Module 2

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Enhanced Interior Gateway Routing Protocol (EIGPR)

part 2

Objectives

- Basic mechanisms of EIGRP
- Backward compatibility of IGRP and EIGRP
- EIGRP configuration
- EIGRP default-route
- EIGRP and load-balancing
- EIGRP authentication
- NTP services
- Summarization in EIGRP
- EIGRP stub
- EIGRP in NBMA

part 2

Router authentication

- Many routing protocols support authentication such that a router authenticates the source of each routing update packet that it receives.

- Simple password authentication is supported by:
  - IS-IS
  - OSPF
  - RIPv2

- MD5 authentication is supported by:
  - OSPF, RIPv2, BGP, EIGRP

Simple password vs. MD5

- **Simple password authentication:**
  - Router sends packet and key.
  - Neighbor checks if received key matches its key.
  - Not secure.

- **MD5 authentication**
  - Configure a “key” (password) and key-id; router generates a message digest, or hash, of the key, key-id and message.
  - Message digest is sent with packet; key is not sent.
  - Secure.

Router authentication

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EIGRP MD5 authentication

- EIGRP supports MD5 authentication.
- Router generates and checks every EIGRP packet. Router authenticates the source of each routing update packet that it receives.
- Configure a “key” (password) and key-id; each participating neighbor must have same key configured.

EIGRP MD5 authentication

- EIGRP MD5 authentication:
  - Router generates a message digest, or hash, of the key, key-id, and message.
  - EIGRP allows keys to be managed using key chains.
  - Specify key-id (number, key, and lifetime of key).
  - First valid activated key, in order of key numbers, is used.

Configuring EIGRP MD5 authentication

```
Router(config-if)#
ip authentication mode eigrp autonomous-system md5
```

- Specifies MD5 authentication for EIGRP packets

```
Router(config-if)#
ip authentication key-chain eigrp autonomous-system
name-of-chain
```

- Enables authentication of EIGRP packets using key in the *key-chain*

Configuring EIGRP MD5 authentication

```
Router(config)#
key chain name-of-chain
```

- Enters configuration mode for the **key-chain**

```
Router(config-keychain)#
key key-id
```

- Identifies key and enters configuration mode for the ***key-id***

Configuring EIGRP MD5 authentication

```
Router(config-keychain-key)#
```

```
key-string text
```

- Identifies key string (password)

```
Router(config-keychain-key)#
```

```
accept-lifetime start-time {infinite | end-time | duration
seconds}
```

- Optional: specifies when key will be accepted for received packets

```
Router(config-keychain-key)#
```

```
send-lifetime start-time {infinite | end-time | duration
seconds}
```

- Optional: specifies when key can be used for sending packets

NTP services

- **NTP client (receiving time configuration):**

Router(config)# ntp server IP [prefer]

- **NTP server (time advertiser):**

Router(config)# ntp master [1-15]

- **Timezone configuration:**

Router(config)# clock timezone CET 1

Router(config)# clock summer-time CEST recurring last Sun Mar 2:00 last Sun Oct 3:00

