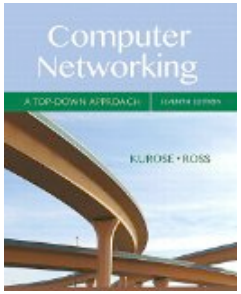
COMP 375: Lecture 34



- **News & Notes:**
  - Project #5
    - Protocol Spec due @ 10PM
    - Code due in one week
  - Quiz #8 in class Friday
- **Reading (Fri, Apr. 27)**
  - Review today's reading

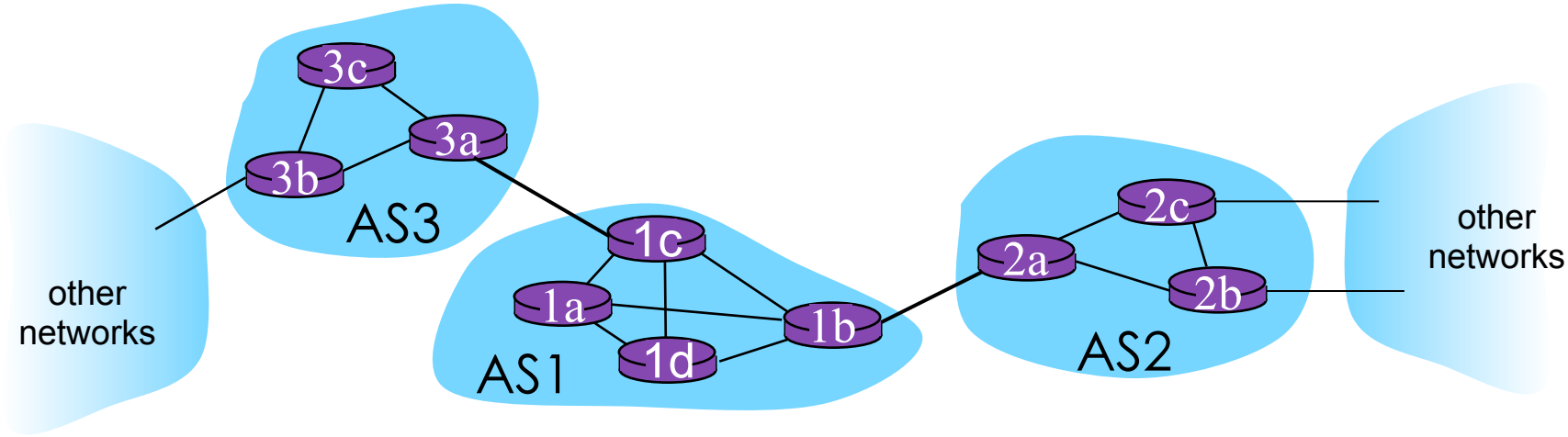
Sections 5.3 – 5.4

INTERNET ROUTING

Our assumptions about a flat network of identical routers is not true in practice.

