

CS144

An Introduction to Computer Networks

Routing

*Link State Protocol: Dijkstra's
shortest path first algorithm*



Nick McKeown

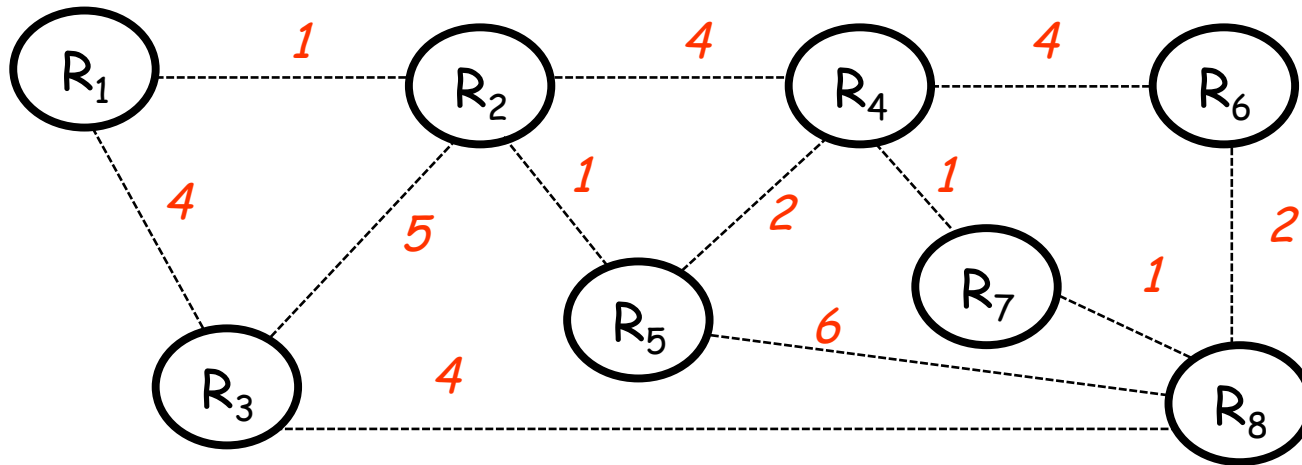
Professor of Electrical Engineering
and Computer Science, Stanford University

Dijkstra's shortest path first algorithm (example of a “Link State Algorithm”)

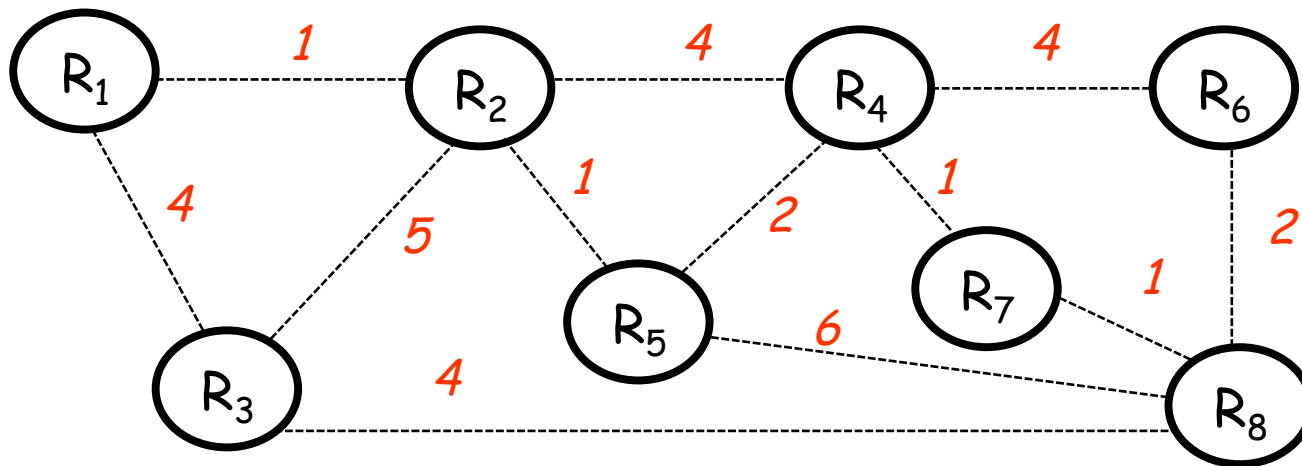
1. Exchange link state: A router floods to every other router the state of links connected to it.
 - Periodically
 - When link state changes
2. Run Dijkstra: Each router independently runs Dijkstra's shortest path first algorithm.

