

Routing Algorithms and Routing in the Internet

Hierarchical Routing

Our routing study thus far - idealization

- ❑ all routers identical
- ❑ network “flat”

... *not* true in practice

scale: with 200 million destinations:

- ❑ can't store all dest's in routing tables!
- ❑ routing table exchange would swamp links!

administrative autonomy

- ❑ internet = network of networks
- ❑ each network admin may want to control routing in its own network

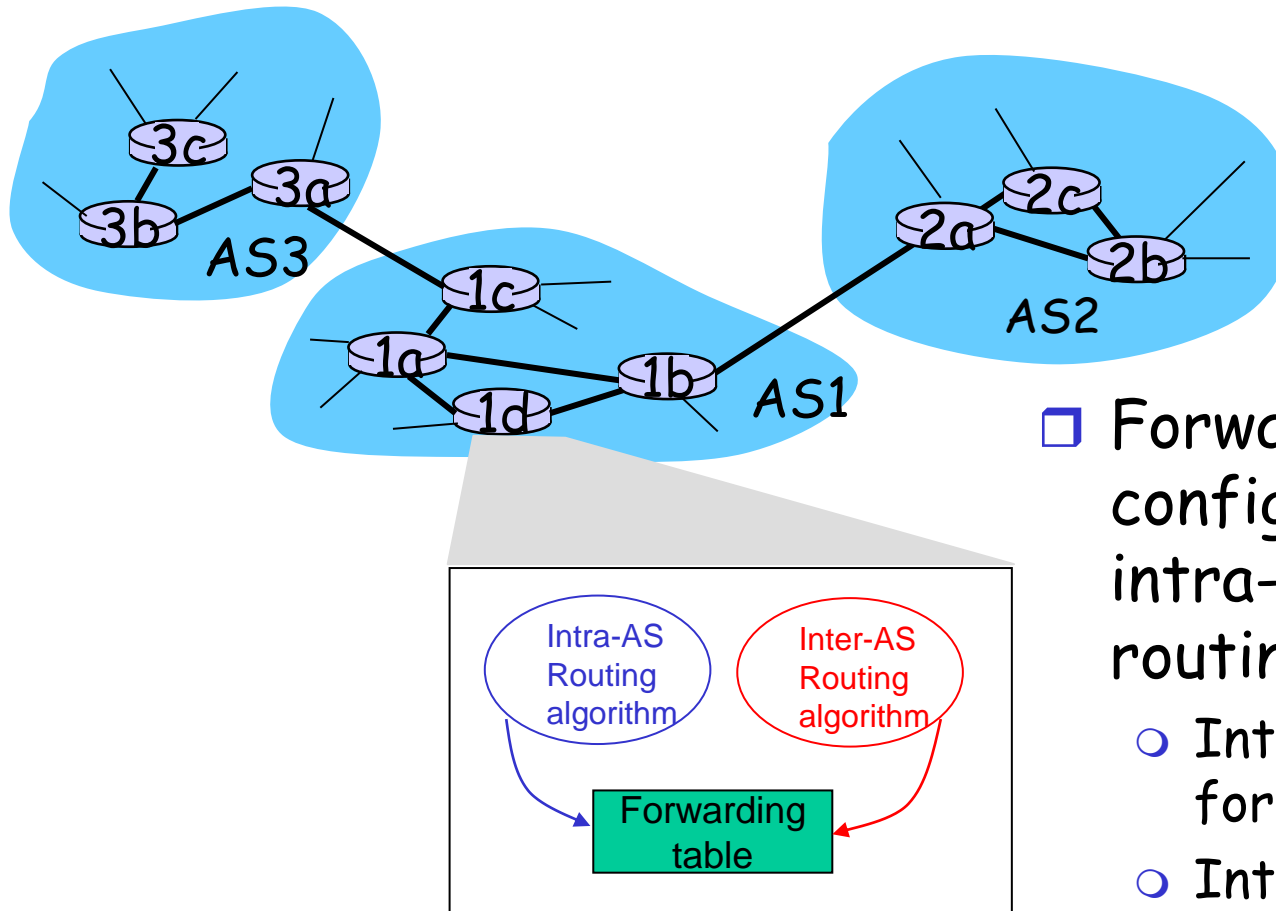
Hierarchical Routing

- ❑ aggregate routers into regions, "autonomous systems" (AS)
- ❑ routers in same AS run same routing protocol
 - "intra-AS" routing protocol
 - routers in different AS can run different intra-AS routing protocol

Gateway router

- ❑ Direct link to router in another AS

Interconnected ASes



- Forwarding table is configured by both intra- and inter-AS routing algorithm
 - Intra-AS sets entries for internal dests
 - Inter-AS & Intra-As sets entries for external dests