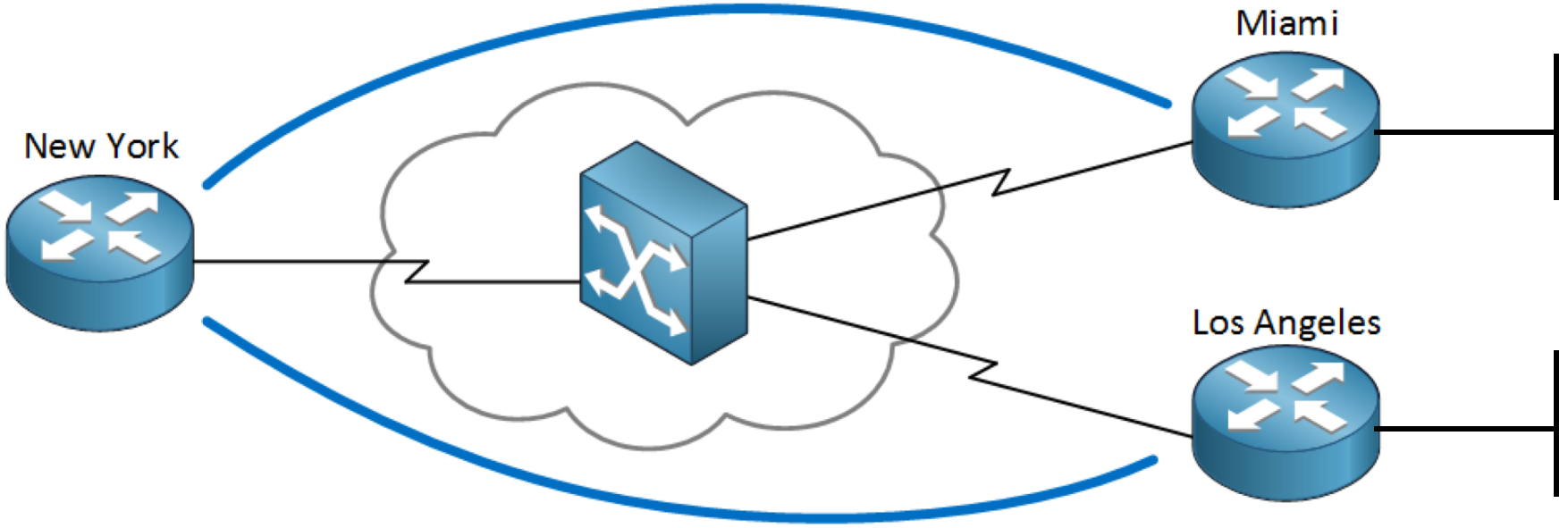
EIGRP summarization

- EIGRP supports manual and automatic summarization
- Automatic summarization on classful boundary is enabled by default

```
Router(config-if)# ip summary-address eigrp AS SIEŤ MASKA
Router(config-if)# router eigrp AS
Router(config-router)# no auto-summary
```

EIGRP stub

- what is a stub router? (stub network)
- typical for HUB & SPOKE topology



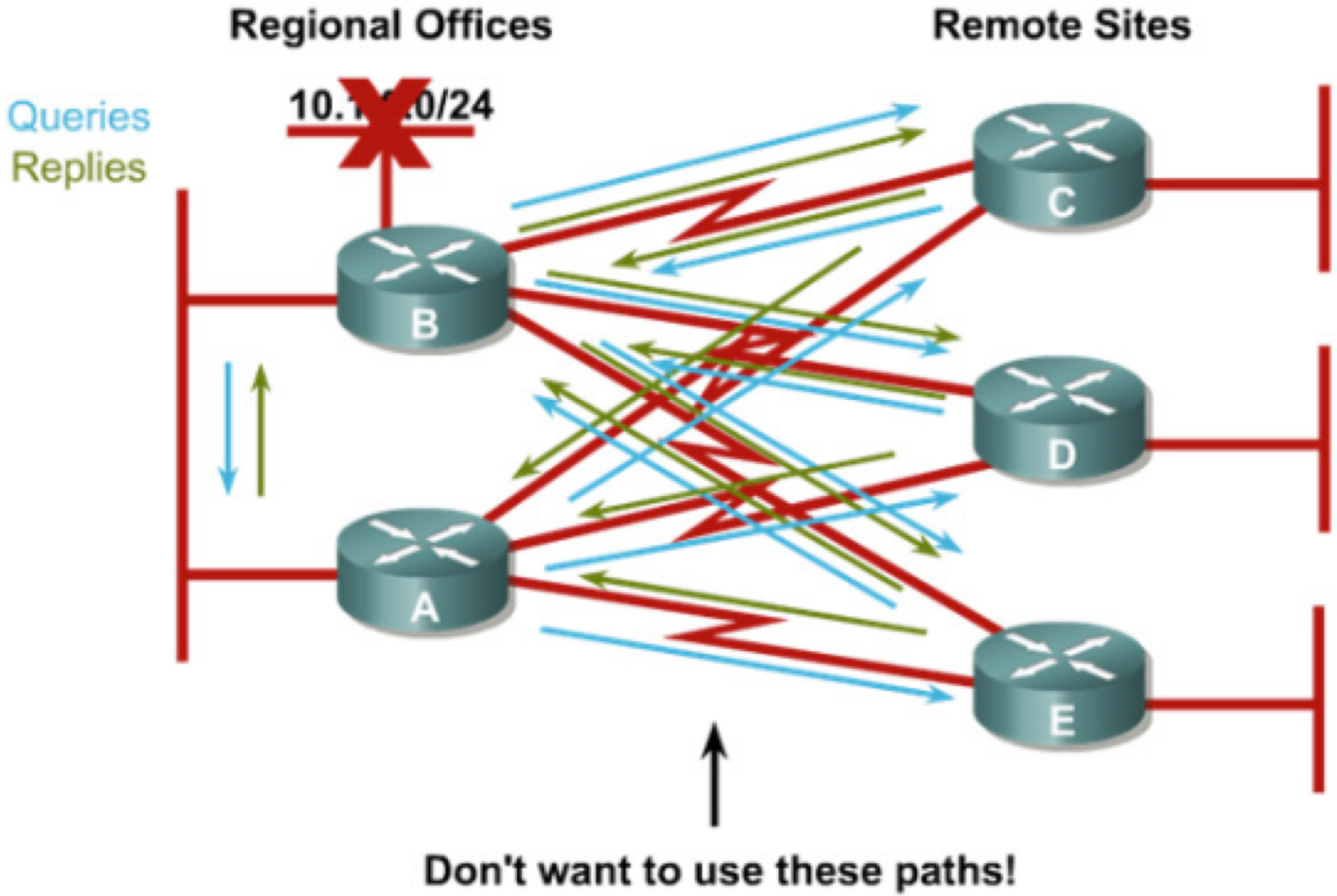
Factors that influence scalability

- Quantity of routing information exchanged between peers: without proper route summarization, this can be excessive.
- Number of routers that must be involved when a topology change occurs.
- Depth of topology: the number of hops that information must travel to reach all routers.
- Number of alternate paths through the network.

