CN-Advanced
L45

BGP

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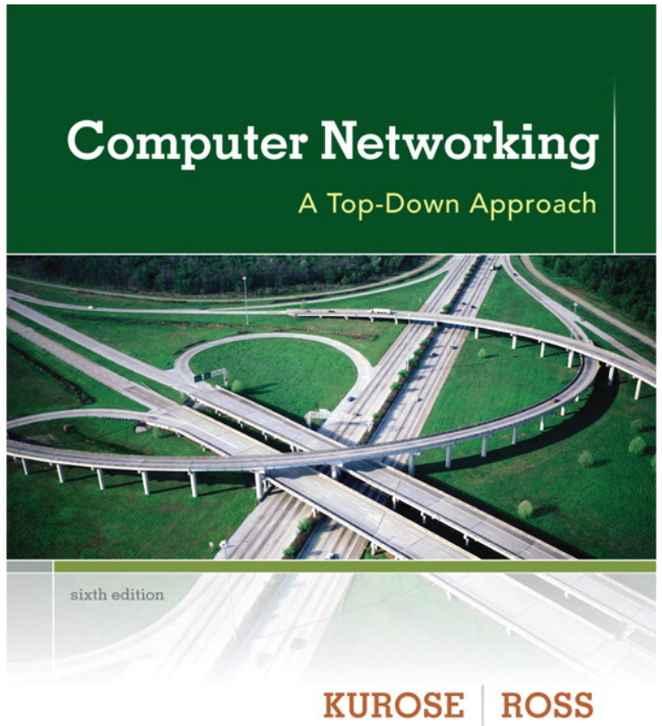
Chapter 4
Wireless and Mobile Networks



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Computer Networking: A Top Down Approach
6th edition
Jim Kurose, Keith Ross
Addison-Wesley
March 2012

Interdomain Routing - Challenges

- Policies for an AS
  - Send traffic via X than Y
  - Can send traffic to Y but
    - not from X to Y (no transit)
    - paid them only to carry my traffic
  - Would like to keep policies private
  - Can have more complex policies
    - Use Y only for routes R1, R2
    - Use X for other routes
  - Does not advertise all routes

Inter Domain Routing - Challenges

- Each domains runs its own protocol
- Practically impossible to calculate meaningful path costs. Why?
  - Costs of one AS could be quite different from cost of other AS
- Issues of trust
  - Relates to complex policies
    - Trust X only if it advertises routes to R1, … Rk

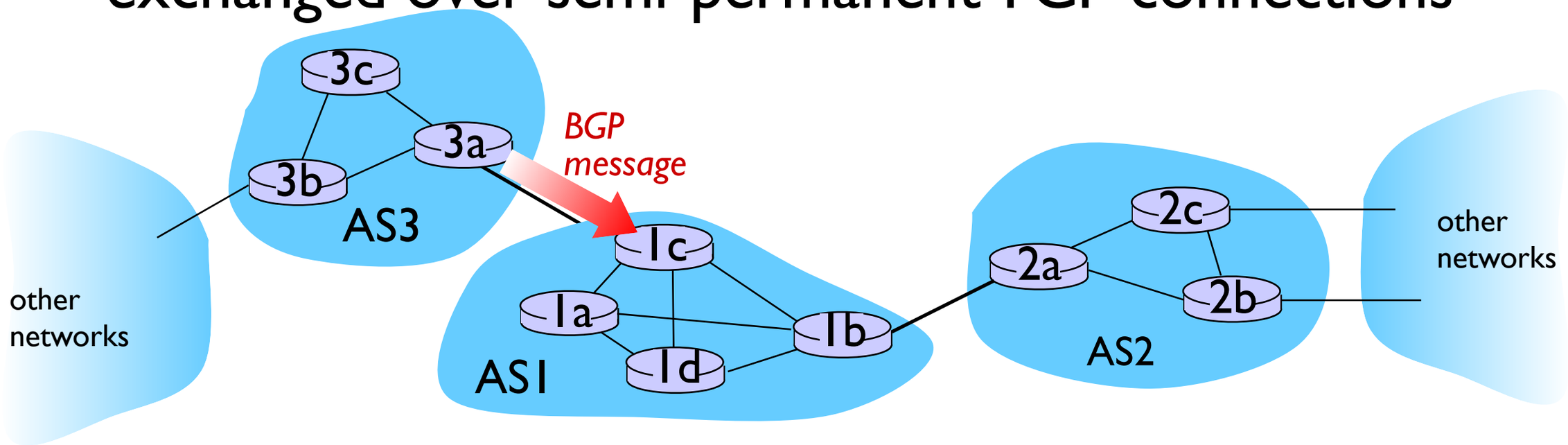
BGP Basics

- Each AS has one or more border routers
  - forwards packets between AS
- BGP does not belong to DV and LS routing class. Why?
- It advertises complete path
  - enumerated list of AS to reach a n/w
    - path vector routing
- needed to support policy decisions
- enables to avoid routing loop