Discuss: *What are some problems with these assumptions?*

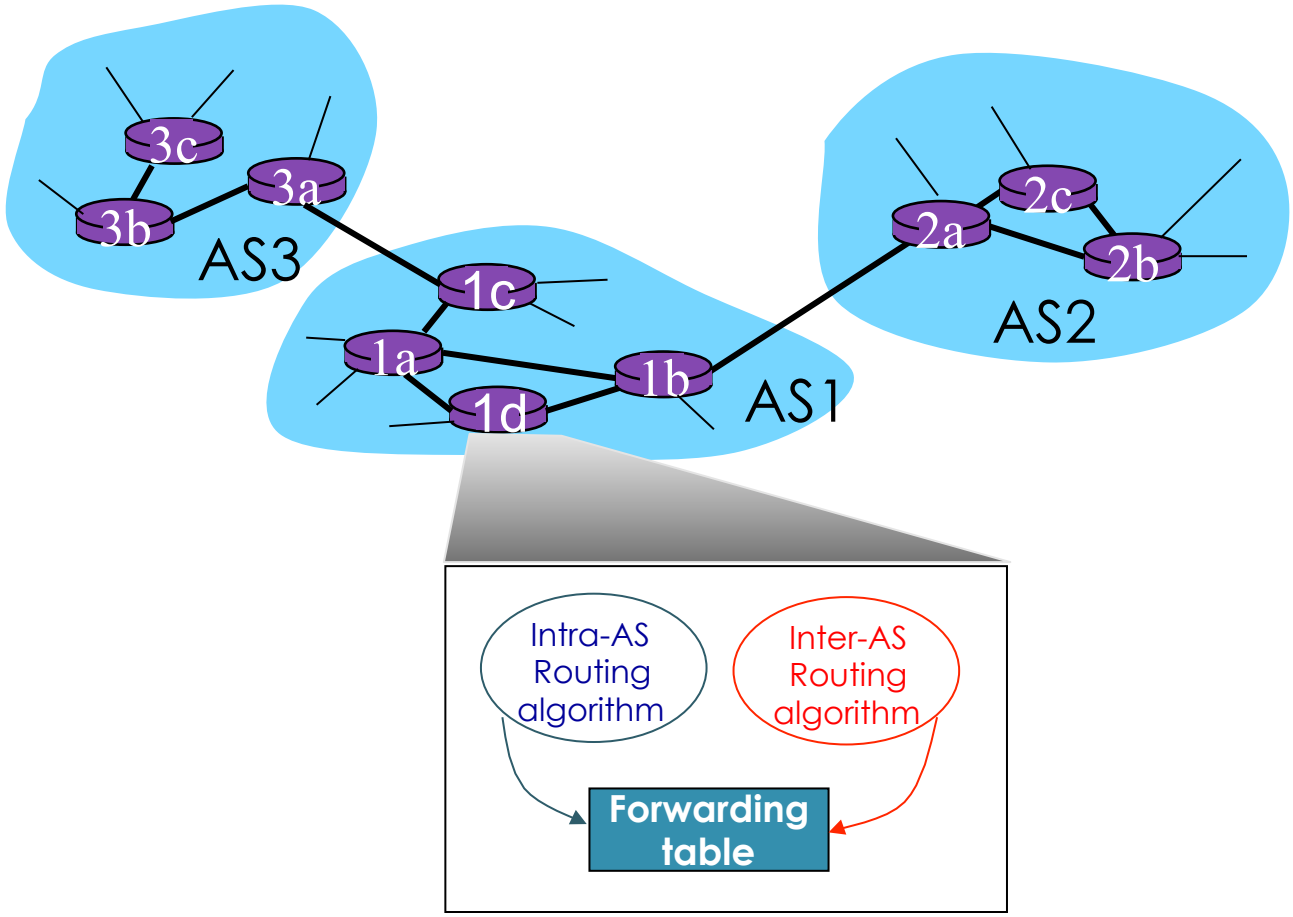
Routers are grouped into **autonomous systems**, with all routers in an AS using the same routing algorithm.



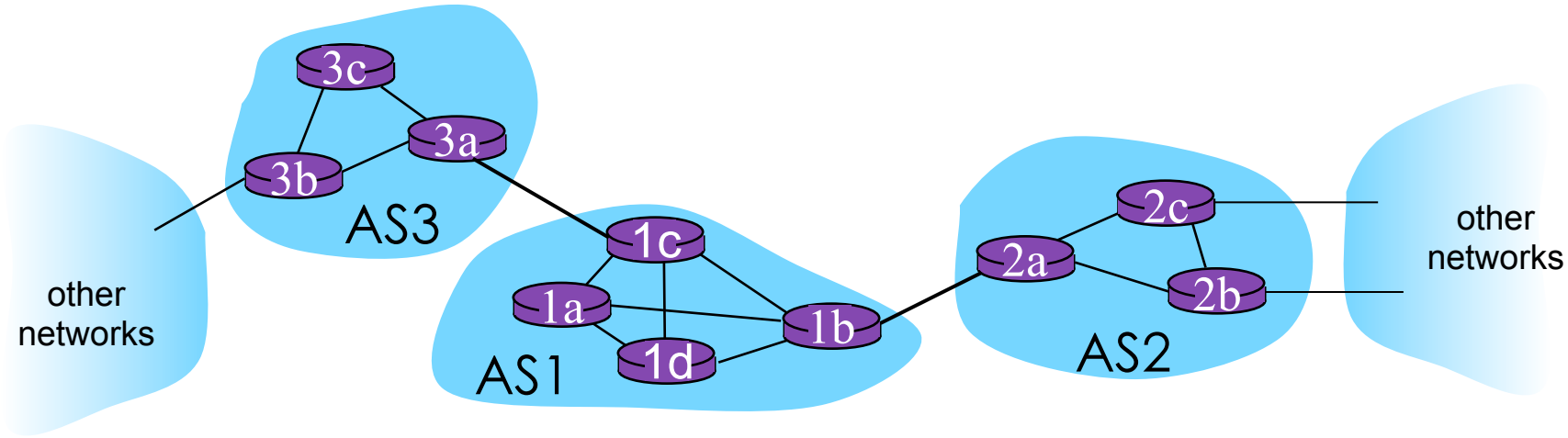
Gateway/border router: Router connected to multiple autonomous systems.

