

Computer Networks

Equal-Cost Multi-Path Routing

(§5.2.1, 5.6.6)



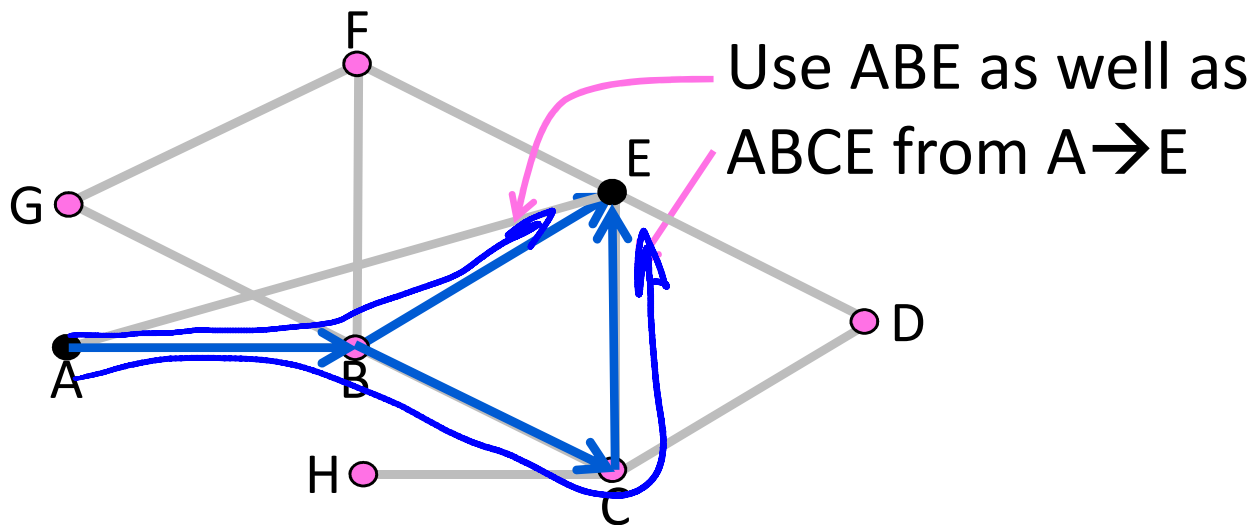
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Topic

