



# COMPUTER COMMUNICATION NETWORKS

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**Inter-AS routing protocols (BGP): Determining the Best Routes, IP Anycast, Routing policy**

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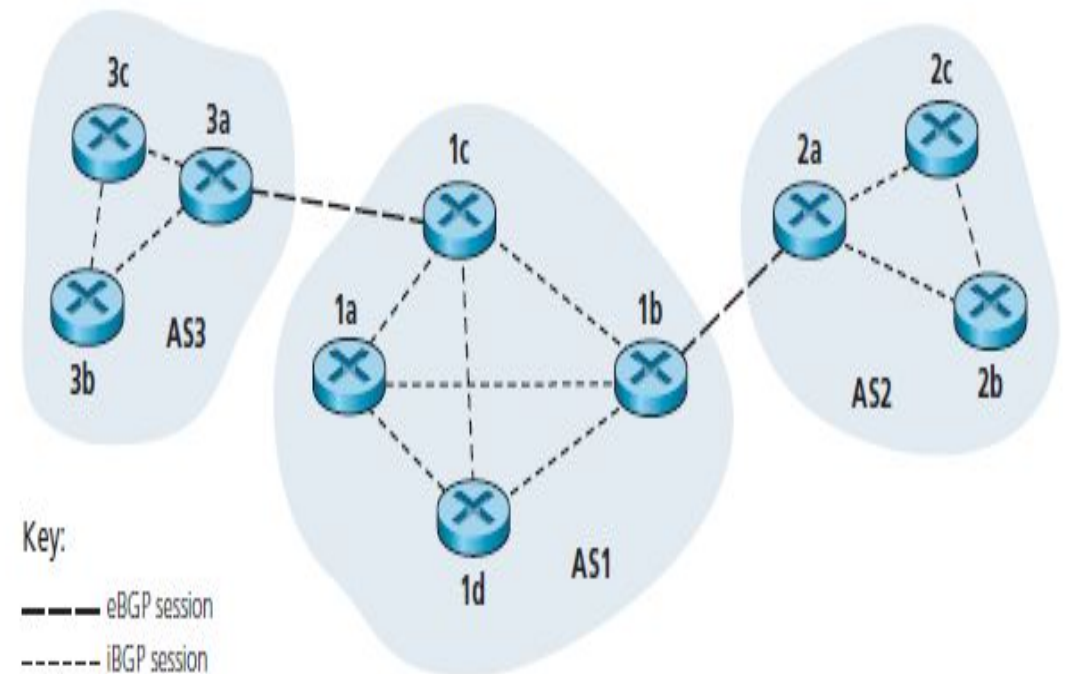
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## Inter-AS routing protocols (BGP): Determining the Best Routes, IP Anycast, Routing policy

### BGP Update message flow

- 3a in AS3 sends an update message to 1c in AS1
- This message has NLRI (network addresses in AS3) and AS\_Path = AS3, Next\_Hop = IP of 3a's interface connected to 1c
- This message reaches 1b via 1c.
- 1b sends a new update message to 2a in AS2 with AS\_Path = AS1AS3 and Next\_Hop = IP of 1b's interface connected to 2a