Which routers in this example are gateways?

Forwarding tables are configured using both Intra- and Inter-AS algorithms.

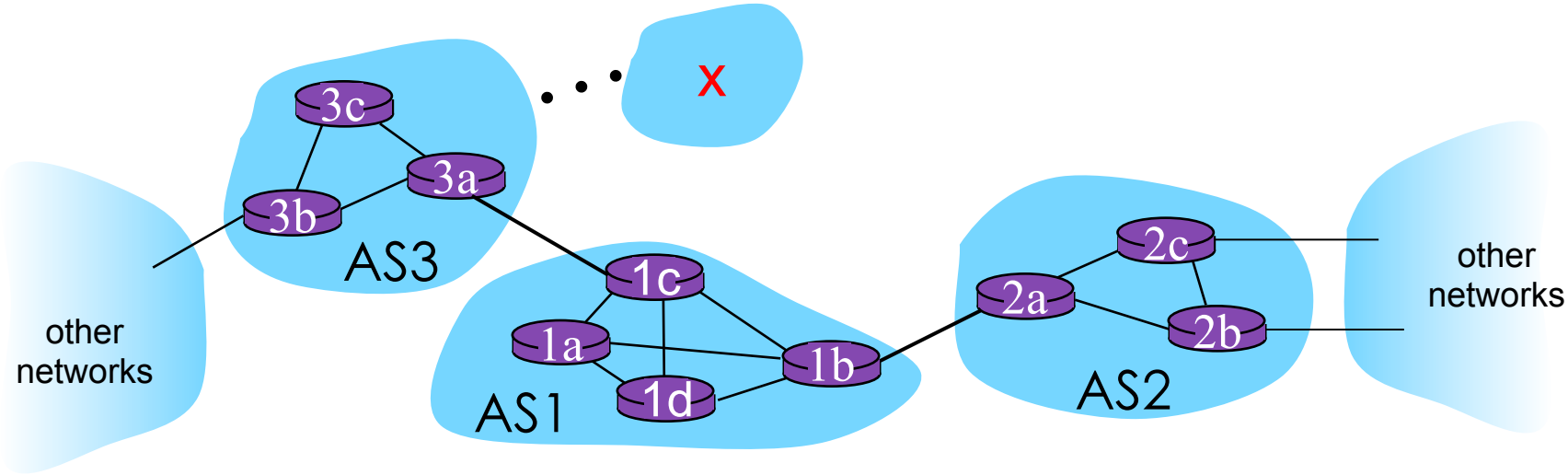


The goal of Inter-AS routing is to propagate reachability info to all routers in an AS.



- **Scenario**: Router 1d receives an IP datagram destined for a host outside of AS1.
- **Question**: Which gateway router should I send this to?

Example: Setting forwarding table in 1d to allow sending datagrams to subnet x.