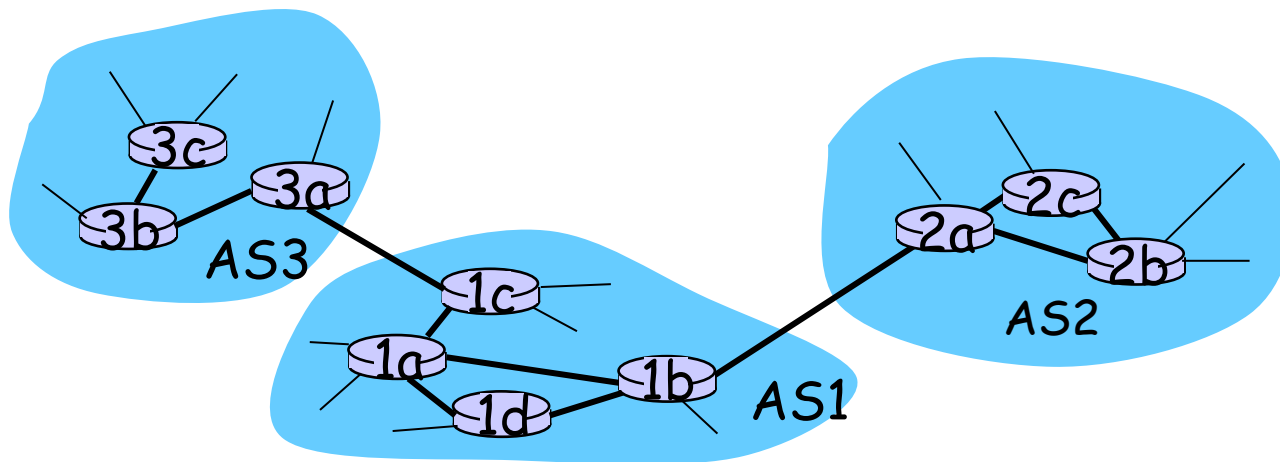
Inter-AS tasks

- ❑ Suppose router in AS1 receives datagram for which dest is outside of AS1
 - Router should forward packet towards one of the gateway routers, but which one?

AS1 needs:

1. to learn which dests are reachable through AS2 and which through AS3
2. to propagate this reachability info to all routers in AS1

Job of inter-AS routing!

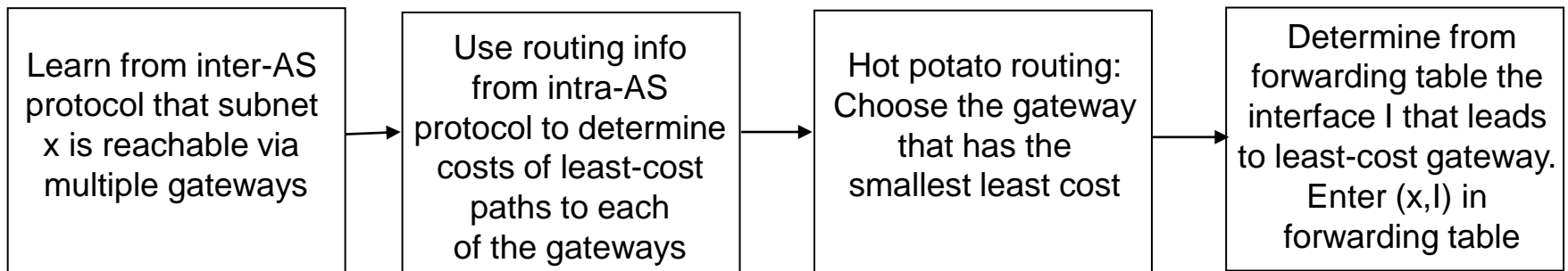


Example: Setting forwarding table in router 1d

- ❑ Suppose AS1 learns from the inter-AS protocol that subnet x is reachable from AS3 (gateway 1c) but not from AS2.
- ❑ Inter-AS protocol propagates reachability info to all internal routers.
- ❑ Router 1d determines from intra-AS routing info that its interface I is on the least cost path to 1c.
- ❑ Puts in forwarding table entry (x, I) .

Example: Choosing among multiple ASes

- ❑ Now suppose AS1 learns from the inter-AS protocol that subnet **x** is reachable from AS3 and from AS2.
- ❑ To configure forwarding table, router 1d must determine towards which gateway it should forward packets for dest **x**.
- ❑ This is also the job on inter-AS routing protocol!
- ❑ **Hot potato routing**: send packet towards closest of two routers.



Intra-AS Routing

- ❑ Also known as **Interior Gateway Protocols (IGP)**
- ❑ Most common Intra-AS routing protocols:
 - RIP: Routing Information Protocol
 - OSPF: Open Shortest Path First
 - IGRP: Interior Gateway Routing Protocol (Cisco proprietary)