How BGP Works

- when AS3 advertises a prefix to AS1:
  - AS3 *promises* it will forward datagrams towards that prefix
  - AS3 can aggregate prefixes in its advertisement

- BGP session: two BGP routers ("peers") exchange BGP messages:
  - advertising *paths* to different destination network prefixes ("path vector" protocol)
  - exchanged over semi-permanent TCP connections



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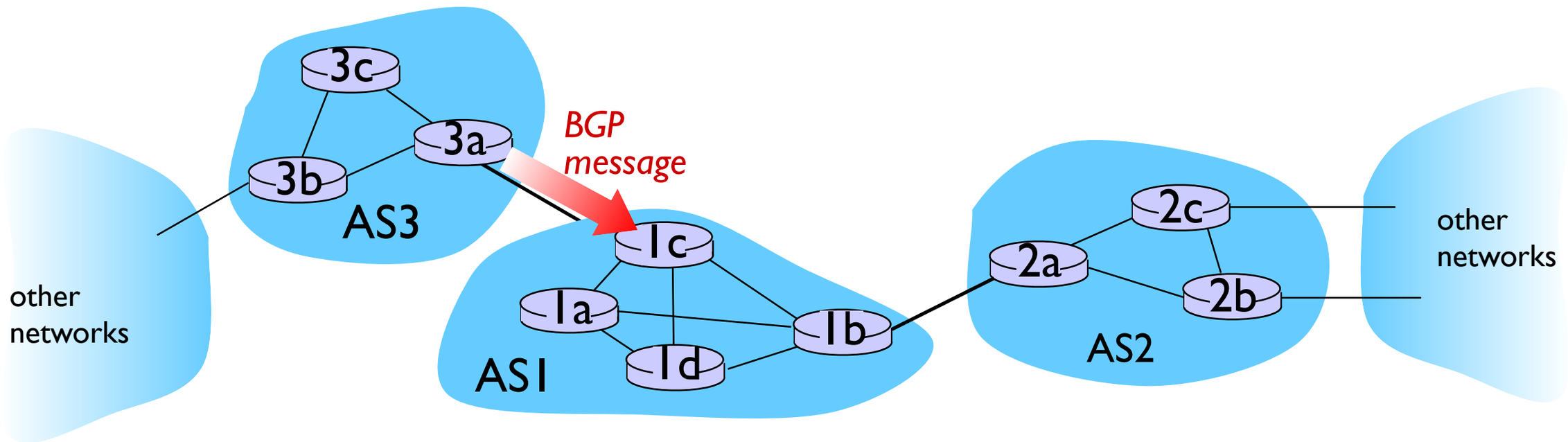
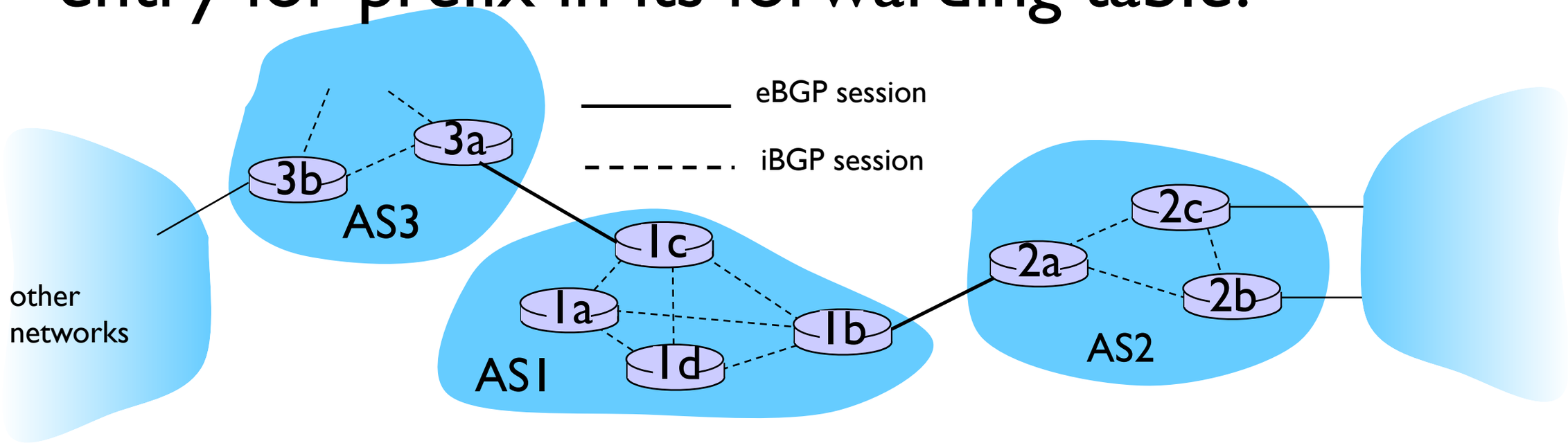