*Each router finds min-cost spanning tree
to every other router.*

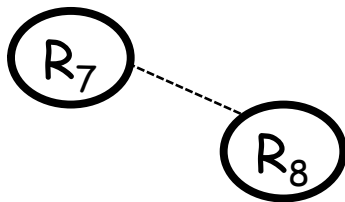
An example: From R_8



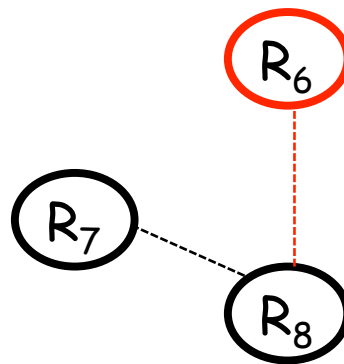
An example: From R_8



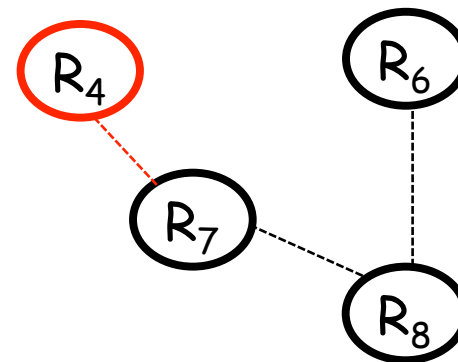
Add path of cost 1



Add path of cost 2

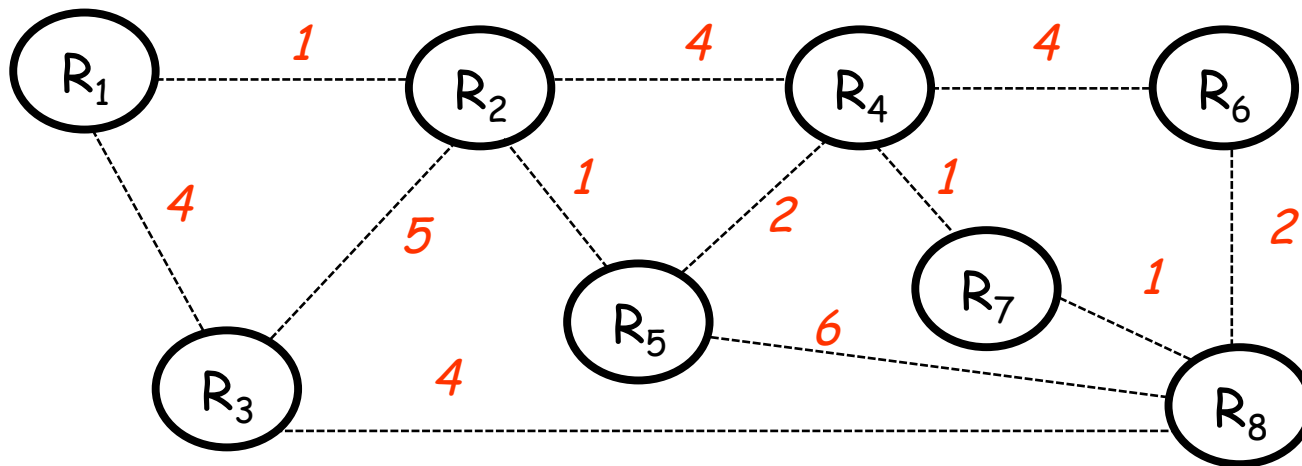


Add path of cost 2

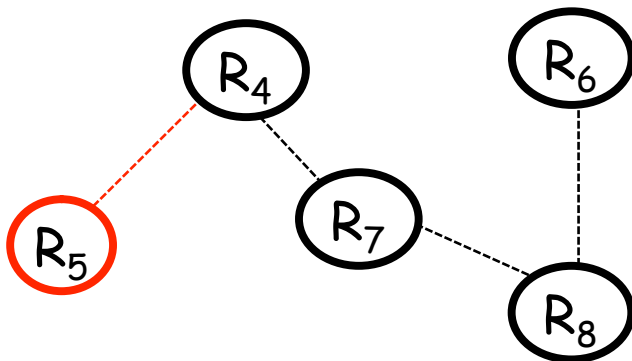


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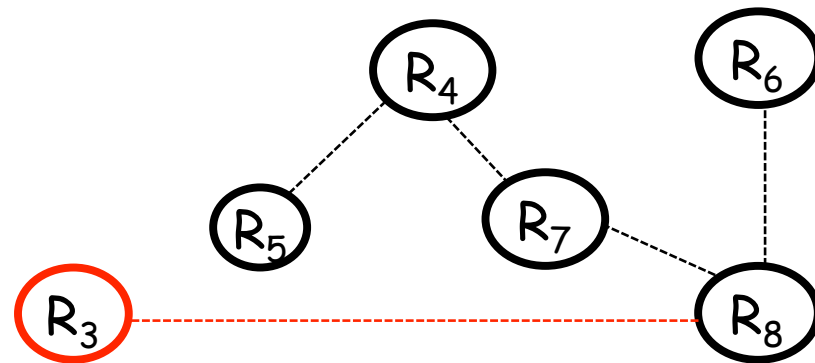
An example: From R_8



