: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to down
*Apr 19 22:24:46.223: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0/3, changed state to down
*Apr 19 22:24:46.227: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0/2, changed state to down
*Apr 19 22:24:46.227: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0/1, changed state to down
*Apr 19 22:24:46.227: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0/0, changed state to downr>
Router>
Router>
Router>enable
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname DALLAS
DALLAS(config)#no ip do
DALLAS(config)#no ip domain lookup
DALLAS(config)#line console 0
DALLAS(config-line)#logging synchronous
DALLAS(config-line)#^Z
DALLAS#
*Apr 19 22:26:12.451: %SYS-5-CONFIG_I: Configured from console by console
DALLAS#conf terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DALLAS(config)#
DALLAS(config)############# Part3 ############
DALLAS(config)#interface FastEthernet 0/0
DALLAS(config-if)#description (DALLAS)<-->(Miami)
DALLAS(config-if)#ip address 192.168.0.9 255.255.255.252
DALLAS(config-if)#no shut
DALLAS(config-if)#exit
DALLAS(config)#
*Apr 19 22:28:48.163: %LINK-3-UPDOWN: Interface FastEthernet0/0, changed state to up
*Apr 19 22:28:49.163: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
DALLAS(config)#
DALLAS(config)#interface fastEthernet 0/1
DALLAS(config-if)#description  (DALLAS)<-->(Paris)
DALLAS(config-if)#ip address 192.168.0.14 255.255.255.252
DALLAS(config-if)#no shut
DALLAS(config-if)#exit
DALLAS(config)#exit
DALLAS#

*Apr 19 22:29:41.531: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Apr 19 22:29:44.595: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
*Apr 19 22:29:52.395: %SYS-5-CONFIG_I: Configured from console by console
*Apr 19 22:30:20.151: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback0, changed state to up
*Apr 19 22:30:53.579: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down
DALLAS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
DALLAS(config)#interface loopback 0
DALLAS(config-if)#
DALLAS(config-if)#ip address 192.168.4.4 255.255.255.252
Bad mask /30 for address 192.168.4.4
DALLAS(config-if)#ip address 192.168.4.4 255.255.255.255
DALLAS(config-if)#no shut
DALLAS(config-if)#exit
DALLAS(config)#exit
*Apr 19 22:33:00.223: %SYS-5-CONFIG_I: Configured from console by console
DALLAS#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            192.168.0.9     YES manual up                    up
FastEthernet0/1            192.168.0.14    YES manual up                    down
FastEthernet0/0/0          unassigned      YES unset  up                    down
FastEthernet0/0/1          unassigned      YES unset  up                    down
FastEthernet0/0/2          unassigned      YES unset  up                    down
FastEthernet0/0/3          unassigned      YES unset  up                    down
```

```
Serial0/1/0                unassigned      YES unset  administratively down down
Serial0/1/1                unassigned      YES unset  administratively down down
Vlan1                      unassigned      YES unset  up                    down
SSLVPN-VIF0                unassigned      NO  unset  up                    up
Loopback0                  192.168.4.4     YES manual up                    up

DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.0.0/30 is subnetted, 1 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
DALLAS#
*Apr 19 22:35:16.779: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
*Apr 19 22:35:17.527: %IP-4-DUPADDR: Duplicate address 192.168.0.14 on FastEthernet0/1, sourced by 0019.0623.6939
DALLAS#
DALLAS#show interfaces
FastEthernet0/0 is up, line protocol is up
  Hardware is MV96340 Ethernet, address is 0018.b9ce.4688 (bia 0018.b9ce.4688)
  Description: (DALLAS)<-->(Miami)
  Internet address is 192.168.0.9/30
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:37, output 00:00:04, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     11 packets input, 3442 bytes
     Received 11 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog
     0 input packets with dribble condition detected
     52 packets output, 5589 bytes, 0 underruns
 --More--
*Apr 19 22:35:47.527: %IP-4-DUPADDR: Duplicate address 192.168.0.14 on FastEthernet0/1, sourced by 0019.0623.6939
     0 output errors, 0 collisions, 1 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
FastEthernet0/1 is up, line protocol is up
  Hardware is MV96340 Ethernet, address is 0018.b9ce.4689 (bia 0018.b9ce.4689)
  Description: (DALLAS)<-->(Paris)
  Internet address is 192.168.0.14/30
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 1 packets/sec
  5 minute output rate 0 bits/sec, 1 packets/sec
     105 packets input, 30326 bytes
 --More--
*Apr 19 22:36:17.527: %IP-4-DUPADDR: Duplicate address 192.168.0.14 on FastEthernet0/1, sourced by 0019.0623.6939
     Received 105 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog
     0 input packets with dribble condition detected
     127 packets output, 10107 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     21 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
FastEthernet0/0/0 is up, line protocol is down
  Hardware is Fast Ethernet, address is 001a.6c36.c55d (bia 001a.6c36.c55d)
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Auto-duplex, Auto-speed
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
```

```
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
FastEthernet0/0/1 is up, line protocol is down
  Hardware is Fast Ethernet, address is 001a.6c36.c55e (bia 001a.6c36.c55e)
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Auto-duplex, Auto-speed
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
FastEthernet0/0/2 is up, line protocol is down
  Hardware is Fast Ethernet, address is 001a.6c36.c55f (bia 001a.6c36.c55f)
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Auto-duplex, Auto-speed
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
FastEthernet0/0/3 is up, line protocol is down
  Hardware is Fast Ethernet, address is 001a.6c36.c560 (bia 001a.6c36.c560)
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 2
*Apr 19 22:36:47.527: %IP-4-DUPADDR: Duplicate address 192.168.0.14 on FastEther
net0/1, sourced by 0019.0623.693955/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Auto-duplex, Auto-speed
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 input packets with dribble condition detected
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
Serial0/1/0 is administratively down, line protocol is down
  Hardware is GT96K Serial
  MTU 1500 bytes, BW 128 Kbit/sec, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set

*Apr 19 22:37:17.527: %IP-4-DUPADDR: Duplicate address 192.168.0.14 on FastEthernet0/1, sourced by 0019.0623.6939
*Apr 19 22:37:47.527: %IP-4-DUPADDR: Duplicate address 192.168.0.14 on FastEthernet0/1, sourced by 0019.0623.6939
*Apr 19 22:38:17.527: %IP-4-DUPADDR: Duplicate address 192.168.0.14 on FastEthernet0/1, sourced by 0019.0623.6939
DALLAS#
*Apr 19 22:39:10.155: %SYS-5-CONFIG_I: Configured from console by console
DALLAS#show interfaces
FastEthernet0/0 is up, line protocol is up
  Hardware is MV96340 Ethernet, address is 0018.b9ce.4688 (bia 0018.b9ce.4688)
  Description: (DALLAS)<-->(Miami)
  Internet address is 192.168.0.9/30
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:24, output 00:00:01, output hang never
  Last clearing of "show interface" counters never
```

```
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     15 packets input, 4934 bytes
     Received 15 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog
     0 input packets with dribble condition detected
     79 packets output, 8469 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
FastEthernet0/1 is up, line protocol is up
  Hardware is MV96340 Ethernet, address is 0018.b9ce.4689 (bia 0018.b9ce.4689)
  Description: (DALLAS)<-->(Paris)
  Internet address is 192.168.0.14/30
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:10, output 00:00:08, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     261 packets input, 40886 bytes
     Received 261 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog
     0 input packets with dribble condition detected
     268 packets output, 19512 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     21 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
FastEthernet0/0/0 is up, line protocol is down
  Hardware is Fast Ethernet, address is 001a.6c36.c55d (bia 001a.6c36.c55d)
  MTU 1500 bytes, BW 100000 Kbit/sec, DLY 100 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Auto-duplex, Auto-speed
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)

