Routing

Distance Vector Routing vs. Link State Routing

BGP

Practice
Distance Vector Routing

What to exchange: distance vector for all nodes

How to route: directly from distance vector

Loop protection, partition detection
Link State Routing

What to exchange: local link states

How to route: calculate shortest path

Computational expensive, more data to be stored
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<th>Link State</th>
<th>Distance Vector</th>
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<td><strong>Flood link state advertisements to all routers</strong></td>
<td><strong>Update distances from neighbors’ distances</strong></td>
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BGP - The interdomain routing problem

Each AS determines its own routing policies

- One AS only wants to send and receive packets from the internet
- One AS can carry transit traffic for others if you pay this service

Political considerations

- Never send traffic from the Pentagon on a route through Iraq

Security considerations

- Traffic starting or ending at Apple should not transit Google

Economic considerations

- Use cheaper service
Interconnection Relationships

Local

Transit

Peering
BGP Basics

Types of routers:

• Border router: packets enter and leave the AS

• BGP Speaker: handles advertisements, usually the same as border routers

Path-vector protocol

• Not distance vector or link-state

• AS Path: list of autonomous systems to reach a particular network

• Built on TCP
Loop Detection

Assign each AS a unique number

- BGP current version: 16 bits
Route selection

Routes via peered networks are favored over routes via transit providers

• Free!

Shorter AS paths are better

Prefer the route that has the lowest cost within the ISP

Only advertise routes that are good enough for you

Allow route withdrawal
One example

Consider the following network with 6 Ases

- AS1 is the provider for AS2, AS3, and AS4
- AS2 is the provider for AS5
- AS3 is the provider for AS5 and AS6
- AS5 and AS6 have a peer agreement
Practices

Consider the network shown in Figure 4.28, in which horizontal lines represent transit providers and numbered vertical lines are interprovider links.

(a) How many routes to P could provider Q’s BGP speakers receive?

(b) Suppose Q and P adopt the policy that outbound traffic is routed to the closest link to the destination’s provider, thus minimizing their own cost. What paths will traffic from host A to host B and from host B to host A take?
Practices

Give an example of an arrangement of routers grouped into autonomous systems so that the path with the fewest hops from a point A to another point B crosses the same AS twice. Explain what BGP would do with this situation.
Practice

Let $A$ be the number of autonomous systems on the Internet, and let $D$ (for diameter) be the maximum AS path length.

Assuming each AS number is 2 bytes and each network number is 4 bytes, give an estimate for the amount of data a BGP speaker must receive to keep track of the AS path to every network. Express your answer in terms of $A$, $D$, and the number of networks $N$. 