BGP Basics: Distributing Path Information

- Using eBGP session between 3a and `1c`, `AS3` sends prefix reachability info to `AS1`.
  - `1c` can then use iBGP to distribute new prefix info to all routers in `AS1`
  - `1b` can then re-advertise new reachability info to `AS2` over `1b`-to-`2a` eBGP session
- when router learns of new prefix, it creates entry for prefix in its forwarding table.

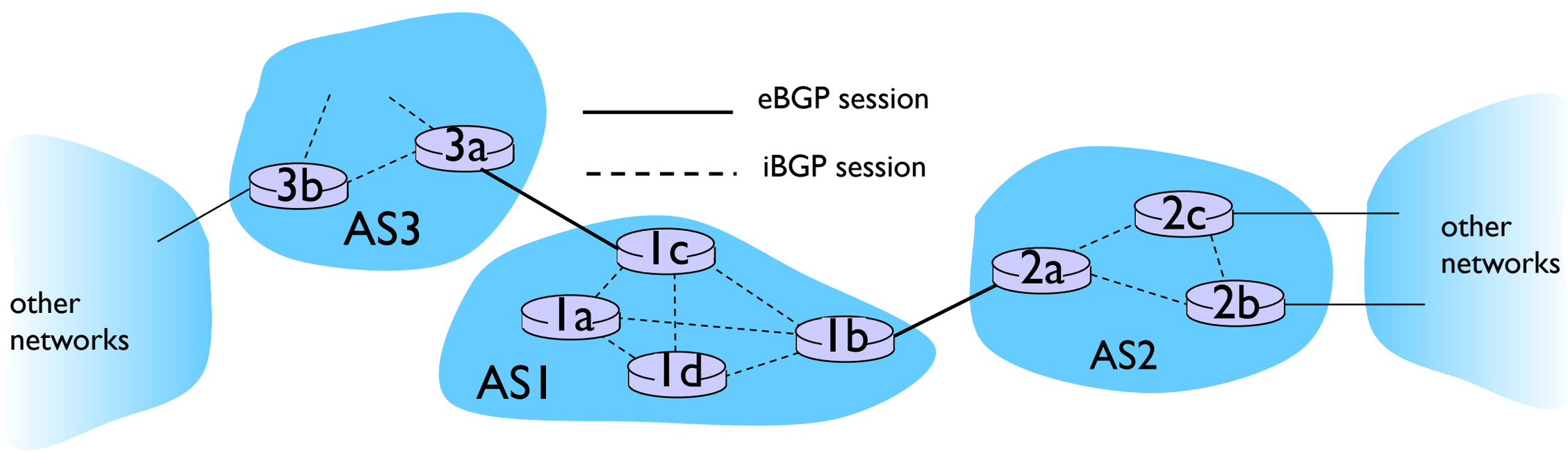


Path attributes and BGP routes

- Advertised prefix includes BGP attributes
  - prefix + attributes = "route"
- Two important attributes:
  - AS-PATH: contains ASs through which prefix advertisement has passed: e.g., AS 67, AS 17
  - NEXT-HOP: indicates specific internal-AS router to next-hop AS. (may be multiple links from current AS to next-hop-AS)
- Gateway router receiving route advertisement uses import policy to accept/decline
  - e.g., never route through AS x
  - *policy-based* routing

Path attributes and BGP routes

- Why Next -Hop?
  - Router `1d` needs to know cost to `3a`
  - Uses Intra-domain routing to know cost
    - Network `3a-1c` is part of it