DALLAS#
DALLAS#show ip interface
FastEthernet0/0 is up, line protocol is up
  Internet address is 192.168.0.9/30
  Broadcast address is 255.255.255.255
  Address determined by setup command
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Outgoing access list is not set
  Inbound  access list is not set
  Proxy ARP is enabled
  Local Proxy ARP is disabled
  Security level is default
  Split horizon is enabled
  ICMP redirects are always sent
  ICMP unreachables are always sent
  ICMP mask replies are never sent
  IP fast switching is enabled
  IP fast switching on the same interface is disabled
  IP Flow switching is disabled
  IP CEF switching is enabled
  IP CEF switching turbo vector
  IP multicast fast switching is enabled
  IP multicast distributed fast switching is disabled
  IP route-cache flags are Fast, CEF
  Router Discovery is disabled
  IP output packet accounting is disabled
  IP access violation accounting is disabled
  TCP/IP header compression is disabled
  RTP/IP header compression is disabled
  Policy routing is disabled
  Network address translation is disabled
  BGP Policy Mapping is disabled
  Input features: MCI Check
  WCCP Redirect outbound is disabled
  WCCP Redirect inbound is disabled
  WCCP Redirect exclude is disabled
FastEthernet0/1 is up, line protocol is up
  Internet address is 192.168.0.14/30
  Broadcast address is 255.255.255.255
  Address determined by setup command
  MTU is 1500 bytes
  Helper address is not set
  Directed broadcast forwarding is disabled
  Outgoing access list is not set
  Inbound  access list is not set
```

```
  Proxy ARP is enabled
  Local Proxy ARP is disabled
  Security level is default
  Split horizon is enabled
  ICMP redirects are always sent
  ICMP unreachables are always sent
  ICMP mask replies are never sent
  IP fast switching is enabled
  IP fast switching on the same interface is disabled
  IP Flow switching is disabled
  IP CEF switching is enabled
  IP CEF switching turbo vector
  IP multicast fast switching is enabled
  IP multicast distributed fast switching is disabled
  IP route-cache flags are Fast, CEF
  Router Discovery is disabled
  IP output packet accounting is disabled
  IP access violation accounting is disabled
  TCP/IP header compression is disabled
  RTP/IP header compression is disabled
  Policy routing is disabled
  Network address translation is disabled
  BGP Policy Mapping is disabled
  Input features: MCI Check

DALLAS#
DALLAS########### 3.1
DALLAS#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            192.168.0.9     YES manual up                    up
FastEthernet0/1            192.168.0.14    YES manual up                    up
FastEthernet0/0/0          unassigned      YES unset  up                    down
FastEthernet0/0/1          unassigned      YES unset  up                    down
FastEthernet0/0/2          unassigned      YES unset  up                    down
FastEthernet0/0/3          unassigned      YES unset  up                    down
Serial0/1/0                unassigned      YES unset  administratively down down
Serial0/1/1                unassigned      YES unset  administratively down down
Vlan1                      unassigned      YES unset  up                    down
SSLVPN-VIF0                unassigned      NO  unset  up                    up
Loopback0                  192.168.4.4     YES manual up                    up

DALLAS#
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.0.0/30 is subnetted, 2 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
DALLAS#
DALLAS#### Test
DALLAS#show ip arp
Protocol  Address          Age (min)  Hardware Addr   Type   Interface
Internet  192.168.0.9              -   0018.b9ce.4688  ARPA   FastEthernet0/0
Internet  192.168.0.14             -   0018.b9ce.4689  ARPA   FastEthernet0/1
DALLAS#
DALLAS#### part 4
DALLAS#### Test
DALLAS#
DALLAS#ping 192.168.0.13
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.0.13, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 1/1/4 ms
DALLAS################## part4
DALLAS#
DALLAS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
DALLAS(config)#router bgp 4
DALLAS(config-router)#
DALLAS(config-router)#network 192.168.4.4 mask 255.255.255.255
DALLAS(config-router)#network 192.168.0.8 mask 255.255.255.252
DALLAS(config-router)#network 192.168.0.12 mask 255.255.255.252
DALLAS(config-router)#neighbor 192.168.0.10 remote-as 3
DALLAS(config-router)#neighbor 192.168.0.13 remote-as 5
DALLAS(config-router)#
*Apr 19 22:52:43.911: %BGP-5-ADJCHANGE: neighbor 192.168.0.10 Up
*Apr 19 22:52:47.299: %BGP-5-ADJCHANGE: neighbor 192.168.0.13 Up
DALLAS(config-router)#no auto-summary
DALLAS(config-router)#
DALLAS(config-router)#^Z
DALLAS#show ip
*Apr 19 22:53:16.275: %SYS-5-CONFIG_I: Configured from console by console
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.0.0/30 is subnetted, 2 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
DALLAS#
```

```
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:00:01
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:00:01
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [20/0] via 192.168.0.10, 00:00:16
B       192.168.0.24 [20/0] via 192.168.0.13, 00:00:02
B       192.168.0.16 [20/0] via 192.168.0.13, 00:00:02
B       192.168.0.20 [20/0] via 192.168.0.10, 00:00:16
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [20/0] via 192.168.0.10, 00:00:40
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [20/0] via 192.168.0.10, 00:00:40
DALLAS#
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:01:34
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:01:34
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [20/0] via 192.168.0.10, 00:01:49
B       192.168.0.24 [20/0] via 192.168.0.13, 00:01:35
B       192.168.0.16 [20/0] via 192.168.0.13, 00:01:35
B       192.168.0.20 [20/0] via 192.168.0.10, 00:01:49
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [20/0] via 192.168.0.10, 00:00:49
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [20/0] via 192.168.0.10, 00:01:51
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [20/0] via 192.168.0.10, 00:01:51
DALLAS#
DALLAS#show ip protocols
Routing Protocol is "bgp 4"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  IGP synchronization is disabled
  Automatic route summarization is disabled
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.0.10
    192.168.0.13
  Maximum path: 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.10          20      00:01:16
    192.168.0.13          20      00:02:04
  Distance: external 20 internal 200 local 200
DALLAS#
DALLAS#####################################################
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:02:23
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:02:23
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [20/0] via 192.168.0.10, 00:02:38
B       192.168.0.24 [20/0] via 192.168.0.13, 00:02:24
B       192.168.0.16 [20/0] via 192.168.0.13, 00:02:24
B       192.168.0.20 [20/0] via 192.168.0.10, 00:02:38
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [20/0] via 192.168.0.10, 00:01:36
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [20/0] via 192.168.0.10, 00:02:39
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [20/0] via 192.168.0.10, 00:02:39
DALLAS#
DALLAS#show ip protocol
Routing Protocol is "bgp 4"
```

```
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  IGP synchronization is disabled
  Automatic route summarization is disabled
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.0.10
    192.168.0.13
  Maximum path: 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.10          20      00:01:45
    192.168.0.13          20      00:02:33
  Distance: external 20 internal 200 local 200
DALLAS#
DALLAS#show ip bgp
BGP table version is 13, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.13                           0 5 6 1 i
*>                  192.168.0.10                           0 3 2 i
*  192.168.0.8/30   192.168.0.10             0            0 3 i
*>                  0.0.0.0                  0        32768 i
*  192.168.0.12/30  192.168.0.13             0            0 5 i
*>                  0.0.0.0                  0        32768 i
*> 192.168.0.16/30  192.168.0.13             0            0 5 i
*> 192.168.0.20/30  192.168.0.10             0            0 3 i
*  192.168.0.24/30  192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 i
*  192.168.1.1/32   192.168.0.13                           0 5 6 1 i
*>                  192.168.0.10                           0 3 2 1 i
*> 192.168.2.2/32   192.168.0.10                           0 3 2 i
*> 192.168.3.3/32   192.168.0.10             0            0 3 i
*> 192.168.4.4/32   0.0.0.0                  0        32768 i
*> 192.168.5.5/32   192.168.0.13             0            0 5 i
*> 192.168.6.6/32   192.168.0.13                           0 5 6 i
DALLAS#
DALLAS#show bgp summary
BGP router identifier 192.168.4.4, local AS number 4
BGP table version is 13, main routing table version 13
12 network entries using 1584 bytes of memory
17 path entries using 884 bytes of memory
8/6 BGP path/bestpath attribute entries using 1184 bytes of memory
6 BGP AS-PATH entries using 144 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
BGP using 3828 total bytes of memory
BGP activity 12/0 prefixes, 17/0 paths, scan interval 60 secs
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.0.10    4     3      11      11       13    0    0 00:04:05        7
192.168.0.13    4     5      10      11       13    0    0 00:04:01        7
DALLAS#
DALLAS#show ip bgp neighbor
BGP neighbor is 192.168.0.10,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:04:26
  Last read 00:00:29, last write 00:00:30, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                6          6
    Keepalives:             4          4
    Route Refresh:          0          0
    Total:                 11         11
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 13, neighbor version 13/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            12          7 (Consumes 364 bytes)
    Prefixes Total:              12          7
    Implicit Withdraw:            0          0
    Explicit Withdraw:            0          0
    Used as bestpath:           n/a          5
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    AS_PATH loop:                    n/a          6
    Total:                             0          6
  Number of NLRIs in the update sent: max 3, min 1
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.9, Local port: 42948
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x21E964):
Timer          Starts    Wakeups            Next
```