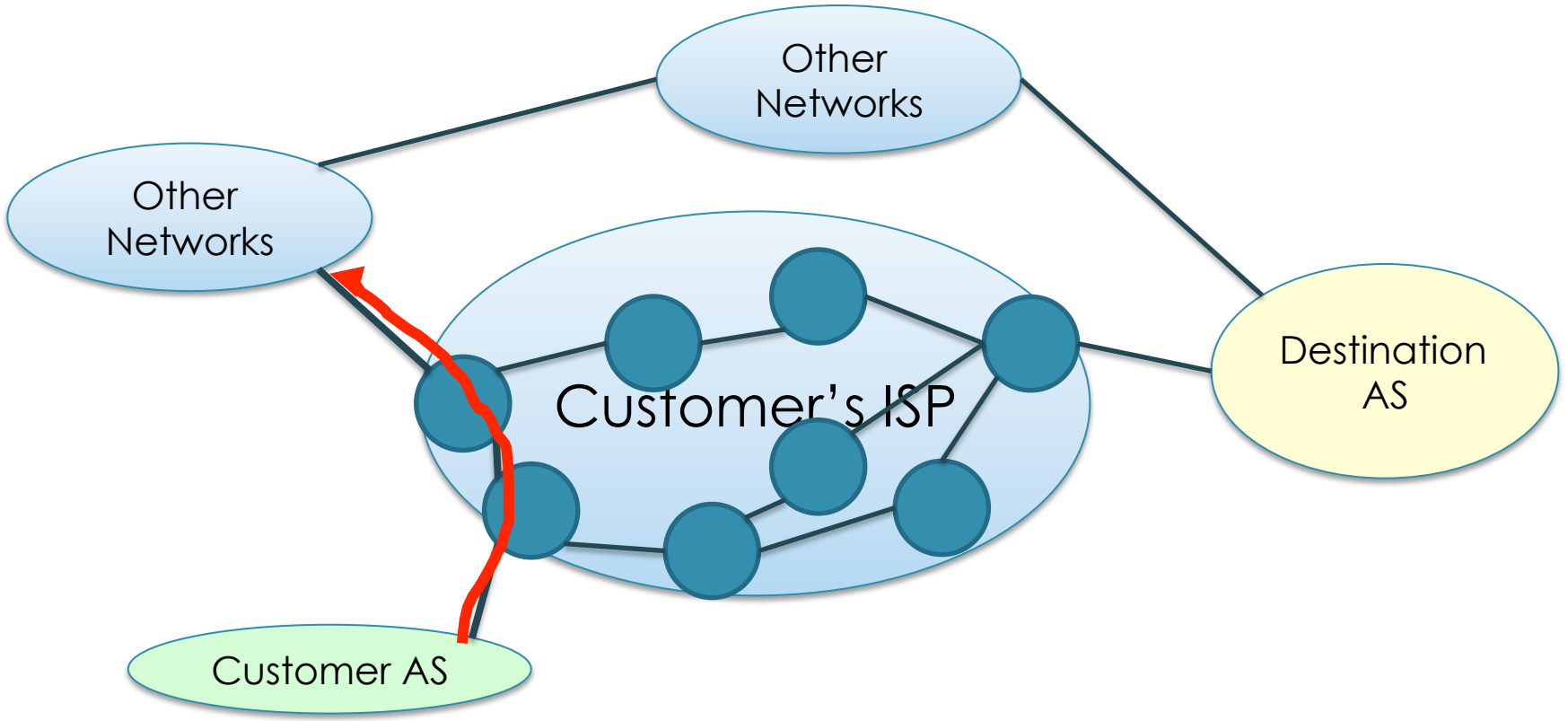
- **Step 1**: Learn reachability of x.
- **Step 2**: Propagate reachability info to all of routers in the AS.
- **Step 3**: Determine best route to gateway router.
- **Step 4**: Add forwarding table entry to Router 1d.

If an external destination is reachable from multiple gateways, a router inside the AS should forward packets for that destination to…

A.	The closest gateway that can reach the destination.
B.	The gateway that has the least-cost external path to the destination.
C.	The gateway that has the least-cost path for both the internal and external path.
D.	Somewhere else.