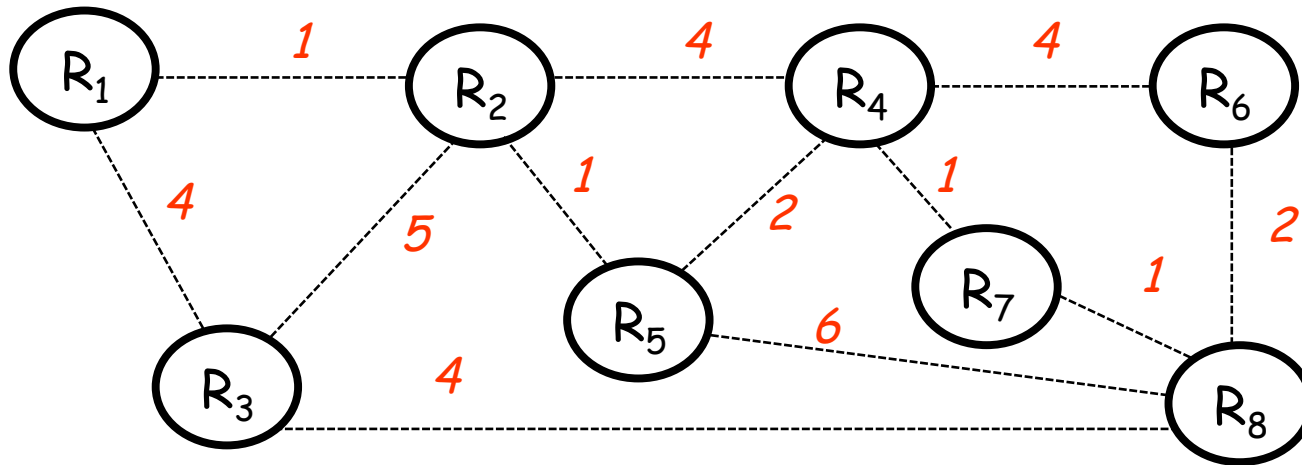
Add path of cost 4



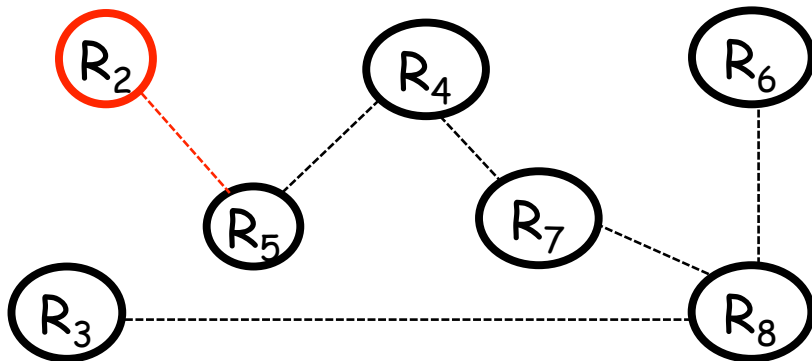
Add path of cost 4



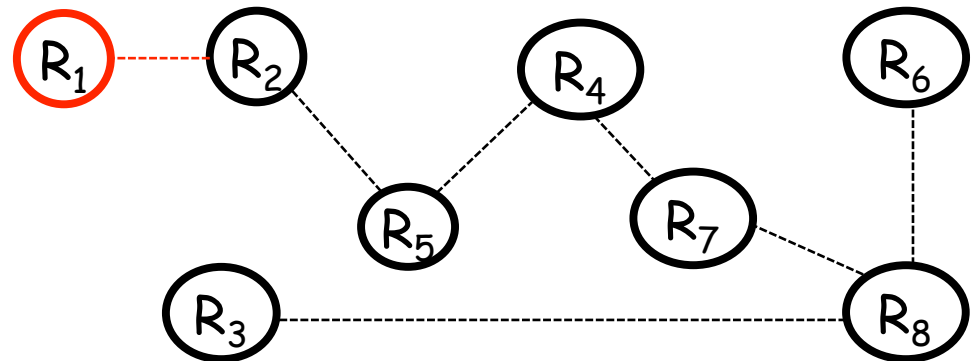
An example: From R_8



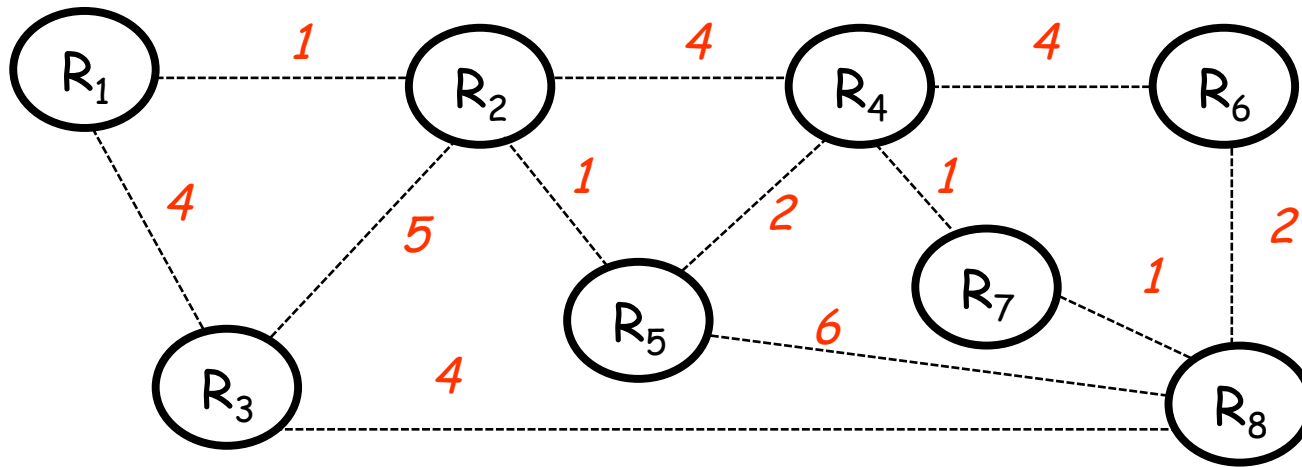
Add path of cost 5



Add path of cost 6

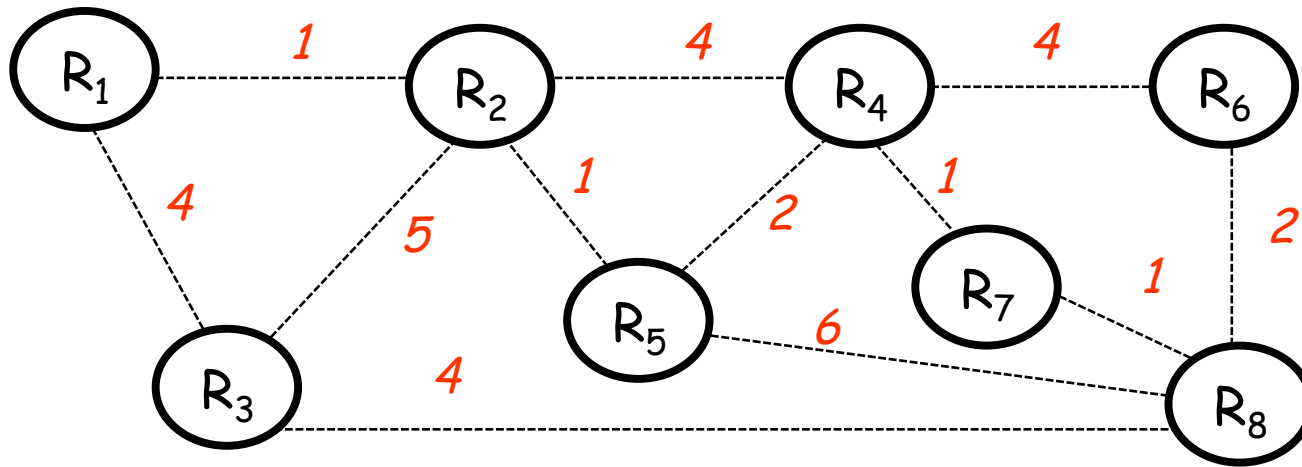


The algorithm



	0	1	2	3	4	5	6	7
Shortest Path Set	R_8							
Candidate Set	R_3R_5 R_6R_7							