```
Retrans             8          0             0x0
TimeWait            0          0             0x0
AckHold             7          5             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger            1          0        0x26EA70
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 1257119701  snduna: 1257120154  sndnxt: 1257120154     sndwnd:  15932
irs: 2910584306  rcvnxt: 2910584764  rcvwnd:      15927  delrcvwnd:    457

SRTT: 197 ms, RTTO: 984 ms, RTV: 787 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 12 (out of order: 0), with data: 8, total data bytes: 457
Sent: 15 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 8, total data bytes: 452
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 192.168.0.13,  remote AS 5, external link
  BGP version 4, remote router ID 192.168.5.5
  BGP state = Established, up for 00:04:32
  Last read 00:00:24, last write 00:00:38, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                6          6
    Keepalives:             4          4
    Route Refresh:          0          0
    Total:                 11         11
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 13, neighbor version 13/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            12          7 (Consumes 364 bytes)
    Prefixes Total:              12          7
    Implicit Withdraw:            0          0
    Explicit Withdraw:            0          0
    Used as bestpath:           n/a          4
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    AS_PATH loop:                    n/a          6
    Total:                             0          6
  Number of NLRIs in the update sent: max 3, min 1
  Address tracking is enabled, the RIB does have a route to 192.168.0.13
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.14, Local port: 15940
Foreign host: 192.168.0.13, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x221038):
Timer          Starts    Wakeups            Next
Retrans             8          0             0x0
TimeWait            0          0             0x0
AckHold             7          6             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger            1          0        0x26F7B0
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 2170312586  snduna: 2170313039  sndnxt: 2170313039     sndwnd:  15932
irs:  846919556  rcvnxt:  846920014  rcvwnd:      15927  delrcvwnd:    457

SRTT: 197 ms, RTTO: 984 ms, RTV: 787 ms, KRTT: 0 ms
minRTT: 4 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 15 (out of order: 0), with data: 8, total data bytes: 457
Sent: 16 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 8, total data bytes: 452
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

DALLAS#
DALLAS###############
DALLAS#show ip protocols
Routing Protocol is "bgp 4"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
```

```
  IGP synchronization is disabled
  Automatic route summarization is disabled
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.0.10
    192.168.0.13
  Maximum path: 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.10         20      00:08:41
    192.168.0.13         20      00:09:29
  Distance: external 20 internal 200 local 200
DALLAS###############
DALLAS#
DALLAS#show ip bgp
BGP table version is 13, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal, r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.13                           0 5 6 1 i
*>                  192.168.0.10                           0 3 2 i
*  192.168.0.8/30   192.168.0.10            0             0 3 i
*>                  0.0.0.0                  0         32768 i
*  192.168.0.12/30  192.168.0.13            0             0 5 i
*>                  0.0.0.0                  0         32768 i
*> 192.168.0.16/30  192.168.0.13            0             0 5 i
*> 192.168.0.20/30  192.168.0.10            0             0 3 i
*  192.168.0.24/30  192.168.0.10                          0 3 2 1 i
*>                  192.168.0.13                           0 5 6 i
*  192.168.1.1/32   192.168.0.13                          0 5 6 1 i
*>                  192.168.0.10                           0 3 2 1 i
*> 192.168.2.2/32   192.168.0.10                          0 3 2 i
*> 192.168.3.3/32   192.168.0.10            0             0 3 i
*> 192.168.4.4/32   0.0.0.0                  0         32768 i
*> 192.168.5.5/32   192.168.0.13            0             0 5 i
*> 192.168.6.6/32   192.168.0.13                          0 5 6 i
DALLAS#
DALLAS## *-valid
DALLAS## >-best
DALLAS## *> valid and best
DALLAS## path - path of AS i(i means IGP)
DALLAS## weight
DALLAS#
DALLAS#
DALLAS## if I don't set the AS as a neighbor, then the packets will not be propagated
DALLAS#
DALLAS#
DALLAS###################################
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:14:23
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:14:23
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [20/0] via 192.168.0.10, 00:14:38
B       192.168.0.24 [20/0] via 192.168.0.13, 00:14:24
B       192.168.0.16 [20/0] via 192.168.0.13, 00:14:24
B       192.168.0.20 [20/0] via 192.168.0.10, 00:14:38

DALLAS#show ip protocols
Routing Protocol is "bgp 4"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  IGP synchronization is disabled
  Automatic route summarization is disabled
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.0.10
    192.168.0.13
  Maximum path: 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.10         20      00:13:43
    192.168.0.13         20      00:14:32
  Distance: external 20 internal 200 local 200
DALLAS#show ip bgp
BGP table version is 13, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal, r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.13                           0 5 6 1 i
*>                  192.168.0.10                           0 3 2 i
*  192.168.0.8/30   192.168.0.10            0             0 3 i
*>                  0.0.0.0                  0         32768 i
*  192.168.0.12/30  192.168.0.13            0             0 5 i
*>                  0.0.0.0                  0         32768 i
*> 192.168.0.16/30  192.168.0.13            0             0 5 i
*> 192.168.0.20/30  192.168.0.10            0             0 3 i
*  192.168.0.24/30  192.168.0.10                          0 3 2 1 i
*>                  192.168.0.13                           0 5 6 i
*  192.168.1.1/32   192.168.0.13                          0 5 6 1 i
*>                  192.168.0.10                           0 3 2 1 i
*> 192.168.2.2/32   192.168.0.10                          0 3 2 i
```

```
*> 192.168.3.3/32   192.168.0.10             0             0 3 i
*> 192.168.4.4/32   0.0.0.0                  0         32768 i
*> 192.168.5.5/32   192.168.0.13             0             0 5 i
*> 192.168.6.6/32   192.168.0.13                           0 5 6 i
DALLAS#
DALLAS#
DALLAS#
DALLAS#show bgp summary
BGP router identifier 192.168.4.4, local AS number 4
BGP table version is 13, main routing table version 13
12 network entries using 1584 bytes of memory
17 path entries using 884 bytes of memory
8/6 BGP path/bestpath attribute entries using 1184 bytes of memory
6 BGP AS-PATH entries using 144 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 1) using 32 bytes of memory
BGP using 3828 total bytes of memory
BGP activity 12/0 prefixes, 17/0 paths, scan interval 60 secs
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.0.10    4     3      22      22       13    0    0 00:15:53        7
192.168.0.13    4     5      22      22       13    0    0 00:15:49        7
DALLAS#
DALLAS#
DALLAS#
DALLAS#show ip bgp neighbor
BGP neighbor is 192.168.0.10,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:16:09
  Last read 00:00:14, last write 00:00:14, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8          8
    Keepalives:            15         15
    Route Refresh:          0          0
    Total:                 24         24
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            11          3 (Consumes 156 bytes)
    Prefixes Total:              14          7
    Implicit Withdraw:            2          0
    Explicit Withdraw:            1          4
    Used as bestpath:           n/a          2
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    AS_PATH loop:                     n/a          7
    Total:                              0          7
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.9, Local port: 42948
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x2C9E0C):
Timer          Starts    Wakeups            Next
Retrans            20          0             0x0
TimeWait            0          0             0x0
AckHold            19         16             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger          708        707        0x2C9EB2
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 1257119701  snduna: 1257120448  sndnxt: 1257120448     sndwnd:  15638
irs: 2910584306  rcvnxt: 2910585063  rcvwnd:      15628  delrcvwnd:    756

SRTT: 279 ms, RTTO: 446 ms, RTV: 167 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 25 (out of order: 0), with data: 20, total data bytes: 756
Sent: 38 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 20, total data bytes: 746
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 192.168.0.13,  remote AS 5, external link
  BGP version 4, remote router ID 192.168.5.5
  BGP state = Established, up for 00:16:13
  Last read 00:00:21, last write 00:00:21, hold time is 180, keepalive interval
is 60 seconds
```