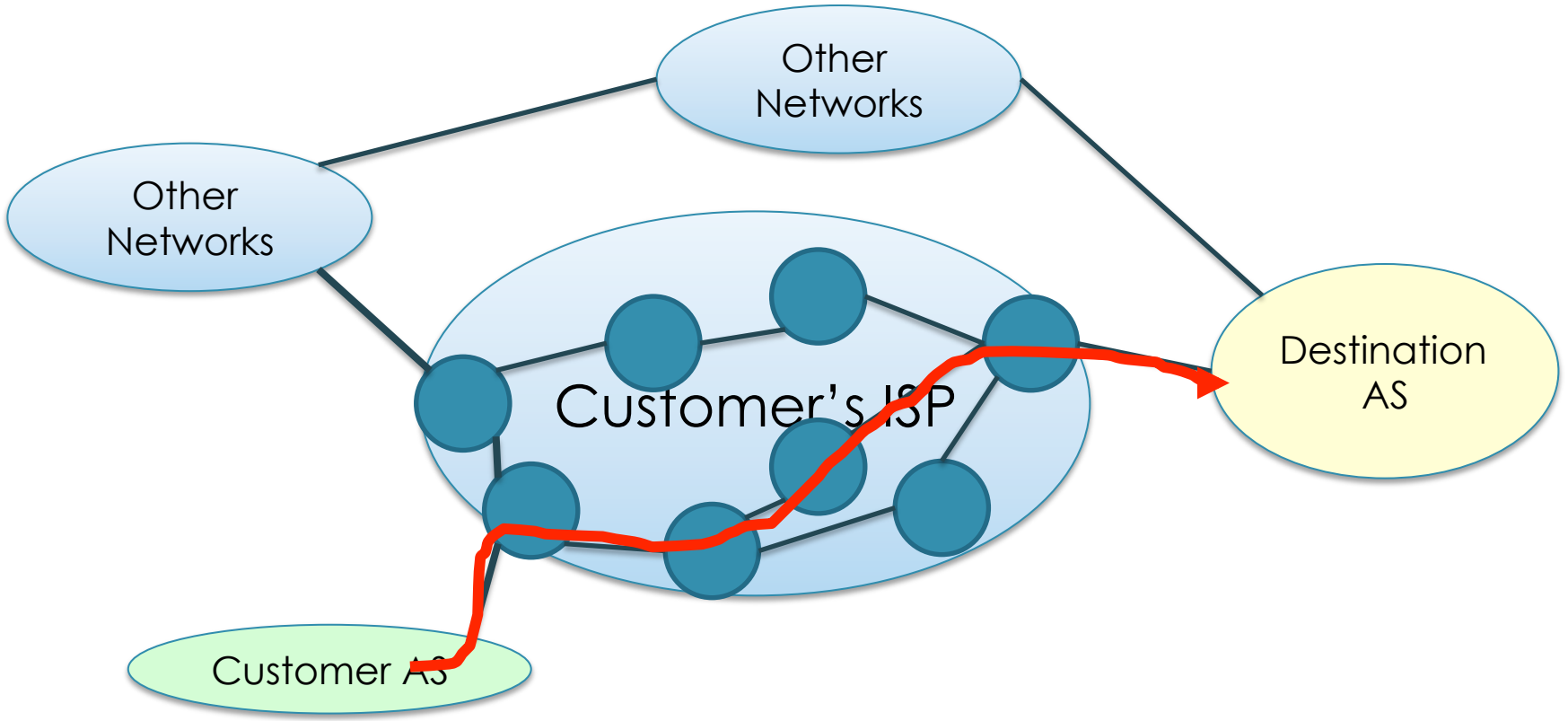
Hot Potato: Don't get burned!

In **Hot Potato** routing, out goal is to get datagrams out of our AS… ASAP!



"It's not my problem, so use as few resources as possible!"

In **Cold Potato** routing, goal is to get datagrams as close to their destination as possible!



"Let's provide the best service possible!"