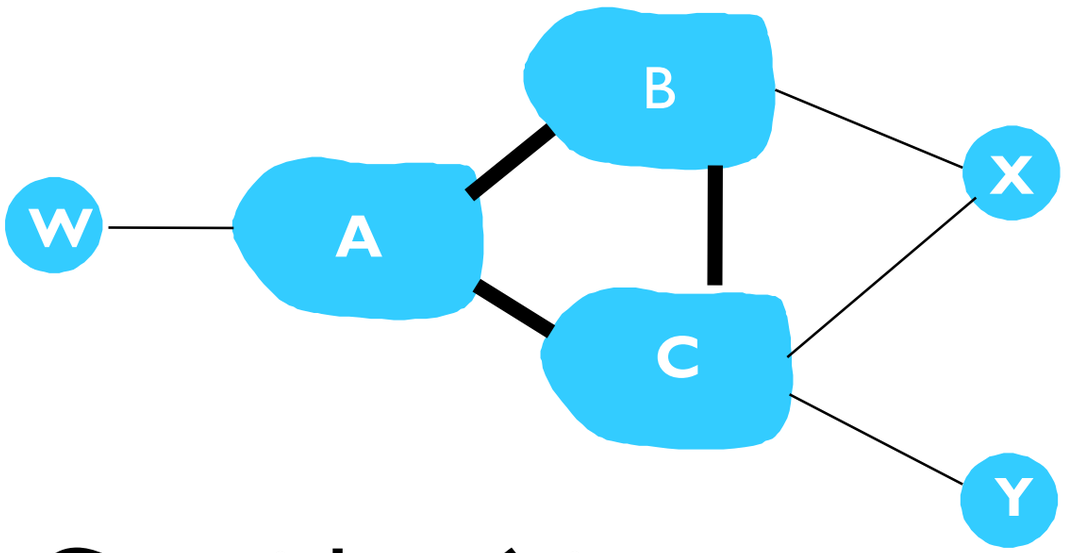
BGP route selection

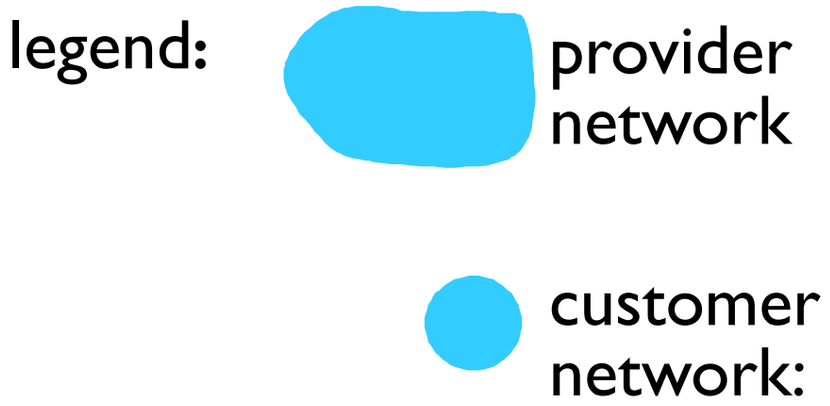
- Router may learn about more than 1 route to destination AS, selects route based on:
  - local preference value attribute: policy decision
  - shortest AS-PATH
  - closest NEXT-HOP router: hot potato routing
  - additional criteria

BGP messages

- BGP messages exchanged between peers over TCP connection
- 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

