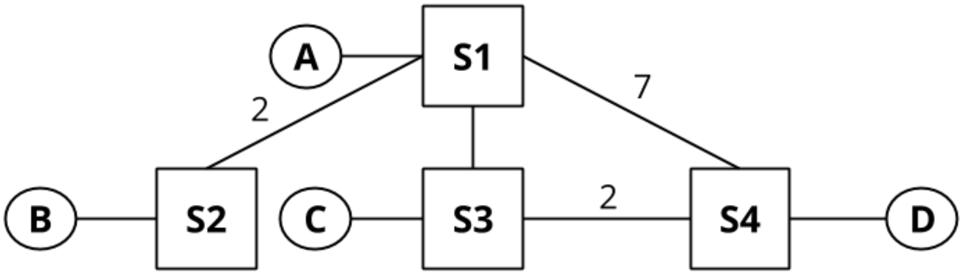
CS 168 Introduction to the Internet: Architecture and Protocols
Spring 2024 Sylvia Ratnasamy & Rob Shakir **Discussion 3: Routing**

1 Distance-Vector Routing



The nodes in the above network share routes with each other using distance-vector routing. Below are the initial routing tables for each node, and a table showing the costs for each of their neighboring links. Links without a distance provided have an implicit distance of **1**.

S1

Dest.	**NextHop, Dist.**
A	Direct, 1

S2

Dest.	**NextHop, Dist.**
B	Direct, 1

S3

Dest.	**NextHop, Dist.**
C	Direct, 1

S4

Dest.	**NextHop, Dist.**
D	Direct, 1

The following questions indicate events that happen consecutively. You can assume that no other events occur other than the ones specified. Note that all blanks may not be necessary.

EVENT: *S3 advertises its routes to S1 and S4.*

1. What do the routing tables for *S*1 and *S*4 look like after receiving *S*3's routes? (You may not need to fill in all the rows)

S1

Dest.	**NextHop, Dist.**
A	Direct, 1
C	S3, 2

S4

Dest.	**NextHop, Dist.**
D	Direct, 1
C	S3, 3

2. Which nodes among *S*1 and *S*4 are expected to advertise their routes after receiving *S*3's routes? (Assuming the advertising routes on a routing table change optimization is being used)

Solution: Since both *S*1 and *S*4 updated their shortest paths, they will both advertise their routing tables.

EVENT: $S1$ *advertises its routes to* $S2$*,* $S3$*, and* $S4$*.*

3. What do the routing tables for $S2$, $S3$, and $S4$ look like after receiving $S1$'s routes? (You may not need to fill in all columns)

S2

Dest.	**NextHop, Dist.**
B	Direct, 1
A	S1, 3
C	S1, 4

S3

Dest.	**NextHop, Dist.**
C	Direct, 1
A	S1, 2

S4

Dest.	**NextHop, Dist.**
D	Direct, 1
C	S3, 3
A	S1, 8

EVENT: $S4$ *advertises its routes to* $S1$ *and* $S3$*.* **EVENT**: $S1$ *advertises its routes to* $S2$*,* $S3$*, and* $S4$*.*

4. At this point, what path does $S2$ use to reach D, and what is the cost?

Solution: $S2 \rightarrow S1 \rightarrow S4$ with a cost of 10.
$S1$ has only heard about a route to D from $S4$. $S1$ in turn advertises this route to $S2$.

EVENT: $S3$ *advertises its routes to* $S1$ *and* $S4$*.*

5. What do the routing tables for $S1$ and $S2$ look like now?

S1

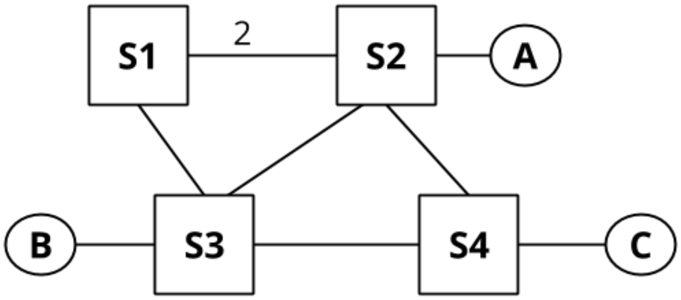
Dest.	**NextHop, Dist.**
A	Direct, 1
C	S3, 2
D	S3, 4

S2

Dest.	**NextHop, Dist.**
B	Direct, 1
A	S1, 3
C	S1, 4
D	S1, 10

Solution: $S2$ has not heard about $S3$'s routing update to $S1$ about a lower cost route to D yet

2 Split Horizon and Poisoned Reverse



All **unlabeled** links have a cost of 1. The parts of the question do *not* build on each other.

1. Assume that the routers use **split horizon**. Say that $S4$ advertises (A: 2, C : 1) to $S3$. Assuming that $S3$ has received no other advertisements, what does $S3$ now tell $S4$ about $S3$'s path to A?

   Solution: Nothing. Split Horizon means that we never tell a neighbor about paths that go through that neighbor. So in this case, $S3$ doesn't tell $S4$ about its path to A.