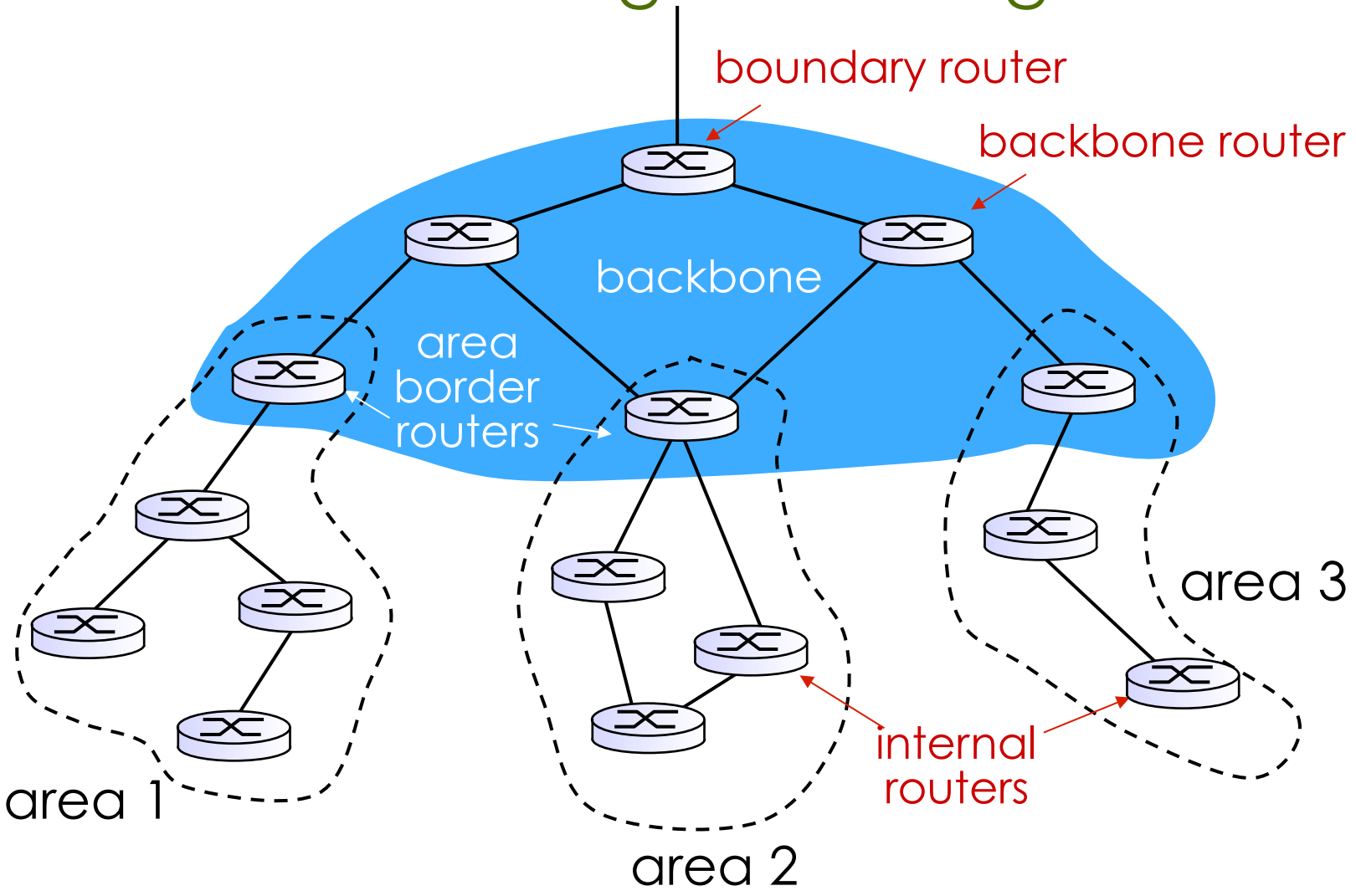
Intra-AS routing uses Link-State or Distance Vector routing.

- **Distance Vector:**
  - **RIP**: Routing Information Protocol
  - **EIGRP**: Interior Gateway Routing Protocol
- **Link State:**
  - **OSPF**: Open Shortest Path First
  - **IS-IS**: **I**ntermediate **S**ystem (IS) to **I**ntermediate **S**ystem (IS)

OSPF is an open, secure and scalable Intra-AS protocol based on link-state.

- **Security**: Message authentication
- **Load Balancing**: Multiple equal-cost paths allowed
- For each link, multiple cost metrics for different goals

Hierarchical OSPF helps reduce overhead of using LS in a large AS.