EIGRP queries

- Queries are sent when a route is lost and no feasible successor is available.
- The lost route is now in “active” state.
- Queries are sent to all neighboring routers on all
- interfaces except the interface to the successor.
- If the neighbors do not have their lost-route information, queries are sent to their neighbors.
- If a router has an alternate route, it answers the query; this stops the query from spreading in that branch of the network.

Queries in Hub & Spoke topology

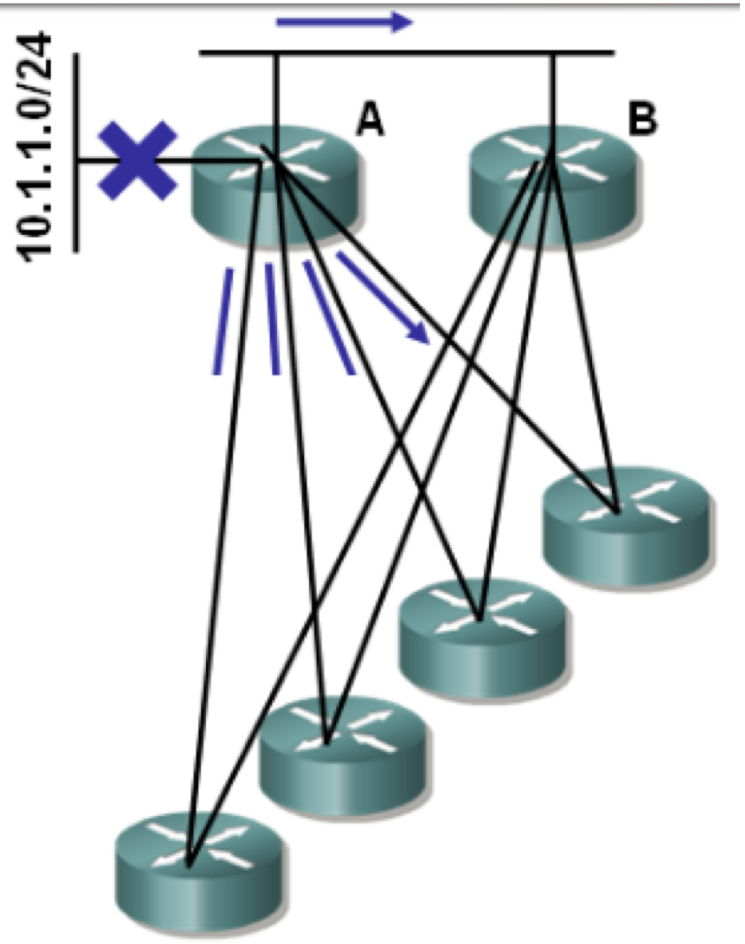


EIGRP stub

- The EIGRP Stub Routing feature
  - Improves network stability
  - Reduces resource utilization and
  - Simplifies remote router (spoke) configuration
- Stub router sends a special peer information packet to all neighboring routers to report its status as a stub router
- Any neighbor that receives a packet informing it of the stub status does not query the stub router for any routes