2. Assume that the routers use **poisoned reverse**. Routing tables have not converged and $S3$ believes its shortest path to A is through $S1$ (this path is $S3$-$S1$-$S2$ of length 4). $S3$ advertises its routes to $S4$. Now,

$S4$ advertises to $S3$. $S4$ bases this advertisement off of it's routing table which has: (B: 2, A: 2, C : 1). After recomputing its routes, $S3$ advertises its routes to $S4$. What is the advertised distance to A?

Solution: $S3$ will tell $S4$ that its distance to A is infinitely long, because $S3$'s new shortest route goes through $S4$.

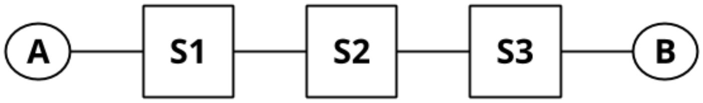
3. Consider the simple topology (A-$S1$-$S2$-$S3$). After the routing tables have converged, link $S1$-$S2$ goes down. When $S2$ advertises to $S3$ (A: ∞), is this an act of **poisoning a route** or **poisoned reverse**?

   Solution: $S2$ is **poisoning a route**. Namely, it tells $S3$ that its distance is ∞, not because $S2$'s new path goes through $S3$, but because $S2$ actually has no route now.

4. **Poisoning a route** and **poisoned reverse** might sound similar, but actually we can think of one of them as being "honest" while the other one is "lying." Which one tells the truth, and which one tells a white lie to keep the network functioning?

   Solution: Poisoned reverse encourages routers to tell a white lie. With poisoned reverse, we tell a neighbor that we have no path to a certain destination if our path goes through that neighbor. Since we actually do have a path, our message is not strictly true. On the other hand, **poisoning a route** happens when a link goes down, and we actually lose our path to some destination. Thus, we're telling the truth when we advertise a distance of ∞ to this destination (given that a infinitely long path is equivalent to no path).

3 Count to Infinity (Guided Q)



1. For part 1 of this question there is **no** split-horizon or poisoned reverse, and advertisements are only sent periodically (aka when it is explicitly stated).

   (a) What do the routing tables look like once $S1$, $S2$ and $S3$ converge?

S1

Dest.	NextHop, Dist.
A	Direct, 1
B	$S2, 3$

S2

Dest.	NextHop, Dist.
A	$S1, 2$
B	$S3, 2$

S3

Dest.	NextHop, Dist.
B	Direct, 1
A	$S2, 3$

   (b) What periodic advertisement will $S1$ and $S2$ send to each other? (One such message is given as an example)

From	To	(Destination, Distance)
$S1$	$S2$	$(A, 1)$
$S1$	$S2$	$(B, 3)$
$S2$	$S1$	$(A, 2)$
$S2$	$S1$	$(B, 2)$

   EVENT: *The link between $S2$ and $S3$ goes down.*

   (c) What will $S1$ and $S2$ send to each other?

From	**To**	**(Destination, Distance)**
$S1$	$S2$	$(A,1)$
$S1$	$S2$	$(B,3)$
$S2$	$S1$	$(A,2)$
$S2$	$S1$	$(B,2)$

Solution: (The tables did not change because no routes have expired yet.

EVENT: *$S2$'s route to B* ***finally*** *expires*

(d) After $S1$ and $S2$ exchange advertisements again, what will their routing tables look like?

S1

Dest.	**NextHop, Dist.**
A	Direct, 1
B	$S2,3$

S2

Dest.	**NextHop, Dist.**
A	$S1,2$
B	$S1,4$

EVENT: *$S1$'s route to B expires*

(e) After $S1$ and $S2$ exchange advertisements again, what will their routing tables look like?

S1

Dest.	**NextHop, Dist.**
A	Direct, 1
B	$S2,5$

S2

Dest.	**NextHop, Dist.**
A	$S1,2$
B	$S1,4$

(f) Is this good? **Solution: NO! This is called count to infinity. Both switches think they have a path to B for a long time after the path ceases to exist.**

2. For part 2 of this question there is **split-horizon**, but **no** poisoned reverse and advertisements are only sent periodically (aka when it is explicitly stated). Also, all dropped links are back up and the routing state starts out converged!

(a) What will $S1$ and $S2$ send to each other after everything has converged?

From	**To**	**(Destination, Distance)**
$S1$	$S2$	$(A,1)$
$S2$	$S1$	$(B,2)$

EVENT: *The link between $S2$ and $S3$ goes down.*

(b) What will $S1$ and $S2$ send to each other?

From	**To**	**(Destination, Distance)**
$S1$	$S2$	$(A,1)$
$S2$	$S1$	$(B,2)$

EVENT: *$S2$'s route to B* ***finally*** *expires*

(c) After $S1$ and $S2$ exchange advertisements again, what will their routing tables look like?

S1

Dest.	**NextHop, Dist.**
A	Direct, 1
B	$S2, 3$

S2

Dest.	**NextHop, Dist.**
A	$S1, 2$

(d) Will this end well?

Solution: Yep! $S1$'s route to B will expire because it has not been updated in a while.