Add	R_7							

The algorithm



	0	1	2	3	4	5	6	7
Shortest Path Set	R ₈	R ₈ R ₇	R ₈ R ₇ R ₆	R ₈ R ₇ R ₆ R ₄	R ₈ R ₇ R ₆ R ₄ R ₃	R ₈ R ₇ R ₆ R ₄ R ₃ R ₂	R ₈ R ₇ R ₆ R ₄ R ₃ R ₂ R ₁	R ₈ R ₇ R ₆ R ₄ R ₃ R ₂ R ₁ R ₅
Candidate Set	R ₃ R ₅ R ₆ R ₇	R ₃ R ₅ R ₆ R ₄	R ₃ R ₅ R ₄	R ₃ R ₅ R ₂	R ₅ R ₂ R ₁	R ₅ R ₁	R ₅	Empty
Add	R ₇	R ₆	R ₄	R ₃	R ₂	R ₁	R ₅	Done

Dijkstra's Algorithm

Questions:

1. How long does the algorithm take to run?
2. What happens when link costs change, or when routers/links fail?

Dijkstra's algorithm in practice

Dijkstra's algorithm is an example of a Link State algorithm.

- Link state is known by every router.
- Each router finds the shortest path spanning tree to every other router.

It is the basis of OSPF (Open Shortest Path First), a very widely used routing protocol.

Another view of Dijkstra...