```
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8          7
    Keepalives:            15         15
    Route Refresh:          0          0
    Total:                 24         23
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                                 Sent       Rcvd
  Prefix activity:               ----       ----
    Prefixes Current:              11          7 (Consumes 364 bytes)
    Prefixes Total:                14          7
    Implicit Withdraw:              2          0
    Explicit Withdraw:              1          0
    Used as bestpath:             n/a          6
    Used as multipath:            n/a          0
                                   Outbound    Inbound
  Local Policy Denied Prefixes:    --------    -------
    AS_PATH loop:                       n/a          6
    Total:                                0          6
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.13
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.14, Local port: 15940
Foreign host: 192.168.0.13, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x2CB390):
Timer          Starts    Wakeups            Next
Retrans            20          0             0x0
TimeWait            0          0             0x0
AckHold            19         18             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger          715        714        0x2CB4A6
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 2170312586  snduna: 2170313333  sndnxt: 2170313333     sndwnd:  15638
irs:  846919556  rcvnxt:  846920251  rcvwnd:      15690  delrcvwnd:    694

SRTT: 279 ms, RTTO: 446 ms, RTV: 167 ms, KRTT: 0 ms
minRTT: 4 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 38 (out of order: 0), with data: 20, total data bytes: 694
Sent: 40 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 20, total data bytes: 746
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

DALLAS#
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.8
BGP routing table entry for 192.168.0.8/30, version 3
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, metric 0, localpref 100, valid, external
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin IGP, metric 0, localpref 100, weight 32768, valid, sourced, local, best
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.20
BGP routing table entry for 192.168.0.20/30, version 5
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, metric 0, localpref 100, valid, external, best
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.4
BGP routing table entry for 192.168.0.4/30, version 16
Paths: (1 available, best #1, table Default-IP-Routing-Table)
Flag: 0x820
  Advertised to update-groups:
        1
  5 6 1
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, localpref 100, valid, external, best
```

```
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.24
BGP routing table entry for 192.168.0.24/30, version 12
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  5 6
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, localpref 100, valid, external, best
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.16
BGP routing table entry for 192.168.0.16/30, version 9
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  5
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, metric 0, localpref 100, valid, external, best
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.12
BGP routing table entry for 192.168.0.12/30, version 4
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  5
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, metric 0, localpref 100, valid, external
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin IGP, metric 0, localpref 100, weight 32768, valid, sourced, local, best
DALLAS#
DALLAS#show ip bgp 192.168.0.28
% Network not in table
DALLAS#
DALLAS## that was a test ;)
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.10
BGP neighbor is 192.168.0.10,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:18:09
  Last read 00:00:43, last write 00:00:13, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8          9
    Keepalives:            17         16
    Route Refresh:          0          0
    Total:                 26         26
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            11          3 (Consumes 156 bytes)
    Prefixes Total:              14          7
    Implicit Withdraw:            2          0
    Explicit Withdraw:            1          4
    Used as bestpath:           n/a          2
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    AS_PATH loop:                     n/a          9
    Total:                              0          9
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.9, Local port: 42948
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x2E7290):
Timer          Starts    Wakeups            Next
Retrans            22          0             0x0
TimeWait            0          0             0x0
AckHold            21         18             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger          984        983        0x2E7399
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 1257119701  snduna: 1257120486  sndnxt: 1257120486     sndwnd:  15600
irs: 2910584306  rcvnxt: 2910585141  rcvwnd:      15550  delrcvwnd:    834

SRTT: 284 ms, RTTO: 413 ms, RTV: 129 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
```

```
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 29 (out of order: 0), with data: 22, total data bytes: 834
Sent: 42 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 22, total data bytes: 784
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0
DALLAS#
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.13
BGP neighbor is 192.168.0.13,  remote AS 5, external link
  BGP version 4, remote router ID 192.168.5.5
  BGP state = Established, up for 00:18:19
  Last read 00:00:28, last write 00:00:27, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8          7
    Keepalives:            17         17
    Route Refresh:          0          0
    Total:                 26         25
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            11          7 (Consumes 364 bytes)
    Prefixes Total:              14          7
    Implicit Withdraw:            2          0
    Explicit Withdraw:            1          0
    Used as bestpath:           n/a          6
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    AS_PATH loop:                    n/a          6
    Total:                             0          6
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.13
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.14, Local port: 15940
Foreign host: 192.168.0.13, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x2EA3C4):
Timer          Starts    Wakeups            Next
Retrans            22          0             0x0
TimeWait            0          0             0x0
AckHold            21         20             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         1009       1008        0x2EA535
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 2170312586  snduna: 2170313371  sndnxt: 2170313371     sndwnd:  15600
irs:  846919556  rcvnxt:  846920289  rcvwnd:      15652  delrcvwnd:    732

SRTT: 284 ms, RTTO: 413 ms, RTV: 129 ms, KRTT: 0 ms
minRTT: 4 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 42 (out of order: 0), with data: 22, total data bytes: 732
Sent: 44 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 22, total data bytes: 784
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.22
% No such neighbor
DALLAS#
DALLAS##  that was a test
DALLAS#
DALLAS#
DALLAS#
DALLAS#traceroute 192.168.6.6
Type escape sequence to abort.
Tracing the route to 192.168.6.6
  1 192.168.0.13 4 msec 0 msec 0 msec
  2 192.168.0.17 [AS 5] 4 msec *  0 msec
DALLAS#
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.10
BGP neighbor is 192.168.0.10,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:21:38
  Last read 00:00:48, last write 00:00:41, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
```

```
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8         10
    Keepalives:            20         19
    Route Refresh:          0          0
    Total:                 29         30
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            11          6 (Consumes 312 bytes)
    Prefixes Total:              14         10
    Implicit Withdraw:            2          0
    Explicit Withdraw:            1          4
    Used as bestpath:           n/a          2
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    AS_PATH loop:                     n/a          9
    Total:                              0          9
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.9, Local port: 42948
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x31B310):
Timer          Starts    Wakeups            Next
Retrans            25          0             0x0
TimeWait            0          0             0x0
AckHold            25         22             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         1525       1524        0x31B3A0
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 1257119701  snduna: 1257120543  sndnxt: 1257120543     sndwnd:  15543
irs: 2910584306  rcvnxt: 2910585258  rcvwnd:      15433  delrcvwnd:    951

SRTT: 289 ms, RTTO: 376 ms, RTV: 87 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 36 (out of order: 0), with data: 26, total data bytes: 951
Sent: 49 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 25, total data bytes: 841
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0
DALLAS#
DALLAS#
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.10
BGP neighbor is 192.168.0.10,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:22:29
  Last read 00:00:39, last write 00:00:32, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8         10
    Keepalives:            21         20
    Route Refresh:          0          0
    Total:                 30         31
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            11          6 (Consumes 312 bytes)
    Prefixes Total:              14         10
    Implicit Withdraw:            2          0
    Explicit Withdraw:            1          4
    Used as bestpath:           n/a          2
    Used as multipath:          n/a          0
                                 Outbound    Inbound
```

```
  Local Policy Denied Prefixes:    --------    -------
    AS_PATH loop:                       n/a          9
    Total:                                0          9
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.9, Local port: 42948
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x326C7C):
Timer          Starts    Wakeups            Next
Retrans            26          0             0x0
TimeWait            0          0             0x0
AckHold            26         23             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         1653       1652        0x326C88
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 1257119701  snduna: 1257120562  sndnxt: 1257120562     sndwnd:  15524
irs: 2910584306  rcvnxt: 2910585277  rcvwnd:      15414  delrcvwnd:    970

