

Network Technologies (TCP/IP Suite)

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Quiz

Problem Set 2

Due: 10/05/07

Outline

▲ Border Gateway Protocol

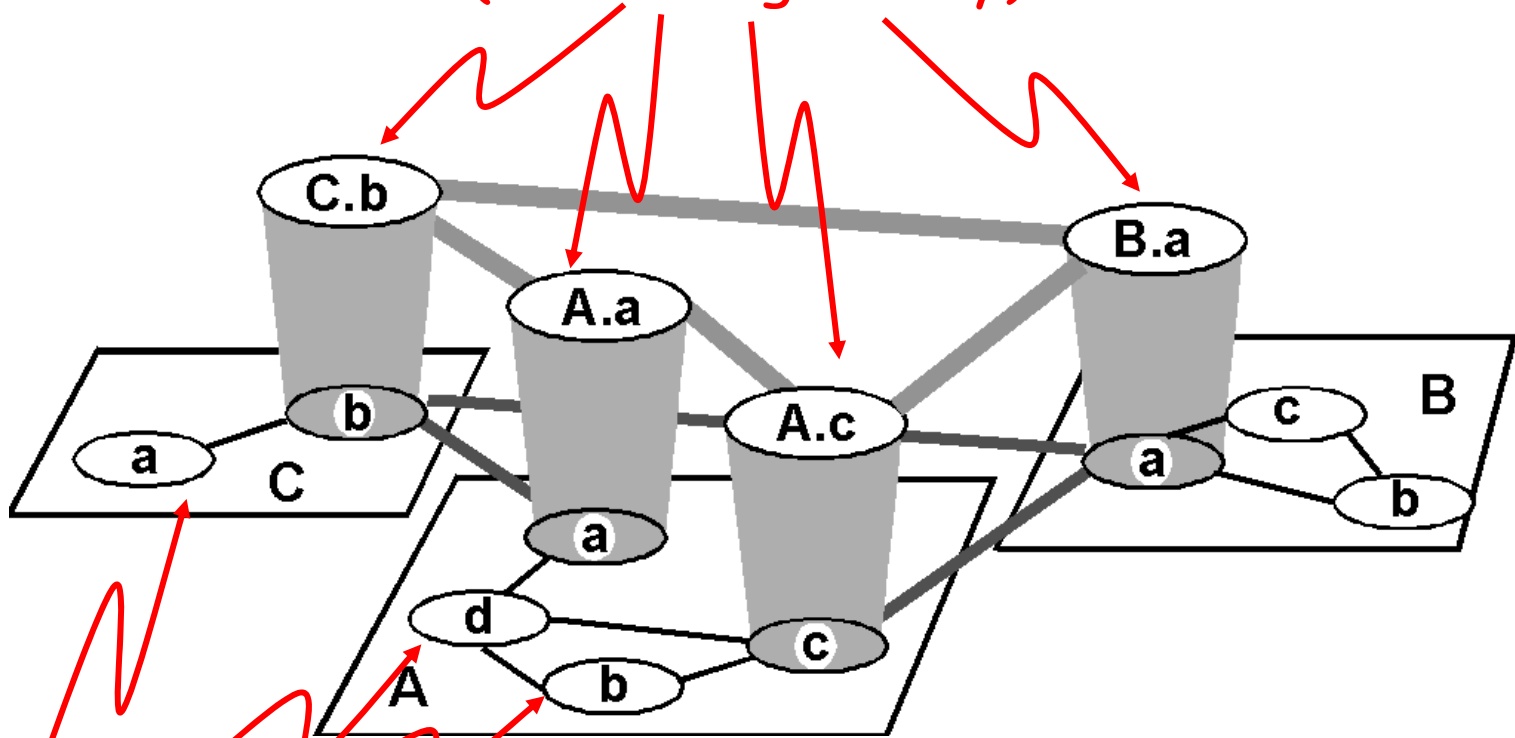
Routing in the Internet

- ▲ The Global Internet consists of Autonomous Systems (AS) interconnected with each other:
 - Stub AS: small corporation: one connection to other AS's
 - Multihomed AS: large corporation (no transit): multiple connections to other AS's
 - Transit AS: provider, hooking many AS's together

- ▲ Two-level routing:
 - Intra-AS: administrator responsible for choice of routing algorithm within network
 - Inter-AS: unique standard for inter-AS routing: BGP