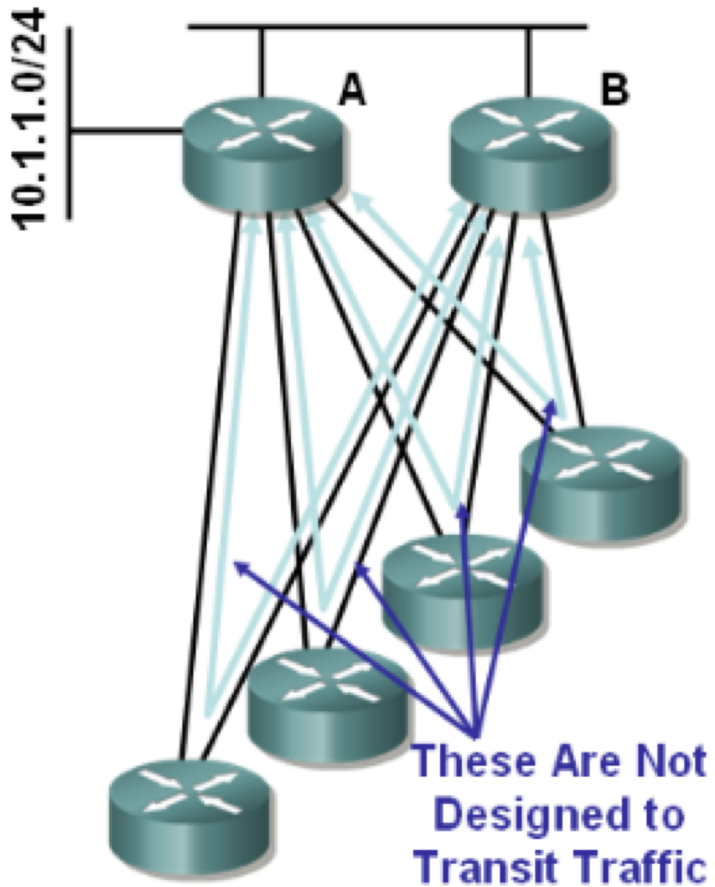
STUB review

- If A loses its connection to 10.1.1.0/24, it must build and transmit five queries: one query to each remote, and one query to B
- Each of the remote sites will also build a query towards B
- B receives five queries which it must process and answer



STUB review

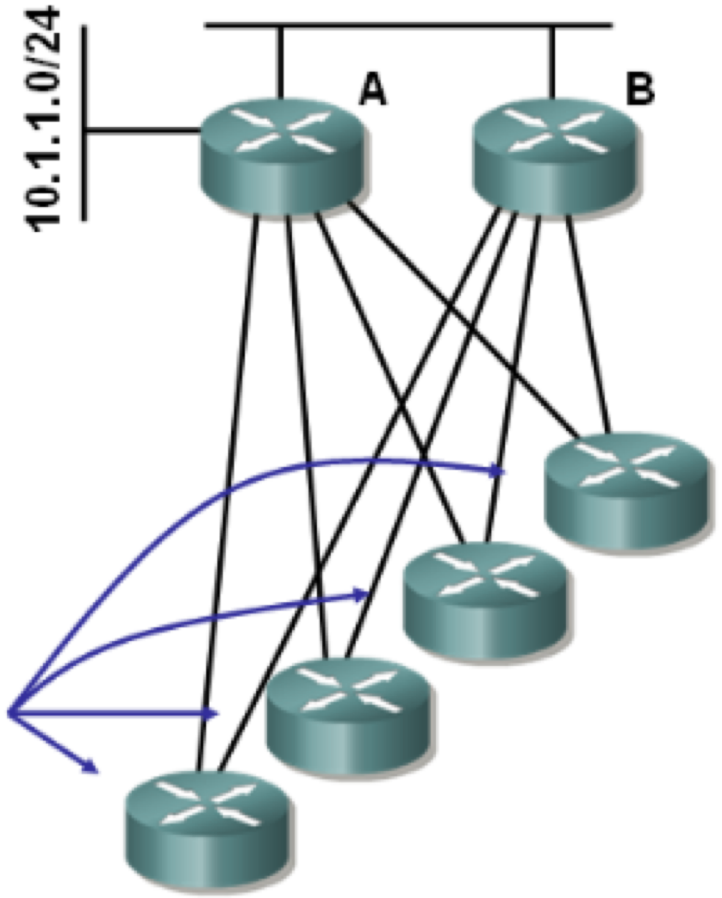
- If these spokes are remotes sites, they typically have two connections for redundancy, not so they can transit traffic between A and B
- A should never use the spokes as a path to anything reachable through B, so there's no reason to learn about, or query for, routes through these spokes



STUB review

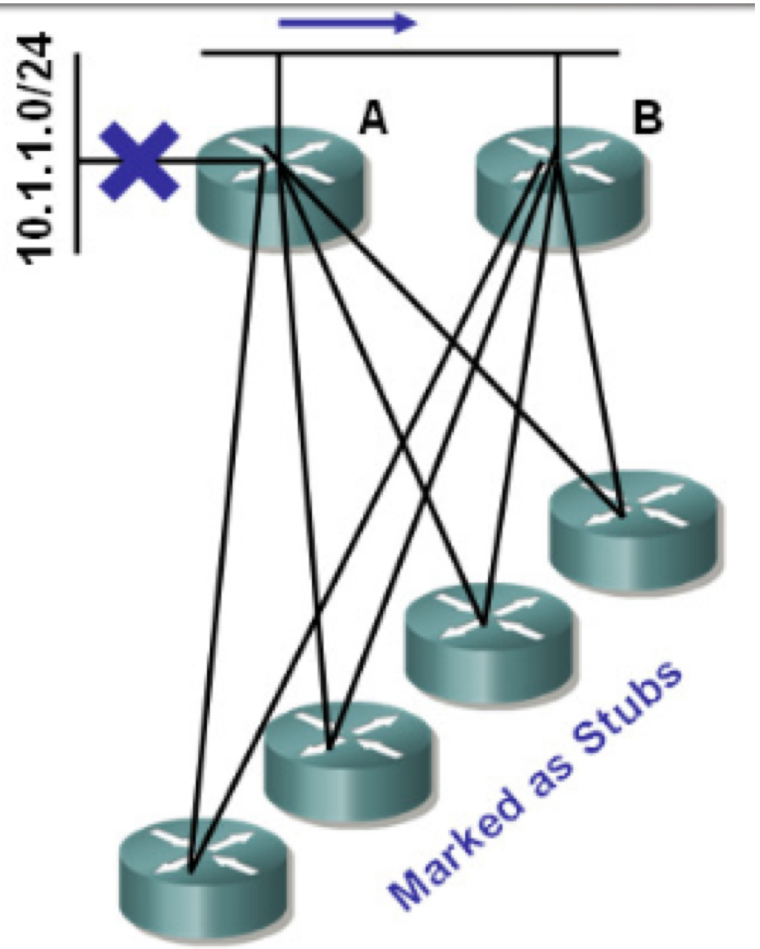
To signal A and B that the paths through the spokes should not be used for transit traffic, the spoke routers can be configured as stubs

```
router#config t#
router(config)#router eigrp 100
router(config-router)#eigrp stub
router(config-router)#
```