SRTT: 291 ms, RTTO: 368 ms, RTV: 77 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 38 (out of order: 0), with data: 27, total data bytes: 970
Sent: 51 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 26, total data bytes: 860
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0
DALLAS#
DALLAS#
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:22:23
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:22:23
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [20/0] via 192.168.0.13, 00:07:37
B       192.168.0.24 [20/0] via 192.168.0.13, 00:22:24
B       192.168.0.16 [20/0] via 192.168.0.13, 00:22:24
B       192.168.0.20 [20/0] via 192.168.0.10, 00:22:38
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [20/0] via 192.168.0.13, 00:07:38
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [20/0] via 192.168.0.10, 00:22:39
DALLAS#
DALLAS#
DALLAS#show ip bgp
BGP table version is 16, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 1 i
*  192.168.0.8/30   192.168.0.10             0             0 3 i
*>                  0.0.0.0                  0         32768 i
*  192.168.0.12/30  192.168.0.13             0             0 5 i
*>                  0.0.0.0                  0         32768 i
*> 192.168.0.16/30  192.168.0.13             0             0 5 i
*> 192.168.0.20/30  192.168.0.10             0             0 3 i
*  192.168.0.24/30  192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 i
*  192.168.1.1/32   192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 1 i
*> 192.168.3.3/32   192.168.0.10             0             0 3 i
*> 192.168.4.4/32   0.0.0.0                  0         32768 i
*> 192.168.5.5/32   192.168.0.13             0             0 5 i
*> 192.168.6.6/32   192.168.0.13                           0 5 6 i
DALLAS#
DALLAS#
DALLAS#show bgp summary
BGP router identifier 192.168.4.4, local AS number 4
BGP table version is 16, main routing table version 16
11 network entries using 1452 bytes of memory
16 path entries using 832 bytes of memory
7/5 BGP path/bestpath attribute entries using 1036 bytes of memory
5 BGP AS-PATH entries using 120 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 2) using 32 bytes of memory
BGP using 3472 total bytes of memory
```

```
BGP activity 12/1 prefixes, 20/4 paths, scan interval 60 secs
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.0.10    4     3      33      31       16    0    0 00:23:56        6
192.168.0.13    4     5      30      31       16    0    0 00:23:52        7
DALLAS#
DALLAS#
DALLAS#show bgp neighbor
BGP neighbor is 192.168.0.10,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:24:07
  Last read 00:00:16, last write 00:00:09, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8         10
    Keepalives:            23         22
    Route Refresh:          0          0
    Total:                 32         33
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:            11          6 (Consumes 312 bytes)
    Prefixes Total:              14         10
    Implicit Withdraw:            2          0
    Explicit Withdraw:            1          4
    Used as bestpath:           n/a          2
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    AS_PATH loop:                     n/a          9
    Total:                              0          9
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.9, Local port: 42948
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x33FF30):
Timer          Starts    Wakeups            Next
Retrans            28          0             0x0
TimeWait            0          0             0x0
AckHold            28         25             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         1940       1939        0x340078
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 1257119701  snduna: 1257120600  sndnxt: 1257120600     sndwnd:  15486
irs: 2910584306  rcvnxt: 2910585315  rcvwnd:      15376  delrcvwnd:   1008

SRTT: 293 ms, RTTO: 352 ms, RTV: 59 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 42 (out of order: 0), with data: 29, total data bytes: 1008
Sent: 55 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 28, total data bytes: 898
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 192.168.0.13,  remote AS 5, external link
  BGP version 4, remote router ID 192.168.5.5
  BGP state = Established, up for 00:24:17
  Last read 00:00:23, last write 00:00:22, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8          7
    Keepalives:            23         23
    Route Refresh:          0          0
    Total:                 32         31
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
```

```
                                Sent       Rcvd
  Prefix activity:              ----       ----
    Prefixes Current:             11          7 (Consumes 364 bytes)
    Prefixes Total:               14          7
    Implicit Withdraw:             2          0
    Explicit Withdraw:             1          0
    Used as bestpath:            n/a          6
    Used as multipath:           n/a          0
                                  Outbound    Inbound
  Local Policy Denied Prefixes:   --------    -------
    AS_PATH loop:                      n/a          6
    Total:                               0          6
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.13
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.14, Local port: 15940
Foreign host: 192.168.0.13, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x342644):
Timer          Starts    Wakeups            Next
Retrans            28          0             0x0
TimeWait            0          0             0x0
AckHold            27         26             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         1962       1961        0x34264C
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 2170312586  snduna: 2170313485  sndnxt: 2170313485     sndwnd:  15486
irs:  846919556  rcvnxt:  846920403  rcvwnd:      15538  delrcvwnd:    846

SRTT: 293 ms, RTTO: 352 ms, RTV: 59 ms, KRTT: 0 ms
minRTT: 4 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 54 (out of order: 0), with data: 28, total data bytes: 846
Sent: 56 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 28, total data bytes: 898
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

DALLAS#
DALLAS#
DALLAS#traceroute 192.168.6.6
Type escape sequence to abort.
Tracing the route to 192.168.6.6
  1 192.168.0.13 0 msec 0 msec 0 msec
  2 192.168.0.17 [AS 5] 4 msec *  0 msec
DALLAS#
DALLAS#
DALLAS#################################
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:25:43
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:25:43
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [20/0] via 192.168.0.13, 00:10:58
B       192.168.0.24 [20/0] via 192.168.0.13, 00:25:45
B       192.168.0.16 [20/0] via 192.168.0.13, 00:25:45
B       192.168.0.20 [20/0] via 192.168.0.10, 00:25:59
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [20/0] via 192.168.0.13, 00:10:59
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [20/0] via 192.168.0.10, 00:25:59
DALLAS#show ip protocols
Routing Protocol is "bgp 4"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  IGP synchronization is disabled
  Automatic route summarization is disabled
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.0.10
    192.168.0.13
  Maximum path: 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.10          20      00:25:02
    192.168.0.13          20      00:11:04
  Distance: external 20 internal 200 local 200
DALLAS#
DALLAS#show ip bgp
BGP table version is 16, local router ID is 192.168.4.4
```

```
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 1 i
*  192.168.0.8/30   192.168.0.10             0            0 3 i
*>                  0.0.0.0                  0        32768 i
*  192.168.0.12/30  192.168.0.13             0            0 5 i
*>                  0.0.0.0                  0        32768 i
*> 192.168.0.16/30  192.168.0.13             0            0 5 i
*> 192.168.0.20/30  192.168.0.10             0            0 3 i
*  192.168.0.24/30  192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 i
*  192.168.1.1/32   192.168.0.10                           0 3 2 1 i
*>                  192.168.0.13                           0 5 6 1 i
*> 192.168.3.3/32   192.168.0.10             0            0 3 i
*> 192.168.4.4/32   0.0.0.0                  0        32768 i
*> 192.168.5.5/32   192.168.0.13             0            0 5 i
*> 192.168.6.6/32   192.168.0.13                           0 5 6 i
DALLAS#
DALLAS#show ip bgp summary
BGP router identifier 192.168.4.4, local AS number 4
BGP table version is 16, main routing table version 16
11 network entries using 1452 bytes of memory
16 path entries using 832 bytes of memory
7/5 BGP path/bestpath attribute entries using 1036 bytes of memory
5 BGP AS-PATH entries using 120 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 1 (at peak 2) using 32 bytes of memory
BGP using 3472 total bytes of memory
BGP activity 12/1 prefixes, 20/4 paths, scan interval 60 secs
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.0.10    4     3      36      35       16    0    0 00:27:24        6
192.168.0.13    4     5      34      35       16    0    0 00:27:21        7
DALLAS#
DALLAS#
DALLAS#show ip bgp neighbo
DALLAS#show ip bgp neighbors
BGP neighbor is 192.168.0.10,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:27:41
  Last read 00:00:49, last write 00:00:42, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8         10
    Keepalives:            26         25
    Route Refresh:          0          0
    Total:                 35         36
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                                 Sent       Rcvd
  Prefix activity:               ----       ----
    Prefixes Current:              11          6 (Consumes 312 bytes)
    Prefixes Total:                14         10
    Implicit Withdraw:              2          0
    Explicit Withdraw:              1          4
    Used as bestpath:             n/a          2
    Used as multipath:            n/a          0
                                   Outbound    Inbound
  Local Policy Denied Prefixes:    --------    -------
    AS_PATH loop:                       n/a          9
    Total:                                0          9
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.9, Local port: 42948
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x372D74):
Timer          Starts    Wakeups            Next
Retrans            31          0             0x0
TimeWait            0          0             0x0
AckHold            31         28             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         2546       2545        0x372E13
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 1257119701  snduna: 1257120657  sndnxt: 1257120657     sndwnd:  15429
irs: 2910584306  rcvnxt: 2910585372  rcvwnd:      15319  delrcvwnd:   1065

SRTT: 295 ms, RTTO: 335 ms, RTV: 40 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
```