### BGP Notification message:

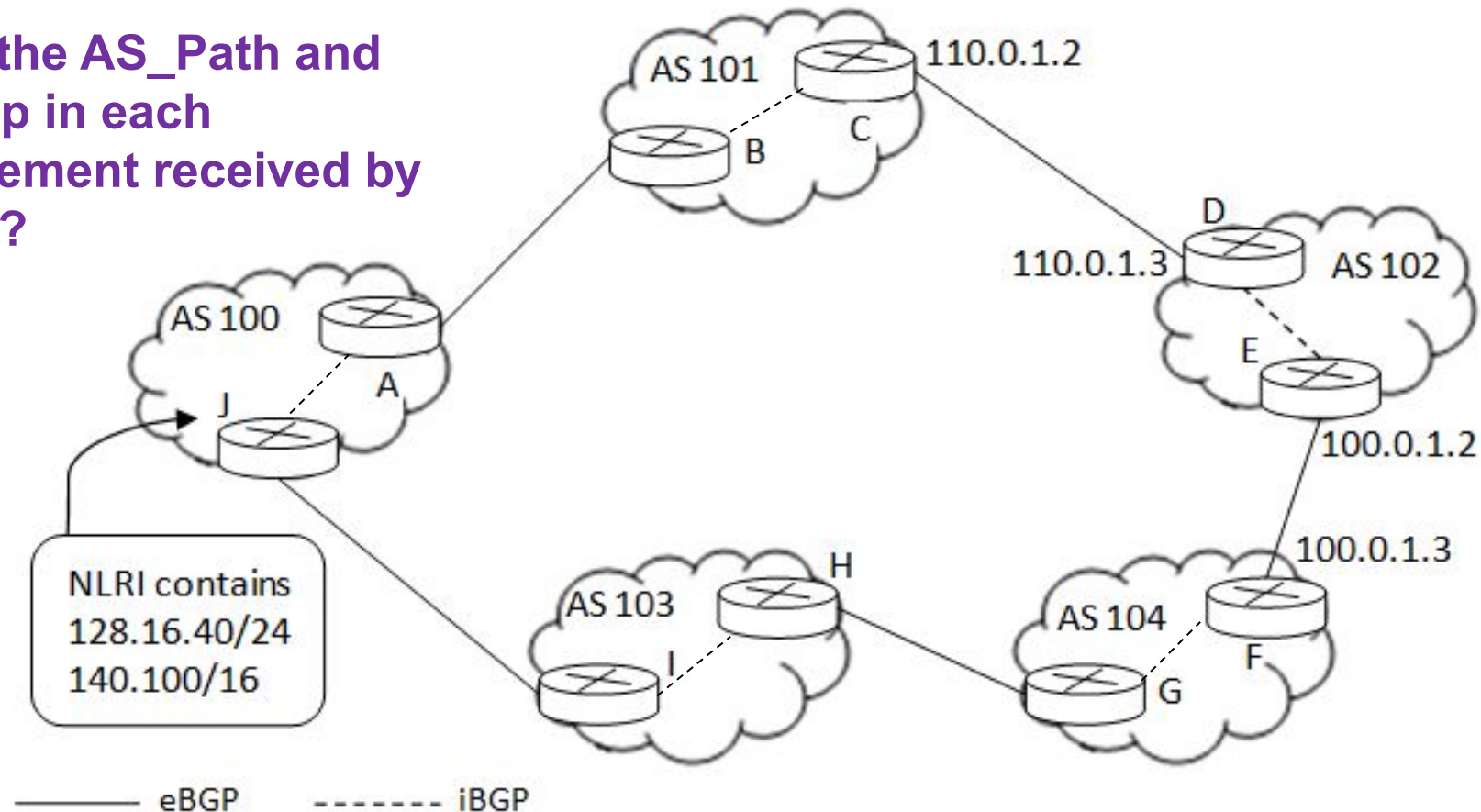
- It is sent whenever an error is detected.
- Types of error messages: Message header error, Open message error, Update message error, Hold timer expired, Finite state machine error and Cease

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### BGP Example:

What is the AS\_Path and Next\_hop in each advertisement received by router D?



One BGP advertisement from AS 100 reaches router D in AS 102 via AS 101.  
Same BGP advertisement reaches router D in AS 102 via AS 103 and AS 104.

- How should a router update its forwarding table when it receives multiple advertisements having the same NLRI?
- Routing paths within a network can be found using the routing algorithms such as LS and DV. However, across ASs we rely on path attributes given in the update message.
- There is no hard and fast rule, instead routing policies are used
- Example: Use Local\_Pref to resolve the issue. If not resolved, use AS\_Path lengths are used to resolve the issue. If that fails, the Next\_Hop is used. If everything fails, use hot potato routing to resolve the issue.