STUB review

- Marking the spokes as stubs allows them to signal A and B that they are not transit paths
- A will not query stubs, reducing the total number of queries in this example to one



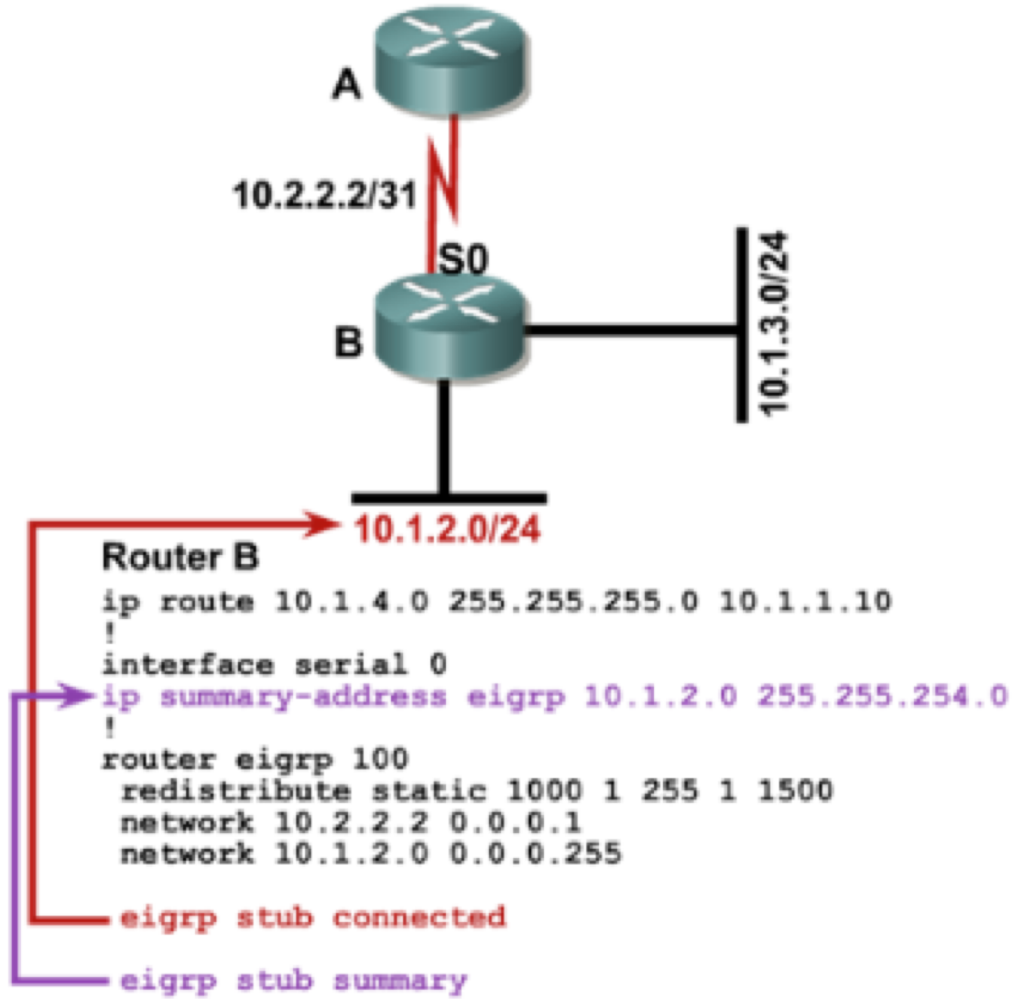
Configure EIGRP stub

```
Router(config-router)#
eigrp stub [receive-only|connected|static|summary]
```

- **`receive-only`**: Prevents the stub from sending any type of route.
- **`connected`**: Permits stub to send connected routes (may still need to redistribute).
- **`static`**: Permits stub to send static routes (must still redistribute).
- **`summary`**: Permits stub to send summary routes.
- Default is **`connected`** and **`summary`**.