```
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 48 (out of order: 0), with data: 32, total data bytes: 1065
Sent: 61 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 31, total data bytes: 955
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 192.168.0.13,  remote AS 5, external link
  BGP version 4, remote router ID 192.168.5.5
  BGP state = Established, up for 00:27:45
  Last read 00:00:50, last write 00:00:49, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                8          7
    Keepalives:            26         26
    Route Refresh:          0          0
    Total:                 35         34
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 16, neighbor version 16/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                                 Sent       Rcvd
  Prefix activity:               ----       ----
    Prefixes Current:              11          7 (Consumes 364 bytes)
    Prefixes Total:                14          7
    Implicit Withdraw:              2          0
    Explicit Withdraw:              1          0
    Used as bestpath:             n/a          6
    Used as multipath:            n/a          0
                                   Outbound    Inbound
  Local Policy Denied Prefixes:    --------    -------
    AS_PATH loop:                       n/a          6
    Total:                                0          6
  Number of NLRIs in the update sent: max 3, min 0
  Address tracking is enabled, the RIB does have a route to 192.168.0.13
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.14, Local port: 15940
Foreign host: 192.168.0.13, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x374930):
Timer          Starts    Wakeups            Next
Retrans            31          0             0x0
TimeWait            0          0             0x0
AckHold            30         29             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         2562       2561        0x374A6F
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 2170312586  snduna: 2170313542  sndnxt: 2170313542     sndwnd:  15429
irs:  846919556  rcvnxt:  846920460  rcvwnd:      15481  delrcvwnd:    903

SRTT: 295 ms, RTTO: 335 ms, RTV: 40 ms, KRTT: 0 ms
minRTT: 4 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 60 (out of order: 0), with data: 31, total data bytes: 903
Sent: 62 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 31, total data bytes: 955
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

DALLAS#
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.8
BGP routing table entry for 192.168.0.8/30, version 3
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, metric 0, localpref 100, valid, external
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin IGP, metric 0, localpref 100, weight 32768, valid, sourced, local,
best
DALLAS#show ip bgp 192.168.0.20
BGP routing table entry for 192.168.0.20/30, version 5
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
```

```
      Origin IGP, metric 0, localpref 100, valid, external, best
DALLAS#
DALLAS#show ip bgp 192.168.0.4
BGP routing table entry for 192.168.0.4/30, version 16
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3 2 1
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, localpref 100, valid, external
  5 6 1
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, localpref 100, valid, external, best
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.24
BGP routing table entry for 192.168.0.24/30, version 12
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3 2 1
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin IGP, localpref 100, valid, external
  5 6
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, localpref 100, valid, external, best
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.16
BGP routing table entry for 192.168.0.16/30, version 9
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  5
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, metric 0, localpref 100, valid, external, best
DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.12
BGP routing table entry for 192.168.0.12/30, version 4
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  5
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin IGP, metric 0, localpref 100, valid, external
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin IGP, metric 0, localpref 100, weight 32768, valid, sourced, local, best
DALLAS#
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.10 routes
BGP table version is 16, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.10                           0 3 2 1 i
*  192.168.0.8/30   192.168.0.10             0             0 3 i
*> 192.168.0.20/30  192.168.0.10             0             0 3 i
*  192.168.0.24/30  192.168.0.10                           0 3 2 1 i
*  192.168.1.1/32   192.168.0.10                           0 3 2 1 i
*> 192.168.3.3/32   192.168.0.10             0             0 3 i
Total number of prefixes 6
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.13 routes
BGP table version is 16, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*> 192.168.0.4/30   192.168.0.13                           0 5 6 1 i
*  192.168.0.12/30  192.168.0.13             0             0 5 i
*> 192.168.0.16/30  192.168.0.13             0             0 5 i
*> 192.168.0.24/30  192.168.0.13                           0 5 6 i
*> 192.168.1.1/32   192.168.0.13                           0 5 6 1 i
*> 192.168.5.5/32   192.168.0.13             0             0 5 i
*> 192.168.6.6/32   192.168.0.13                           0 5 6 i
Total number of prefixes 7
DALLAS#
DALLAS#
DALLAS#traceroute 192.168.6.6
Type escape sequence to abort.
Tracing the route to 192.168.6.6
  1 192.168.0.13 0 msec 4 msec 0 msec
  2 192.168.0.17 [AS 5] 0 msec *  0 msec
DALLAS#
DALLAS#######################################################
DALLAS#######################################################
DALLAS#######################################################
DALLAS#
DALLAS## Part5
DALLAS#
DALLAS## Removing BGP config
DALLAS#
DALLAS#conf t
DALLAS#conf terminal
Enter configuration commands, one per line.  End with CNTL/Z.
DALLAS(config)#no router bgp
*Apr 19 23:24:07.115: %BGP-5-ADJCHANGE: neighbor 192.168.0.10 Down Peer closed the session
*Apr 19 23:24:31.343: %BGP-5-ADJCHANGE: neighbor 192.168.0.13 Down Peer closed the session
DALLAS(config)#no router bgp
DALLAS(config)#no router bgp 4
DALLAS(config)#
DALLAS(config)#
```

```
DALLAS(config)##  took off BGP AS#
DALLAS(config)##  re insert BGP AS#
DALLAS(config)#
DALLAS(config)#router bgp 2
DALLAS(config-router)#no sync
DALLAS(config-router)#no synchronization
DALLAS(config-router)#redistribute connected
DALLAS(config-router)## ?
DALLAS(config-router)#?
Router configuration commands:
  address-family       Enter Address Family command mode
  aggregate-address    Configure BGP aggregate entries
  auto-summary         Enable automatic network number summarization
  bgp                  BGP specific commands
  default              Set a command to its defaults
  default-information  Control distribution of default information
  default-metric       Set metric of redistributed routes
  distance             Define an administrative distance
  distribute-list      Filter networks in routing updates
  exit                 Exit from routing protocol configuration mode
  help                 Description of the interactive help system
  maximum-paths        Forward packets over multiple paths
  neighbor             Specify a neighbor router
  network              Specify a network to announce via BGP
  no                   Negate a command or set its defaults
  redistribute         Redistribute information from another routing protocol
  synchronization      Perform IGP synchronization
  table-map            Map external entry attributes into routing table
  template             Enter template command mode
  timers               Adjust routing timers
DALLAS(config-router)#
DALLAS(config-router)#neighbor 192.168.0.10 remote-as 2
DALLAS(config-router)#neighbor 192.168.0.10 remote-as
*Apr 19 23:27:23.883: %BGP-5-ADJCHANGE: neighbor 192.168.0.10 Up
DALLAS(config-router)#neighbor 192.168.0.13 remote-as 3
DALLAS(config-router)#
DALLAS(config-router)#
DALLAS(config-router)#
DALLAS(config-router)#
*Apr 19 23:27:32.371: %BGP-5-ADJCHANGE: neighbor 192.168.0.13 Up
DALLAS(config-router)#no auto-summary
DALLAS(config-router)#?
Router configuration commands:
  address-family       Enter Address Family command mode
  aggregate-address    Configure BGP aggregate entries
  auto-summary         Enable automatic network number summarization
  bgp                  BGP specific commands
  default              Set a command to its defaults
  default-information  Control distribution of default information
  default-metric       Set metric of redistributed routes
  distance             Define an administrative distance
  distribute-list      Filter networks in routing updates
  exit                 Exit from routing protocol configuration mode
  help                 Description of the interactive help system
  maximum-paths        Forward packets over multiple paths
  neighbor             Specify a neighbor router
  network              Specify a network to announce via BGP
  no                   Negate a command or set its defaults
  redistribute         Redistribute information from another routing protocol
  synchronization      Perform IGP synchronization
  table-map            Map external entry attributes into routing table
  template             Enter template command mode
  timers               Adjust routing timers
*Apr 19 23:28:39.555: %SYS-5-CONFIG_I: Configured from console by console
DALLAS(config-router)#
DALLAS(config-router)#
DALLAS(config-router)#####################
DALLAS(config-router)#^Z
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:00:36
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:00:05
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [200/0] via 192.168.0.21, 00:01:14
B       192.168.0.24 [20/0] via 192.168.0.13, 00:00:06
B       192.168.0.16 [20/0] via 192.168.0.13, 00:00:37
B       192.168.0.20 [200/0] via 192.168.0.10, 00:01:19
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [200/0] via 192.168.0.21, 00:01:06
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [200/0] via 192.168.0.21, 00:01:15
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [200/0] via 192.168.0.10, 00:01:20
DALLAS#
DALLAS#traceroute 192.168.6.6
Type escape sequence to abort.
Tracing the route to 192.168.6.6
  1 192.168.0.13 4 msec 0 msec 0 msec
  2 192.168.0.17 [AS 3] 4 msec *  0 msec
DALLAS#
DALLAS#
DALLAS#show ip route
```