- More on shortest path routes
 - Allow multiple shortest paths

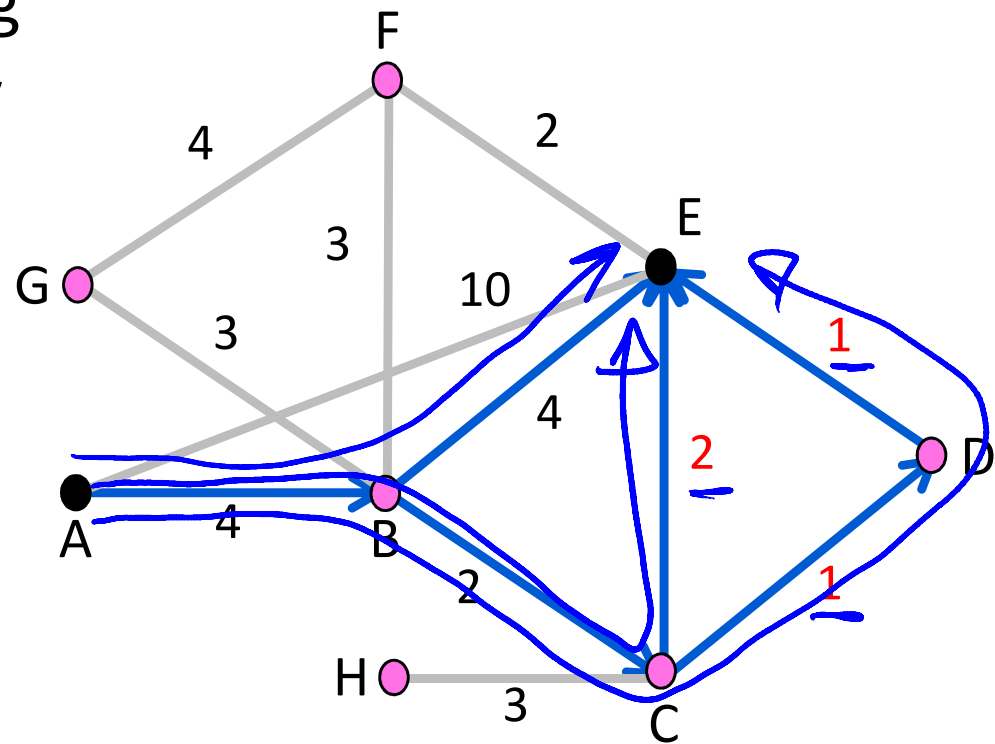


Multipath Routing

- Allow multiple routing paths from node to destination be used at once
 - Topology has them for redundancy
 - Using them can improve performance
- Questions:
 - How do we find multiple paths?
 - How do we send traffic along them?

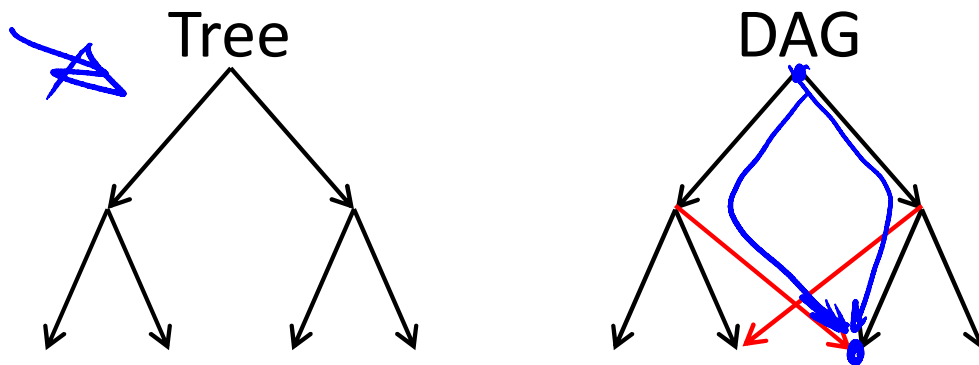
Equal-Cost Multipath Routes

- One form of multipath routing
 - Extends shortest path model by keeping set if there are ties
- Consider $A \rightarrow E$
 - $ABE = 4 + 4 = 8$
 - $ABCE = 4 + 2 + 2 = 8$
 - $ABCDE = 4 + 2 + 1 + 1 = 8$
 - Use them all!



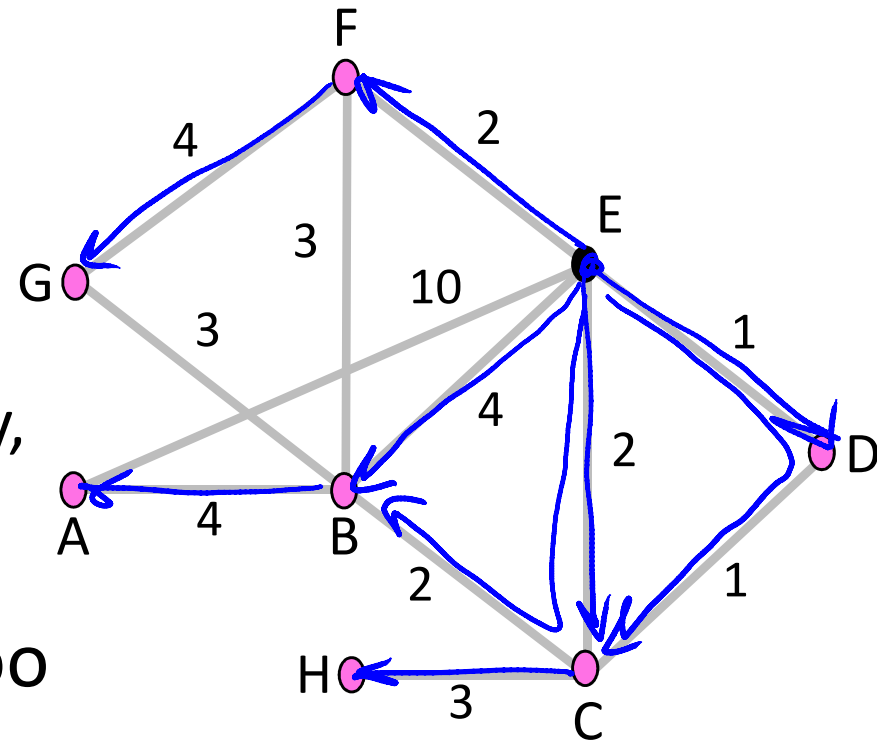
Source “Trees”