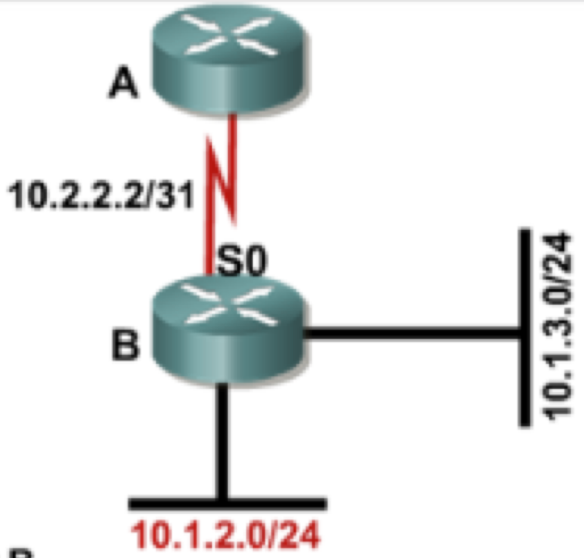
EIGRP stub

- If `stub connected` is configured:
  - B will advertise 10.1.2.0/24 to A.
  - B will not advertise 10.1.2.0/23, 10.1.3.0/23, or 10.1.4.0/24.
- If `stub summary` is configured:
  - B will advertise 10.1.2.0/23 to A.
  - B will not advertise 10.1.2.0/24, 10.1.3.0/24, or 10.1.4.0/24.



EIGRP stub

- If `stub static` is configured:
  - B will advertise 10.1.4.0/24 to A.
  - B will not advertise 10.1.2.0/24, 10.1.2.0/23, or 10.1.3.0/24.
- If `stub receive-only` is configured:
  - B won't advertise anything to A, so A needs to have a static route to the networks behind B to reach them.



Router B

```
ip route 10.1.4.0 255.255.255.0 10.1.1.10
!
interface serial 0
ip summary-address eigrp 10.1.2.0 255.255.254.0
!
router eigrp 100
 redistribute static 1000 1 255 1 1500
 network 10.2.2.2 0.0.0.1
 network 10.1.2.0 0.0.0.255

 eigrp stub static

 eigrp stub summary
```

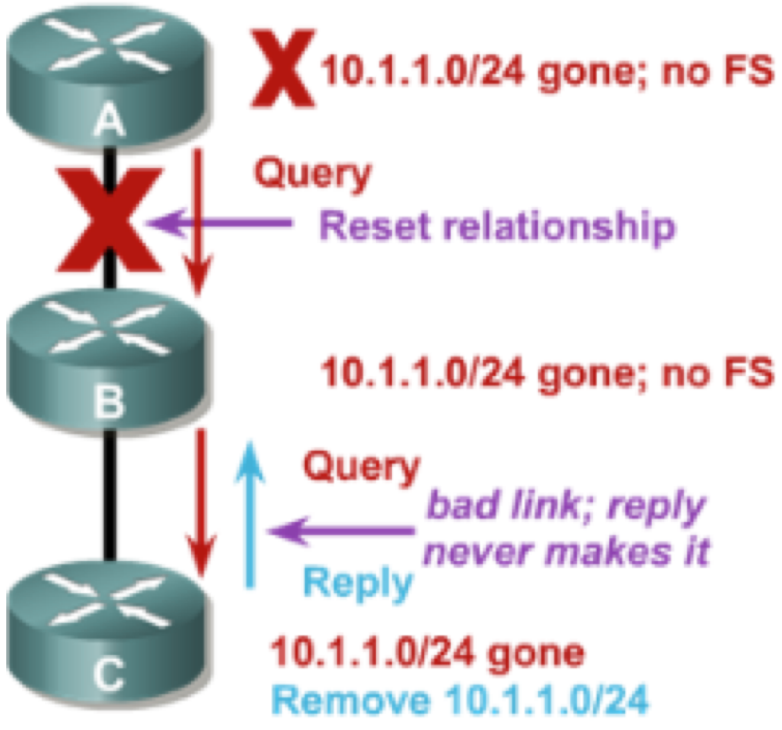
EIGRP stuck in active

- The router has to get all the replies from the neighbors with an outstanding query before the router calculates the successor information.
  - If any neighbor fails to reply to the query within three minutes, by default, the route is SIA, and the router resets the neighbor relationship with the neighbor that fails to reply.