```
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:02:06
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:01:35
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [200/0] via 192.168.0.21, 00:02:44
B       192.168.0.24 [20/0] via 192.168.0.13, 00:01:36
B       192.168.0.16 [20/0] via 192.168.0.13, 00:02:07
B       192.168.0.20 [200/0] via 192.168.0.10, 00:02:49
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [200/0] via 192.168.0.21, 00:02:36
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [200/0] via 192.168.0.21, 00:02:46
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [200/0] via 192.168.0.10, 00:02:51
DALLAS#################
DALLAS## NOTE:  same AS# link path is set to 200 cost
DALLAS#
DALLAS## IGP cost = 200
DALLAS## EGP cost = 20
DALLAS#
DALLAS## EGP is preferred
DALLAS#
DALLAS#show ip inter
DALLAS#show ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            192.168.0.9     YES manual up                    up
FastEthernet0/1            192.168.0.14    YES manual up                    up
FastEthernet0/0/0          unassigned      YES unset  up                    down
FastEthernet0/0/1          unassigned      YES unset  up                    down
FastEthernet0/0/2          unassigned      YES unset  up                    down
FastEthernet0/0/3          unassigned      YES unset  up                    down
Serial0/1/0                unassigned      YES unset  administratively down down
Serial0/1/1                unassigned      YES unset  administratively down down
Vlan1                      unassigned      YES unset  up                    down
SSLVPN-VIF0                unassigned      NO  unset  up                    up
Loopback0                  192.168.4.4     YES manual up                    up
DALLAS#
DALLAS#
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:32:10
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:31:39
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [200/0] via 192.168.0.21, 00:32:48
B       192.168.0.24 [20/0] via 192.168.0.13, 00:31:40
B       192.168.0.16 [20/0] via 192.168.0.13, 00:32:11
B       192.168.0.20 [200/0] via 192.168.0.10, 00:32:53
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [200/0] via 192.168.0.21, 00:32:40
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [200/0] via 192.168.0.21, 00:32:50
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [200/0] via 192.168.0.10, 00:32:55
DALLAS#
DALLAS#
DALLAS#
DALLAS#
DALLAS#############################################################
DALLAS#############################################################
DALLAS#
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:32:28
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:31:57
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [200/0] via 192.168.0.21, 00:33:06
```

```
B       192.168.0.24 [20/0] via 192.168.0.13, 00:31:58
B       192.168.0.16 [20/0] via 192.168.0.13, 00:32:29
B       192.168.0.20 [200/0] via 192.168.0.10, 00:33:11
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [200/0] via 192.168.0.21, 00:32:58
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [200/0] via 192.168.0.21, 00:33:07
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [200/0] via 192.168.0.10, 00:33:12
DALLAS#
DALLAS#
DALLAS#show ip bgp
BGP table version is 15, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.13                         0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
* i192.168.0.8/30   192.168.0.10             0    100      0 ?
*>                  0.0.0.0                  0         32768 ?
*  192.168.0.12/30  192.168.0.13             0             0 3 ?
*>                  0.0.0.0                  0         32768 ?
*> 192.168.0.16/30  192.168.0.13             0             0 3 ?
*>i192.168.0.20/30  192.168.0.10             0    100      0 ?
*> 192.168.0.24/30  192.168.0.13                         0 3 ?
* i                 192.168.0.21             0    100      0 1 ?
*  192.168.1.1/32   192.168.0.13                         0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
*  192.168.2.2/32   192.168.0.13                         0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
*>i192.168.3.3/32   192.168.0.10             0    100      0 ?
*> 192.168.4.4/32   0.0.0.0                  0         32768 ?
*> 192.168.5.5/32   192.168.0.13             0             0 3 ?
   Network          Next Hop            Metric LocPrf Weight Path
*> 192.168.6.6/32   192.168.0.13                         0 3 ?
DALLAS#
DALLAS#
DALLAS#traceroute 192.168.6.6
Type escape sequence to abort.
Tracing the route to 192.168.6.6
  1 192.168.0.13 4 msec 0 msec 0 msec
  2 192.168.0.17 [AS 3] 4 msec *  0 msec
DALLAS#
DALLAS#
DALLAS##############################################
DALLAS#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     192.168.4.0/32 is subnetted, 1 subnets
C       192.168.4.4 is directly connected, Loopback0
     192.168.5.0/32 is subnetted, 1 subnets
B       192.168.5.5 [20/0] via 192.168.0.13, 00:40:00
     192.168.6.0/32 is subnetted, 1 subnets
B       192.168.6.6 [20/0] via 192.168.0.13, 00:39:29
     192.168.0.0/30 is subnetted, 6 subnets
C       192.168.0.8 is directly connected, FastEthernet0/0
C       192.168.0.12 is directly connected, FastEthernet0/1
B       192.168.0.4 [200/0] via 192.168.0.21, 00:40:38
B       192.168.0.24 [20/0] via 192.168.0.13, 00:39:30
B       192.168.0.16 [20/0] via 192.168.0.13, 00:40:01
B       192.168.0.20 [200/0] via 192.168.0.10, 00:40:43
     192.168.1.0/32 is subnetted, 1 subnets
B       192.168.1.1 [200/0] via 192.168.0.21, 00:40:29
     192.168.2.0/32 is subnetted, 1 subnets
B       192.168.2.2 [200/0] via 192.168.0.21, 00:40:39
     192.168.3.0/32 is subnetted, 1 subnets
B       192.168.3.3 [200/0] via 192.168.0.10, 00:40:44
DALLAS#
DALLAS#show ip bgp
BGP table version is 15, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.13                         0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
* i192.168.0.8/30   192.168.0.10             0    100      0 ?
*>                  0.0.0.0                  0         32768 ?
*  192.168.0.12/30  192.168.0.13             0             0 3 ?
*>                  0.0.0.0                  0         32768 ?
*> 192.168.0.16/30  192.168.0.13             0             0 3 ?
*>i192.168.0.20/30  192.168.0.10             0    100      0 ?
*> 192.168.0.24/30  192.168.0.13                         0 3 ?
* i                 192.168.0.21             0    100      0 1 ?
*  192.168.1.1/32   192.168.0.13                         0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
*  192.168.2.2/32   192.168.0.13                         0 3 1 ?
*>i                 192.168.0.21             0    100      0 1 ?
*>i192.168.3.3/32   192.168.0.10             0    100      0 ?
*> 192.168.4.4/32   0.0.0.0                  0         32768 ?
*> 192.168.5.5/32   192.168.0.13             0             0 3 ?
   Network          Next Hop            Metric LocPrf Weight Path
*> 192.168.6.6/32   192.168.0.13                         0 3 ?
DALLAS#
DALLAS#
DALLAS#show ip protocols
Routing Protocol is "bgp 2"
  Outgoing update filter list for all interfaces is not set
```

```
  Incoming update filter list for all interfaces is not set
  IGP synchronization is disabled
  Automatic route summarization is disabled
  Redistributing: connected
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.0.10
    192.168.0.13
  Maximum path: 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.10         200      00:40:12
    192.168.0.13          20      00:39:44
  Distance: external 20 internal 200 local 200
DALLAS#
DALLAS#
DALLAS#show ip bgp summary
BGP router identifier 192.168.4.4, local AS number 2
BGP table version is 15, main routing table version 15
12 network entries using 1584 bytes of memory
18 path entries using 936 bytes of memory
7/5 BGP path/bestpath attribute entries using 1036 bytes of memory
3 BGP AS-PATH entries using 72 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
Bitfield cache entries: current 3 (at peak 3) using 96 bytes of memory
BGP using 3724 total bytes of memory
BGP activity 12/0 prefixes, 19/1 paths, scan interval 60 secs
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.0.10    4     2      47      45       15    0    0 00:41:08        7
192.168.0.13    4     3      45      48       15    0    0 00:41:00        8
DALLAS#
DALLAS#
DALLAS#show ip bgp neighbor
BGP neighbor is 192.168.0.10,  remote AS 2, internal link
  BGP version 4, remote router ID 192.168.3.3
  BGP state = Established, up for 00:41:22
  Last read 00:00:51, last write 00:00:52, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                3          5
    Keepalives:            41         41
    Route Refresh:          0          0
    Total:                 45         47
  Default minimum time between advertisement runs is 0 seconds
 For address family: IPv4 Unicast
  BGP table version 15, neighbor version 15/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:             7          7 (Consumes 364 bytes)
    Prefixes Total:               7          8
    Implicit Withdraw:            0          0
    Explicit Withdraw:            0          1
    Used as bestpath:            n/a         5
    Used as multipath:           n/a         0
                                  Outbound    Inbound
  Local Policy Denied Prefixes:   --------    -------
    Bestpath from this peer:              7        n/a
    Total:                                7          0
  Number of NLRIs in the update sent: max 3, min 2
  Address tracking is enabled, the RIB does have a route to 192.168.0.10
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 255
Local host: 192.168.0.9, Local port: 39155
Foreign host: 192.168.0.10, Foreign port: 179
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x636D24):
Timer          Starts    Wakeups            Next
Retrans            45          0             0x0
TimeWait            0          0             0x0
AckHold            44         43             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger         5190       5189        0x636DEA
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss: 3459572822  snduna: 3459573843  sndnxt: 3459573843     sndwnd:  15364
irs:  401391493  rcvnxt:  401392604  rcvwnd:      15274  delrcvwnd:   1110