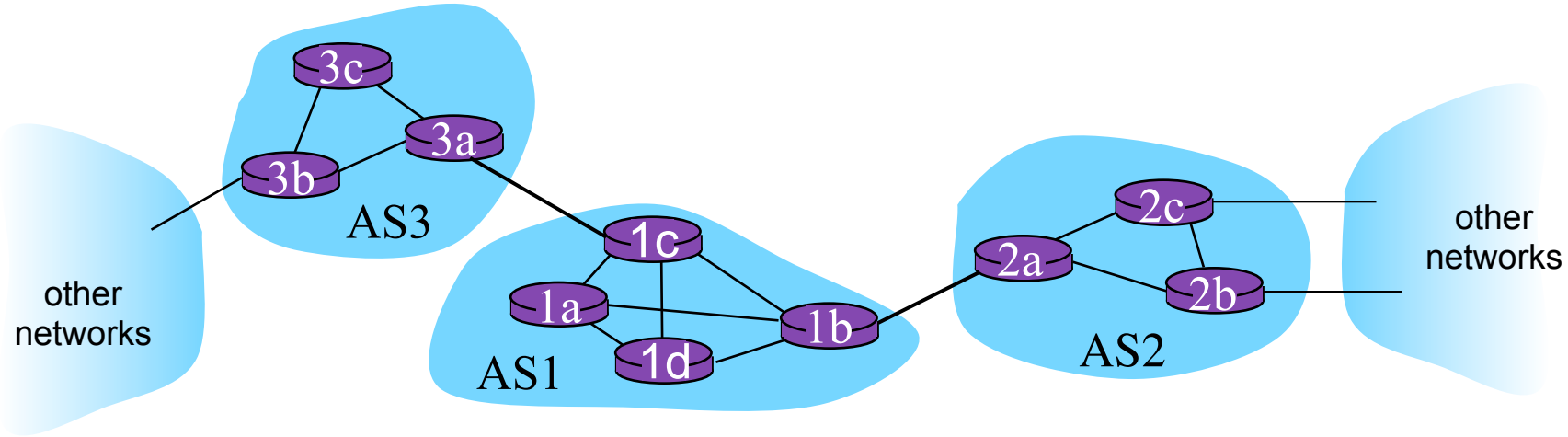


Section 5.4

BORDER GATEWAY PROTOCOL

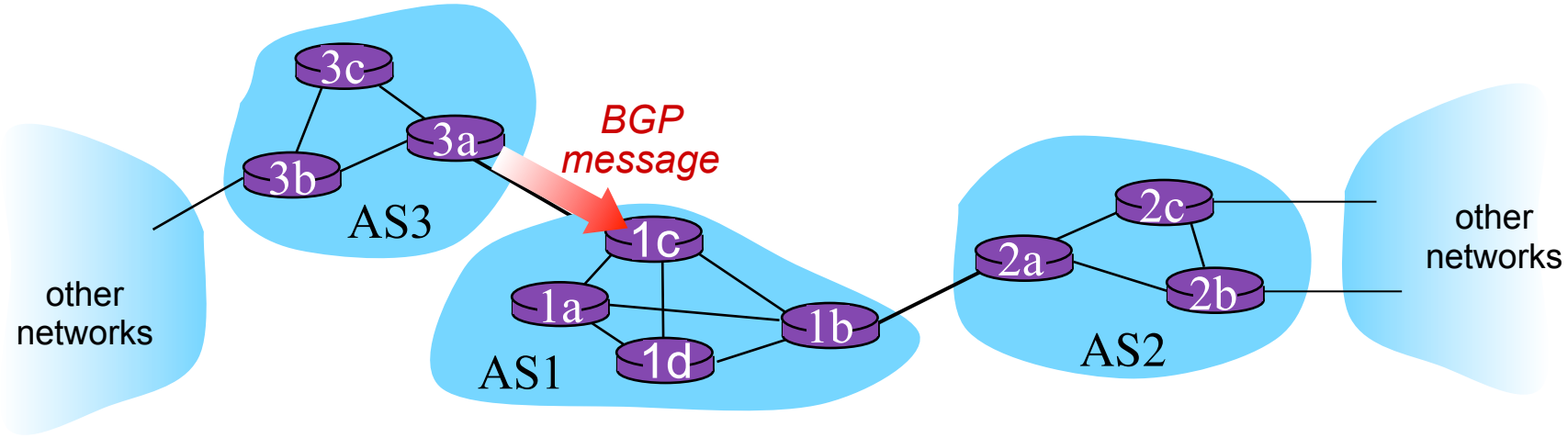
BGP allows subnet advertising, picks routes based on reachability and policy.

- BGP defines two types of connections:
  - **External BGP (eBGP)**: Inter-AS connection
  - **Internal BGP (iBGP)**: Intra-AS connection



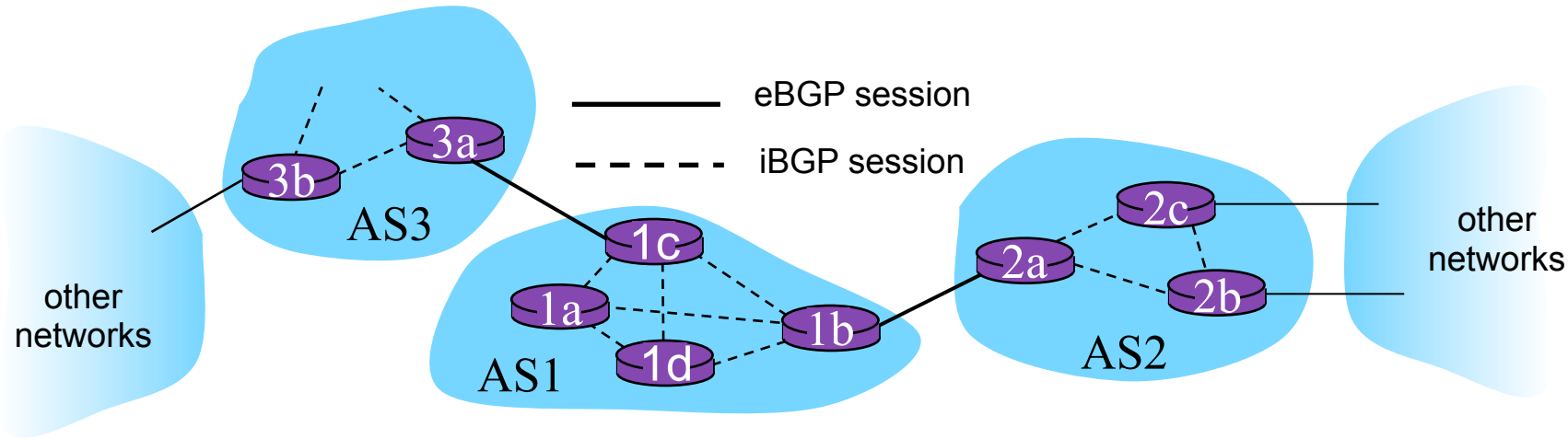
BGP sessions involve advertising paths to different subnets/prefixes.