Active process enhancement

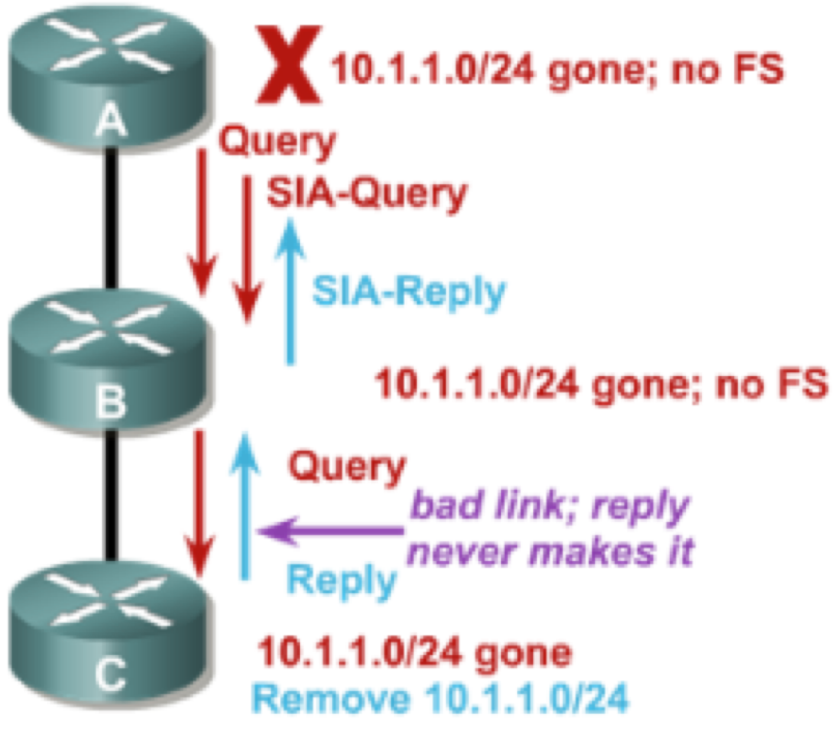
Before

- Router A resets relationship to router B when the normal active timer expires. However, the problem is the link between router B and C.