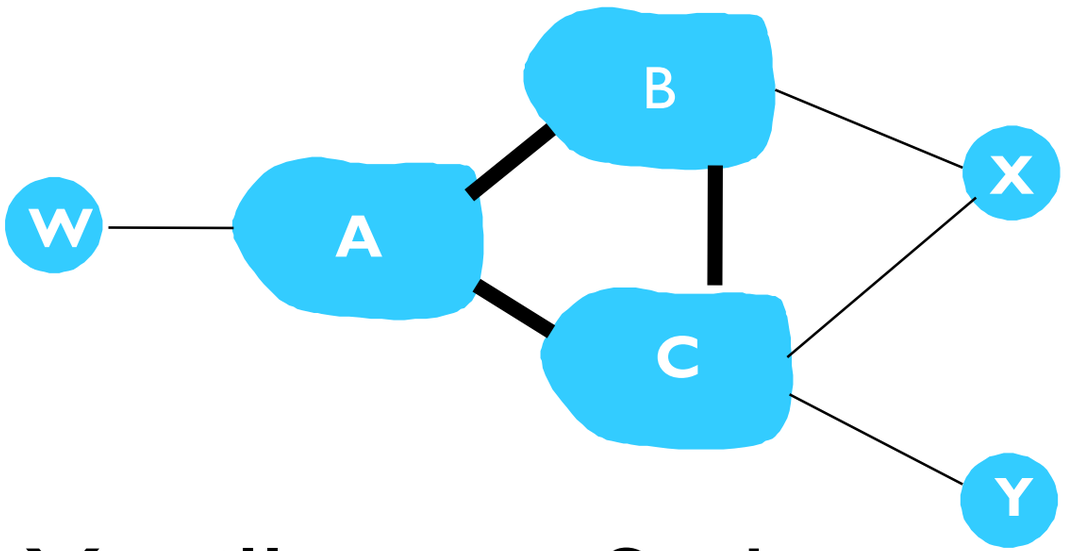
BGP routing policy

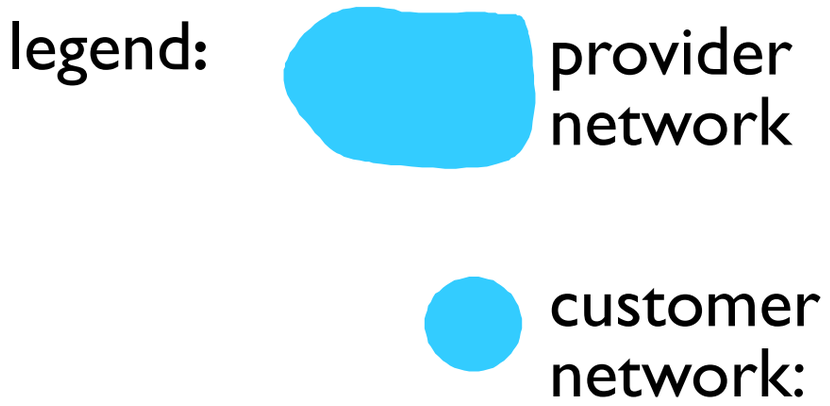




- Consider 6 interconnected ASes
- A,B,C are *provider networks*; peer to each other
- X,W,Y are customer (Stub AS; of provider n/ws)
- X is *dual-homed:* attached to two networks
  - X does not want to route from B to C (via X)
  - .. so X will not advertise to B a route to C

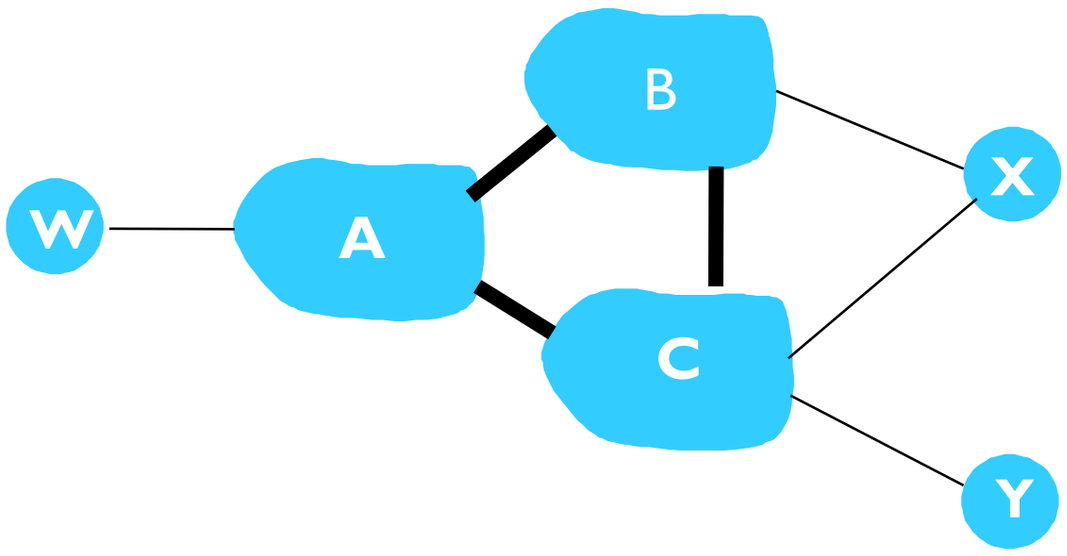
BGP routing policy





- X will act as Stub network
  - It will not advertise any other destination
    - other than itself
  - .. so X will not advertise to B a route to C
  - .. so X will not advertise to C a route to B
- Should X aderverise XCY to B?

BGP routing policy (2)



legend:

provider network

customer network:

- A advertises path AW to B
- B advertises path BAW to X
- Should B advertise path BAW to C?
  - 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!

Why different Intra-, 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
  - Cost can't be used as criteria

Summary

- BGP basics
- Distributed path information
- Path attributes
- BGP Route selection
- BGP routing policies