Computer Networks

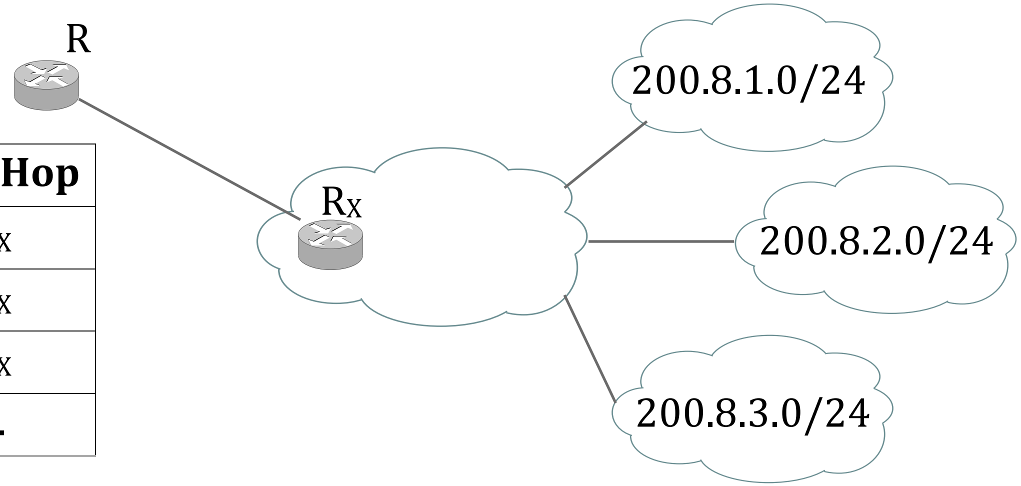
Tutorial 4:

Routing

Scope of This Tutorial

- Aggregation of routing vectors
- Distance-Vector mechanism
- Shortest Path First algorithm

Aggregation of Routing Vectors



Destination	Next Hop
200.8.1.0/24	R_X
200.8.2.0/24	R_X
200.8.3.0/24	R_X
...	...

R can aggregate these vectors

Destination	Next Hop
200.8.0.0/22	R_X
...	...

Longest-Match Rule

If destination D matches both B1/k1 and B2/k2, with k1 < k2

then the longer B2/k2 match is to be used

e.g.

Destination	Next Hop
200.8.1.0/24	R_X
...	...
200.8.1.0/18	R_y
...	...

- Such vectors are legal
- R_X is chosen for packet forwarding to obtain the most specific route

Exercise 1

Destination	Next Hop
200.0.0.0/8	A
200.64.0.0/10	B
200.64.0.0/12	C
200.64.0.0/16	D

$64_d = 0100\ 0000_b$

Destination address of a packet

a) 200.63.1.1 — $63_d = 0011\ 1111_b$

b) 200.80.1.1 — $80_d = 0101\ 0000_b$

c) 200.72.1.1 — $72_d = 0100\ 1000_b$

d) 200.64.1.1

e) 200.64.2.2

f) 200.73.2.2 — $73_d = 0100\ 1001_b$

g) 200.88.2.2 — $88_d = 0101\ 8000_b$

What is the next hop for the packets?

Exercise 2

Aggregate entries of the following tables.

Destination	Next Hop
200.128.1.0/24	X
200.128.2.0/24	X
200.128.3.0/24	X
200.128.8.0/24	T

Destination	Next Hop
200.128.0.0/16	Y
200.129.0.0/16	Y
200.130.0.0/16	Y
200.131.0.0/16	Y

Destination	Next Hop
37.149.0000 0000.0/18	A
37.149.0100 0000.0/18	A
37.149.1000 0000.0/18	A
37.149.1100 0000.0/18	B

Hint: Remember about longest-match rule

Distance-Vector Mechanism

Routing table of a router

Destination	Next Hop	Cost
A	S	3
B	T	4
C	S	5
D	U	6

Message from its neighbour S

Destination	Cost
A	2
B	3
C	5
D	4
E	2

The table after processing the message

Destination	Next Hop	Cost	Reason
A	S	3	No change; S probably sent this report before
B	T	4	No change; R's cost via S is tied with R's cost via T
C	S	6	Next_hop increase
D	S	5	Lower-cost route via S
E	S	3	New destination

Source: Peter Dordal, *An Introduction to Computer Networks*, Loyola University Chicago

Exercise 3

Routing table of a router

Destination	Next Hop	Cost
A	R1	2
B	R2	3
C	R1	4
D	R3	5

Message from R1

Destination	Cost
A	1
B	2
C	4
D	3

Link cost to R1 = 1

The table after processing the message

Destination	Next Hop	Cost	Reason
A	R1		
B	R2		
C	R1		
D	R3		

Exercise 4

Routing table of a router

Destination	Next Hop	Cost
A	R1	5
B	R1	6
C	R2	7
D	R2	8
E	R3	9

Message from R1

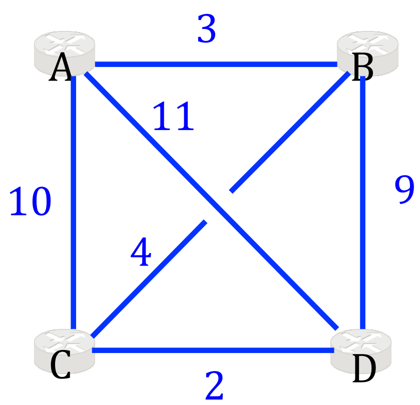
Destination	Cost
A	4
B	7
C	7
D	6
E	8
F	8

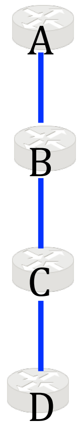
Link cost to R1 = 1

The table after processing the message

Destination	Next Hop	Cost	Reason
A	R1		
B	R1		
C	R2		
D	R2		
E	R3		

Shortest Path First Algorithm – an Example





Forwarding table of A

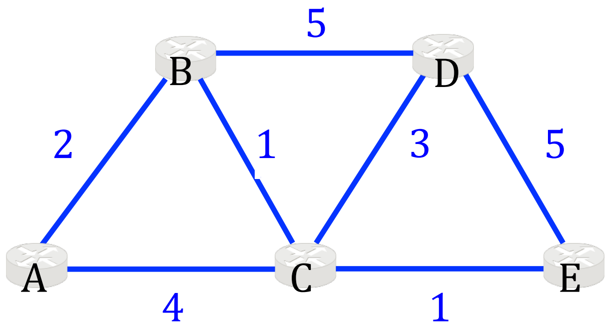
Destination	Next Hop	Cost
B	B	3
C	B	7
D	B	9

A builds a tree of shortest paths to all other routers

Step	Final Set of Paths	Current Node	Tentative Set
1		A	**<A-B, 3>** <A-C, 10> <A-D, 11>
2	<A-B, 3>	B	<A-C, 10> <A-D, 11> | **<A-B-C, 7>** <A-B-D, 12>
3	<A-B-C, 7>	C	<A-C, 10> <A-D, 11> <A-B-D, 12> | **<A-B-C-D, 9>**
4	<A-B-C-D, 9>		

Is it efficient to transmit all packets via those 3 links?

Exercise 5



Find the shortest path from A to all other routers

Step	Final Set of Paths	Current Node	Tentative Set
1		A	
2			
3			
4			