Internet AS Hierarchy

Inter-AS border (exterior gateway) routers



Intra-AS interior routers

Inter-AS routing in the Internet: BGP

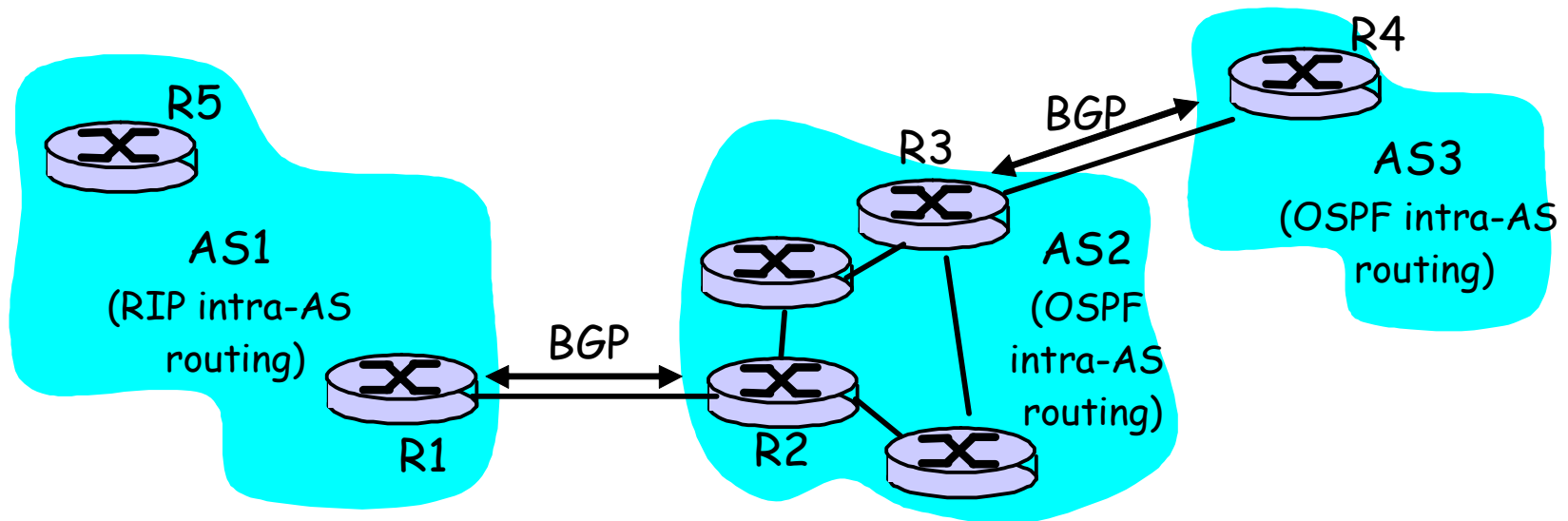


Figure 4.5.2-new2: BGP use for inter-domain routing

Internet inter-AS routing: BGP

- ▲ **BGP (Border Gateway Protocol)**: *the* de facto standard
- ▲ **Path Vector** protocol:
 - similar to Distance Vector protocol
 - each Border Gateway broadcast to neighbors (peers) *entire path* (i.e., sequence of AS's) to destination
 - BGP routes to networks (ASs), not individual hosts
 - E.g., Gateway X may send its path to dest. Z:
Path (X,Z) = X,Y1,Y2,Y3,...,Z

Internet inter-AS routing: BGP

- ▲ Suppose: gateway X send its path to peer gateway W
- ▲ W may or may not select path offered by X
 - cost, policy (don't route via competitors AS), loop prevention reasons.
- ▲ If W selects path advertised by X, then:
- ▲ Path (W,Z) = w, Path (X,Z)
- ▲ Note: X can control incoming traffic by controlling its route advertisements to peers:
 - e.g., don't want to route traffic to Z -> don't advertise any routes to Z