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



eBGP is used to advertise reachability, iBGP is used to propagate that info.

- Using **eBGP** session between 3a and 1c, AS3 sends prefix reachability info to AS1.
  - 1c can then use **iBGP** do 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

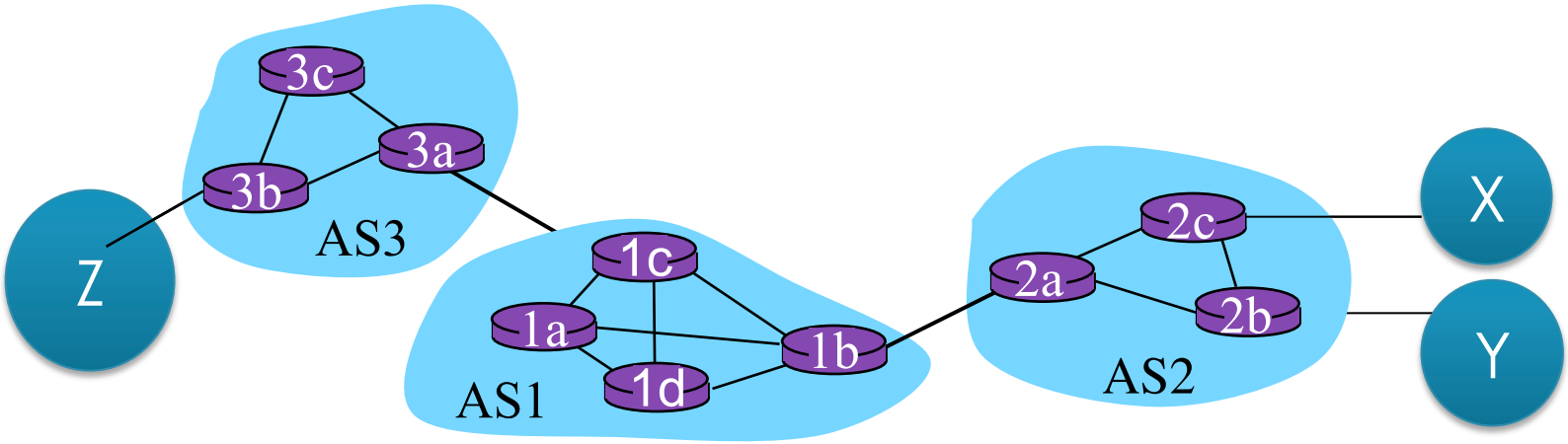


A BGP **route** includes *both* a **destination prefix** and some **attributes**.

- Key Attributes:
  - **AS-PATH**: List of ASs through which prefix advertisement has passed
  - **NEXT-HOP:** Router interface that begins AS-PATH
  - **Local Preference**: Weighting set by the network admin

Which row is correct if we are **routing from Router 3b**?

	Destination	AS-PATH	NEXT-HOP
A.	X	AS1	1b-2a
B.	Y	AS1 AS2	3a-1c
C.	X	AS1 AS2	3b-3a
D.	Y	AS3 AS1 AS2	3b-3a



If there are multiple routes available, router must select one.

- Possible Selection Criteria:
  1. Local preference value attribute: administrative policy
  2. Shortest AS-PATH
  3. Closest NEXT-HOP router (hot potato)
  4. Other...

Which routes are **advertised** will depend on which of the following?

A.	Which ISPs have contractual agreements.
B.	The shortest path to a subnet/prefix.
C.	Which subnets are customers of an ISP.
D.	Exactly two of the above.
E.	All of the above (i.e. A, B, and C)