SRTT: 299 ms, RTTO: 306 ms, RTV: 7 ms, KRTT: 0 ms
minRTT: 4 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: active open
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 88 (out of order: 0), with data: 46, total data bytes: 1110
Sent: 90 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 45, total data bytes: 1020
```

```
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

BGP neighbor is 192.168.0.13,  remote AS 3, external link
  BGP version 4, remote router ID 192.168.5.5
  BGP state = Established, up for 00:41:20
  Last read 00:00:58, last write 00:00:33, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    InQ depth is 0
    OutQ depth is 0

                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                6          3
    Keepalives:            41         41
    Route Refresh:          0          0
    Total:                 48         45
  Default minimum time between advertisement runs is 30 seconds
 For address family: IPv4 Unicast
  BGP table version 15, neighbor version 15/0
  Output queue size : 0
  Index 2, Offset 0, Mask 0x4
  2 update-group member
                               Sent       Rcvd
  Prefix activity:             ----       ----
    Prefixes Current:             8          8 (Consumes 416 bytes)
    Prefixes Total:              10          8
    Implicit Withdraw:            0          0
    Explicit Withdraw:            2          0
    Used as bestpath:           n/a          4
    Used as multipath:          n/a          0
                                 Outbound    Inbound
  Local Policy Denied Prefixes:  --------    -------
    Bestpath from this peer:              4        n/a
    Total:                                4          0
  Number of NLRIs in the update sent: max 3, min 1
  Address tracking is enabled, the RIB does have a route to 192.168.0.13
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Connection is ECN Disabled, Mininum incoming TTL 0, Outgoing TTL 1
Local host: 192.168.0.14, Local port: 179
Foreign host: 192.168.0.13, Foreign port: 38535
Connection tableid (VRF): 0
Enqueued packets for retransmit: 0, input: 0  mis-ordered: 0 (0 bytes)
Event Timers (current time is 0x6386B8):
Timer          Starts    Wakeups            Next
Retrans            45          0             0x0
TimeWait            0          0             0x0
AckHold            44         42             0x0
SendWnd             0          0             0x0
KeepAlive           0          0             0x0
GiveUp              0          0             0x0
PmtuAger            0          0             0x0
DeadWait            0          0             0x0
Linger              0          0             0x0
ProcessQ            0          0             0x0
iss:  405233408  snduna:  405234536  sndnxt:  405234536     sndwnd:  15257
irs: 3799927971  rcvnxt: 3799928987  rcvwnd:      15369  delrcvwnd:   1015

SRTT: 299 ms, RTTO: 306 ms, RTV: 7 ms, KRTT: 0 ms
minRTT: 0 ms, maxRTT: 300 ms, ACK hold: 200 ms
Status Flags: passive open, gen tcbs
Option Flags: nagle, path mtu capable
IP Precedence value : 6
Datagrams (max data segment is 1460 bytes):
Rcvd: 90 (out of order: 0), with data: 45, total data bytes: 1015
Sent: 89 (retransmit: 0, fastretransmit: 0, partialack: 0, Second Congestion: 0)
, with data: 46, total data bytes: 1127
 Packets received in fast path: 0, fast processed: 0, slow path: 0
 fast lock acquisition failures: 0, slow path: 0

DALLAS#
DALLAS#
DALLAS#show ip bgp 192.168.0.8
BGP routing table entry for 192.168.0.8/30, version 3
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1    2
  Local
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin incomplete, metric 0, localpref 100, valid, internal
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin incomplete, metric 0, localpref 100, weight 32768, valid, sourced, best
DALLAS#
DALLAS#show ip bgp 192.168.0.20
BGP routing table entry for 192.168.0.20/30, version 5
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        2
  Local
    192.168.0.10 from 192.168.0.10 (192.168.3.3)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
DALLAS#
DALLAS#show ip bgp 192.168.0.4
BGP routing table entry for 192.168.0.4/30, version 7
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        2
```

```
  3 1
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin incomplete, localpref 100, valid, external
  1
    192.168.0.21 from 192.168.0.10 (192.168.3.3)
      Origin incomplete, metric 0, localpref 100, valid, internal, best
DALLAS#
DALLAS#show ip bgp 192.168.0.24
BGP routing table entry for 192.168.0.24/30, version 15
Paths: (2 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin incomplete, localpref 100, valid, external, best
  1
    192.168.0.21 from 192.168.0.10 (192.168.3.3)
      Origin incomplete, metric 0, localpref 100, valid, internal
DALLAS#
DALLAS#show ip bgp 192.168.0.16
BGP routing table entry for 192.168.0.16/30, version 11
Paths: (1 available, best #1, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1
  3
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin incomplete, metric 0, localpref 100, valid, external, best
DALLAS#
DALLAS#show ip bgp 192.168.0.12
BGP routing table entry for 192.168.0.12/30, version 4
Paths: (2 available, best #2, table Default-IP-Routing-Table)
  Advertised to update-groups:
        1    2
  3
    192.168.0.13 from 192.168.0.13 (192.168.5.5)
      Origin incomplete, metric 0, localpref 100, valid, external
  Local
    0.0.0.0 from 0.0.0.0 (192.168.4.4)
      Origin incomplete, metric 0, localpref 100, weight 32768, valid, sourced, best
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.10 routes
BGP table version is 15, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*>i192.168.0.4/30   192.168.0.21             0    100      0 1 ?
* i192.168.0.8/30   192.168.0.10             0    100      0 ?
*>i192.168.0.20/30  192.168.0.10             0    100      0 ?
* i192.168.0.24/30  192.168.0.21             0    100      0 1 ?
*>i192.168.1.1/32   192.168.0.21             0    100      0 1 ?
*>i192.168.2.2/32   192.168.0.21             0    100      0 1 ?
*>i192.168.3.3/32   192.168.0.10             0    100      0 ?
Total number of prefixes 7
DALLAS#
DALLAS#
DALLAS#show ip bgp neighbor 192.168.0.13 routes
BGP table version is 15, local router ID is 192.168.4.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
   Network          Next Hop            Metric LocPrf Weight Path
*  192.168.0.4/30   192.168.0.13                           0 3 1 ?
*  192.168.0.12/30  192.168.0.13             0             0 3 ?
*> 192.168.0.16/30  192.168.0.13             0             0 3 ?
*> 192.168.0.24/30  192.168.0.13                           0 3 ?
*  192.168.1.1/32   192.168.0.13                           0 3 1 ?
*  192.168.2.2/32   192.168.0.13                           0 3 1 ?
*> 192.168.5.5/32   192.168.0.13             0             0 3 ?
*> 192.168.6.6/32   192.168.0.13                           0 3 ?
Total number of prefixes 8
DALLAS#
DALLAS#
DALLAS#
DALLAS#
DALLAS#traceroute 192.168.6.6
Type escape sequence to abort.
Tracing the route to 192.168.6.6
  1 192.168.0.13 0 msec 0 msec 4 msec
  2 192.168.0.17 [AS 3] 0 msec *  0 msec
DALLAS#
DALLAS#
DALLAS#
DALLAS#
```