BGP: controlling who routes to you

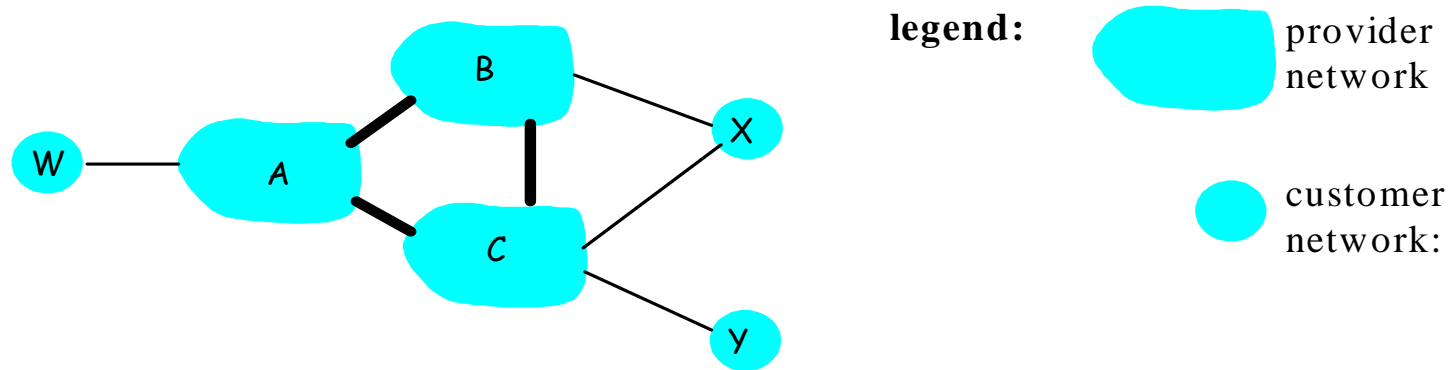


Figure 4.5-BGPnew: a simple BGP scenario

- ▲ 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

BGP: controlling who routes to you

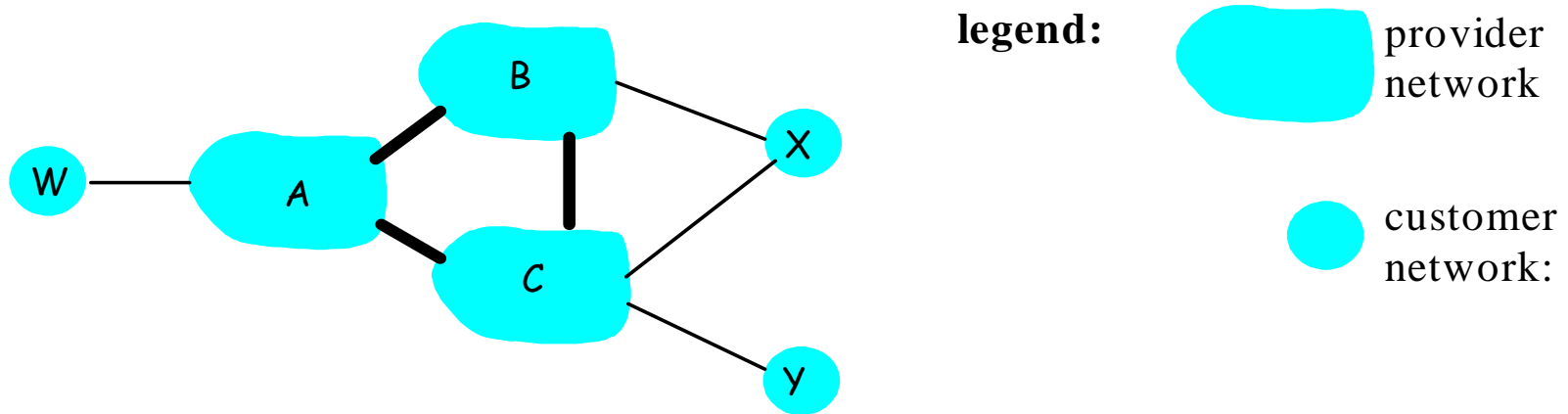


Figure 4.5-BGPnew: a simple BGP scenario

- ▲ A advertises to B the path AW
- ▲ B advertises to X the path BAW
- ▲ Should B advertise to C the path BAW?
 - No way! 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!

BGP operation

Q: What does a BGP router do?

- ▶ Receiving and filtering route advertisements from directly attached neighbor(s).
- ▶ Route selection.
 - To route to destination X, which path (of several advertised) will be taken?
- ▶ Sending route advertisements to neighbors.

BGP messages

- ▲ BGP messages exchanged using TCP.
- ▲ BGP messages:
 - OPEN: opens TCP connection to peer and authenticates sender
 - UPDATE: advertises new path (or withdraws old)
 - KEEPALIVE keeps connection alive in absence of UPDATES; also ACKs OPEN request
 - NOTIFICATION: reports errors in previous msg; also used to close connection

Why different Intra- and Inter-AS routing ?