### Steps in BGP decision process:

- If multiple advertisements are received, then the following steps may be used before resolving and adding a unique route

Step	Attribute	Controlled by local or neighbor AS?
1.	Highest LocalPref	local
2.	Lowest AS path length	neighbor
3.	Lowest origin type	neither
4.	Lowest MED	neighbor
5.	eBGP-learned over iBGP-learned	neither
6.	Lowest IGP cost to border router	local
7.	Lowest router ID (to break ties)	neither

### IP Anycast

- BGP is often used to implement the IP anycast service [RFC 1546, RFC 7094].
- In many applications, we are interested in
  - (1) replicating the same content on different servers in many different dispersed geographical locations, and
  - (2) having each user access the content from the server that is closest.



### IP Anycast

**For example,** a CDN may replicate videos and other objects on servers in different countries. When a user wants to access this replicated content, it is desirable to point the user to the “nearest” server with the replicated content. BGP’s route-selection algorithm provides an easy and natural mechanism for doing so.

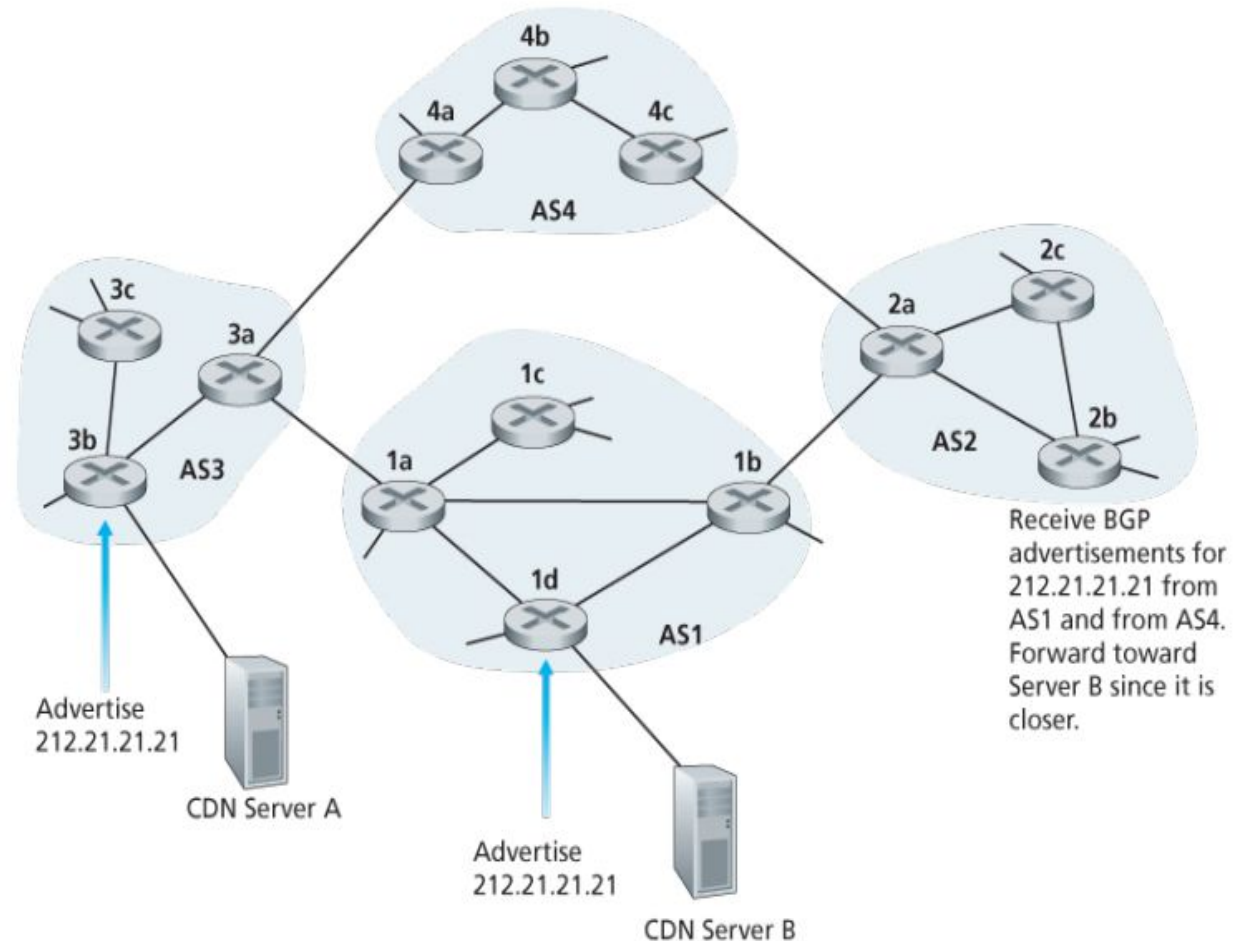


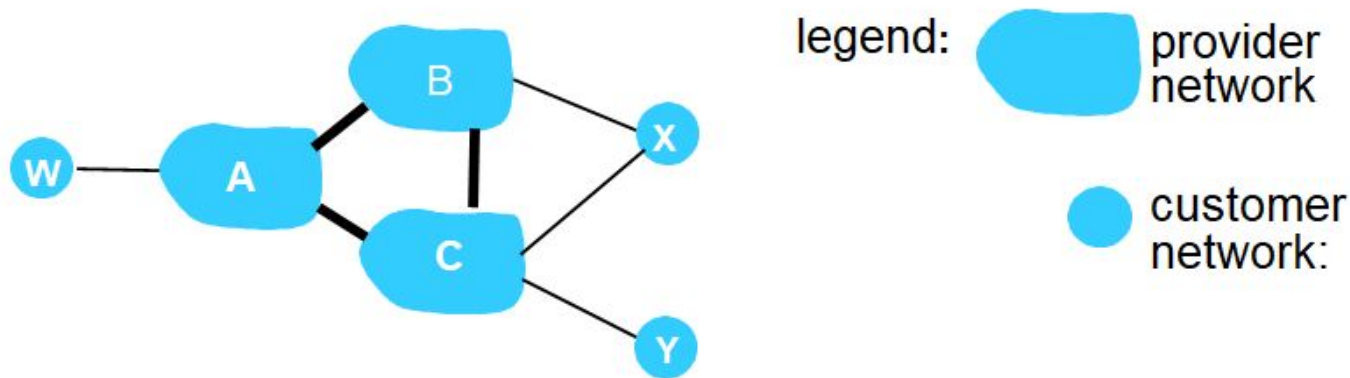
Figure 5.12 Using IP-anycast to bring users to the closest CDN server

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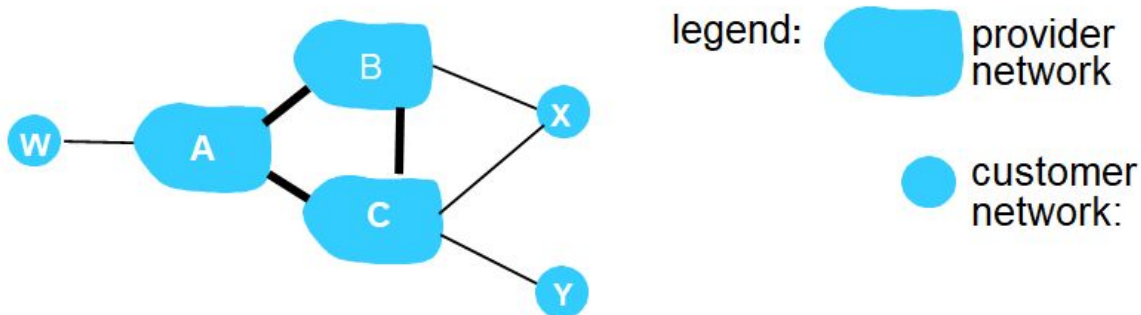
### Routing policy

- A,B,C are **provider networks**
- X,W,Y are customer (of provider networks)
- X is **dual-homed**: attached to two networks
  - X does not want to route from B via X to C
  - so X will not advertise to B a route to C



### Routing policy

- A advertises path AW to B
- B advertises path BAW to X
- Should B advertise path BAW to C?
  - No, B gets no “revenue” for routing CBAW since neither W nor C are B’s customers
  - B wants to force C to route to w via A
  - B wants to route *only* to/from its customers





# THANK YOU

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