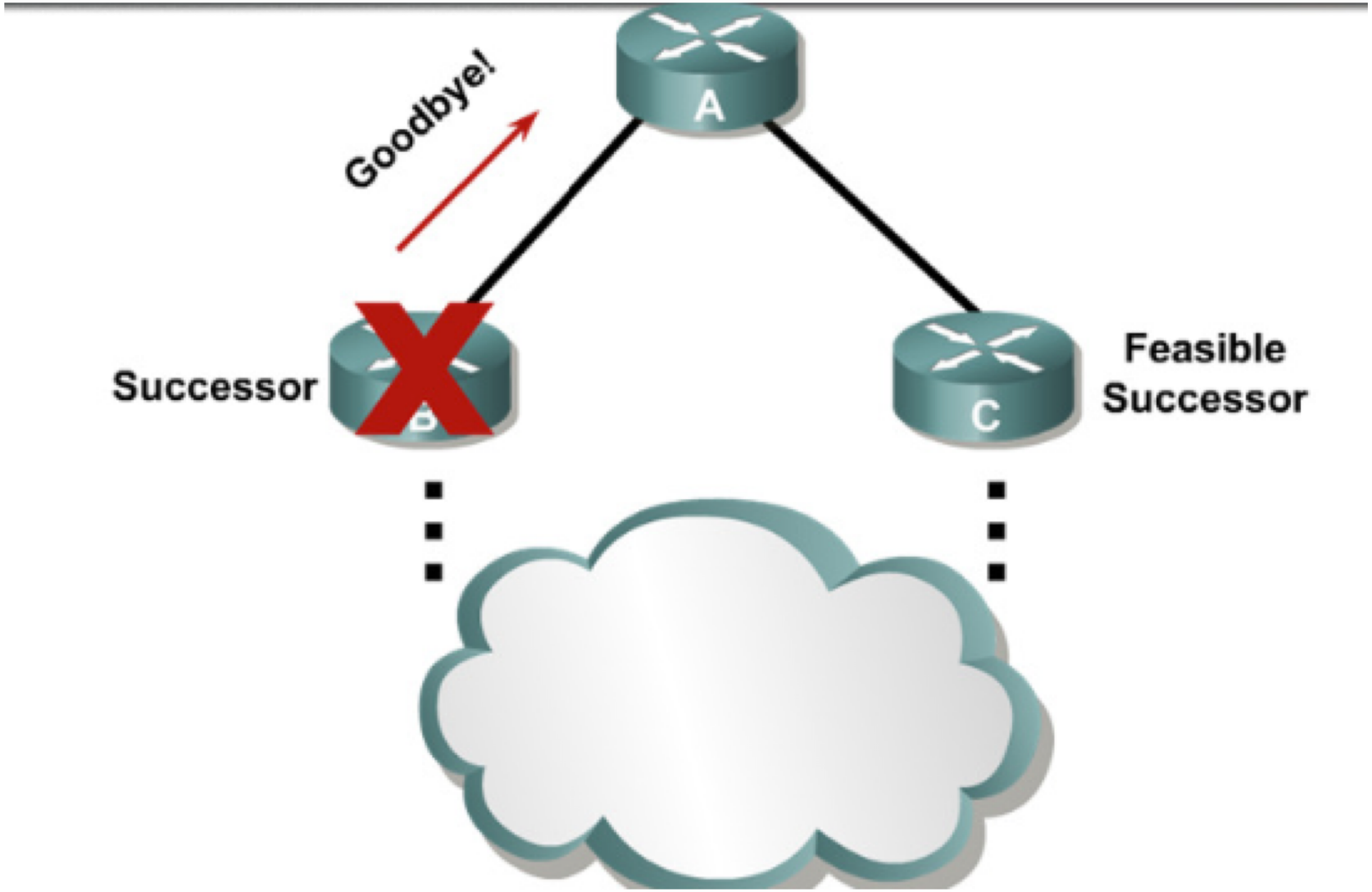


After

- Router A sends an SIA-Query at half of the normal active timer. Router B acknowledges the query there by keeping the relationship up.



Graceful shutdown



EIGRP NBMA

Split-horizon can cause problems on multipoint interfaces, but can be adjusted (disabled):

```
Router(config-if)# no ip split-horizon eigrp AS_NUMBER
```

It is possible to make unicast communication.
In this case, use following command for neighbor specification:

```
Router(config-router)# neighbor IP IFACE
```

Verifying EIGRP

```
R1#show ip eigrp neighbors
IP-EIGRP neighbors for process 100
H   Address         Interface   Hold  Uptime    SRTT   RTO  Q  Seq
                                (sec)           (ms)       Cnt Num
0   192.168.1.102   Se0/0/1     10    00:07:22   10   2280  0  5
R1#
```

Verifying EIGRP

```
R1#show ip route eigrp
D    172.17.0.0/16 [90/40514560] via 192.168.1.102, 00:07:01, Serial0/0/1
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
D       172.16.0.0/16 is a summary, 00:05:13, Null0
     192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
D       192.168.1.0/24 is a summary, 00:05:13, Null0

R1#show ip route
<output omitted>
Gateway of last resort is not set
D    172.17.0.0/16 [90/40514560] via 192.168.1.102, 00:06:55, Serial0/0/1
     172.16.0.0/16 is variably subnetted, 2 subnets, 2 masks
D       172.16.0.0/16 is a summary, 00:05:07, Null0
C       172.16.1.0/24 is directly connected, FastEthernet0/0
     192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.96/27 is directly connected, Serial0/0/1
D       192.168.1.0/24 is a summary, 00:05:07, Null0
```

Verifying EIGRP

```
R1#show ip protocols
Routing Protocol is "eigrp 100"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
  EIGRP maximum hopcount 100
  EIGRP maximum metric variance 1
  Redistributing: eigrp 100
  EIGRP NSF-aware route hold timer is 240s
<output omitted>

Maximum path: 4
  Routing for Networks:
    172.16.1.0/24
    192.168.1.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    (this router)           90      00:09:38
    Gateway         Distance      Last Update
    192.168.1.102           90      00:09:40
  Distance: internal 90 external 170
```

Verifying EIGRP

```
R1#show ip eigrp interfaces
IP-EIGRP interfaces for process 100
                        Xmit Queue   Mean   Pacing Time   Multicast    Pending
Interface        Peers  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Fa0/0              0        0/0        0        0/10          0           0
Se0/0/1            1        0/0       10       10/380       424          0
```

Verifying EIGRP

```
R1#show ip eigrp topology
IP-EIGRP Topology Table for AS(100)/ID(192.168.1.101)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status
P 192.168.1.96/27, 1 successors, FD is 40512000
        via Connected, Serial0/0/1
P 192.168.1.0/24, 1 successors, FD is 40512000
        via Summary (40512000/0), Null0
P 172.16.0.0/16, 1 successors, FD is 28160
        via Summary (28160/0), Null0
P 172.16.1.0/24, 1 successors, FD is 28160
        via Connected, FastEthernet0/0
P 172.17.0.0/16, 1 successors, FD is 40514560
        via 192.168.1.102 (40514560/28160), Serial0/0/1
```

Verifying EIGRP

```
R1#show ip eigrp traffic
IP-EIGRP Traffic Statistics for AS 100
  Hellos sent/received: 429/192
  Updates sent/received: 4/4
  Queries sent/received: 1/0
  Replies sent/received: 0/1
  Acks sent/received: 4/3
  Input queue high water mark 1, 0 drops
  SIA-Queries sent/received: 0/0
  SIA-Replies sent/received: 0/0
  Hello Process ID: 113
  PDM Process ID: 73
```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