▲ Policy:

- Inter-AS: admin wants control over how its traffic routed, who routes through its net.
- Intra-AS: single admin, so no policy decisions needed

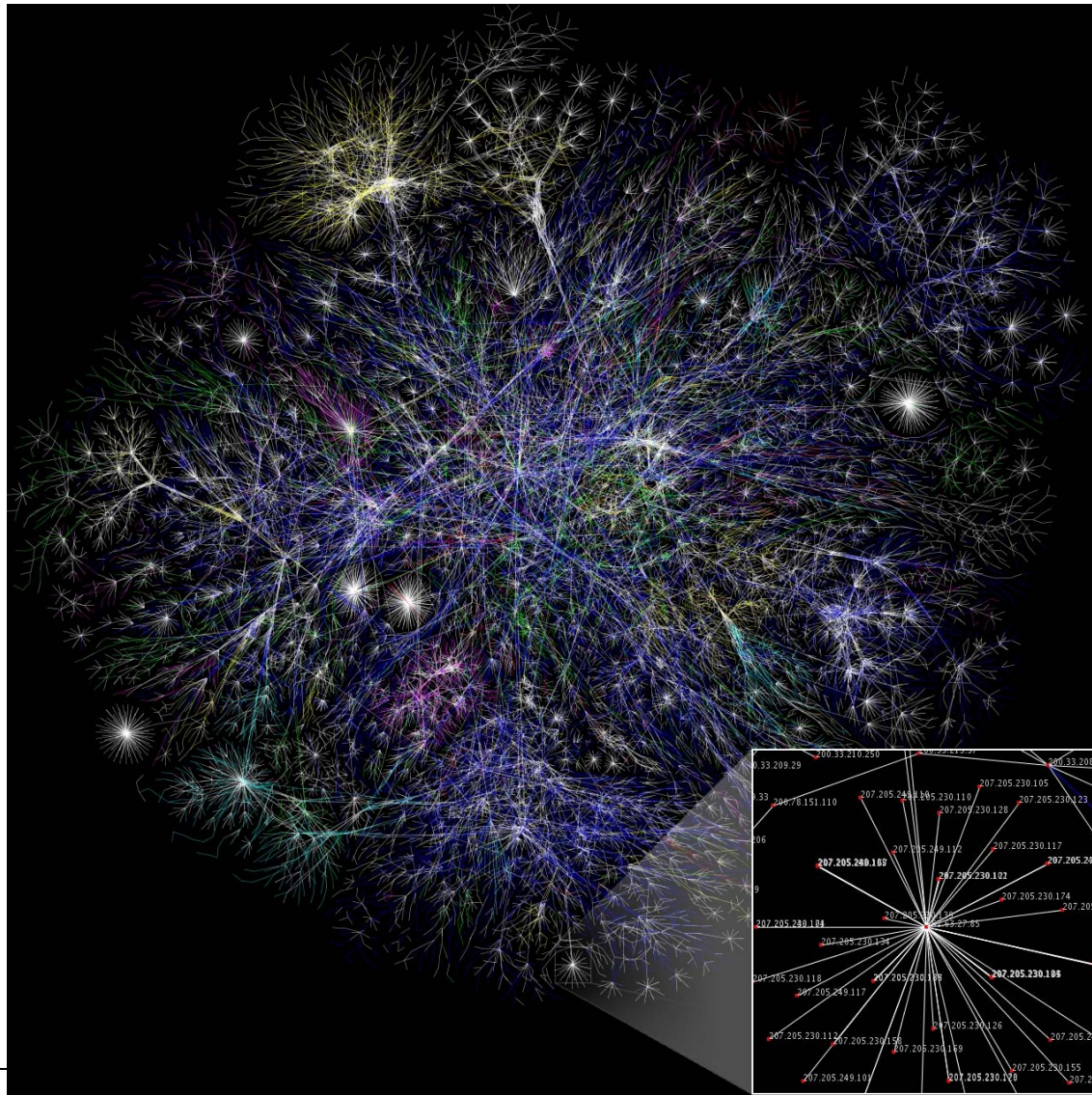
▲ Scale:

- hierarchical routing saves table size, reduced update traffic

▲ Performance:

- Intra-AS: can focus on performance
- Inter-AS: policy may dominate over performance

A glimpse of the Internet!



Questions?

That's all for today!