- With ECMP, source/sink “tree” is a directed acyclic graph (DAG)
 - Each node has set of next hops
 - Still a compact representation

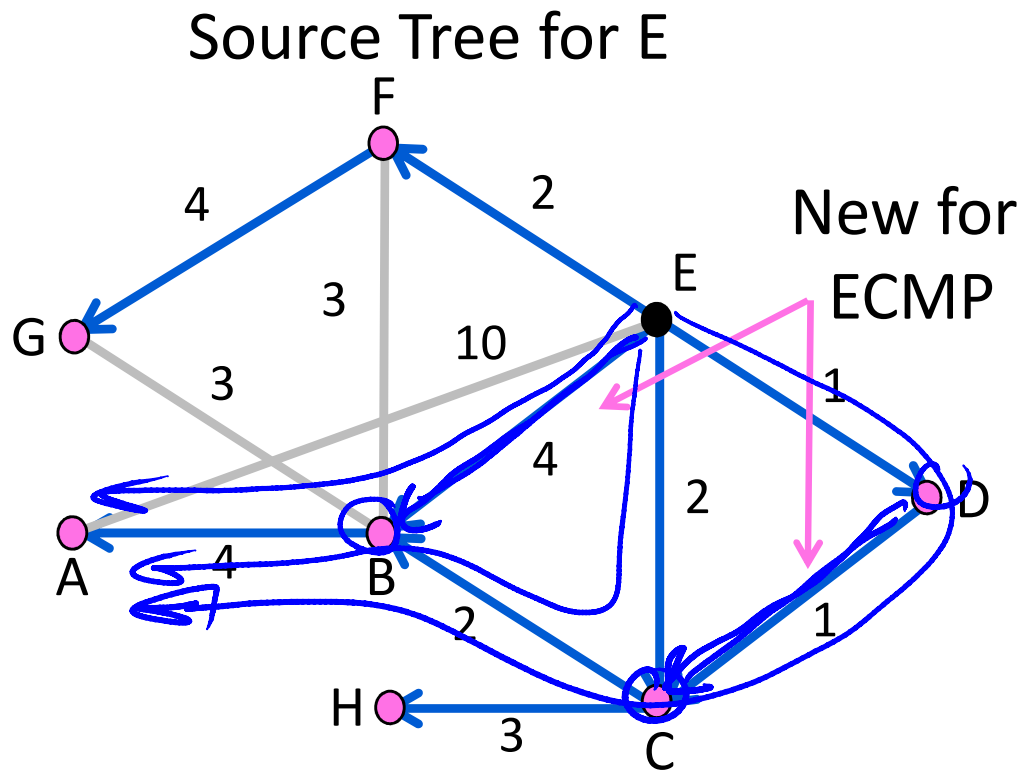


Source “Trees” (2)

- Find the source “tree” for E
 - Procedure is Dijkstra, simply remember set of next hops
 - Compile forwarding table similarly, may have set of next hops
- [Straightforward to extend DV too
 - Just remember set of neighbors



Source "Trees" (3)



E's Forwarding Table

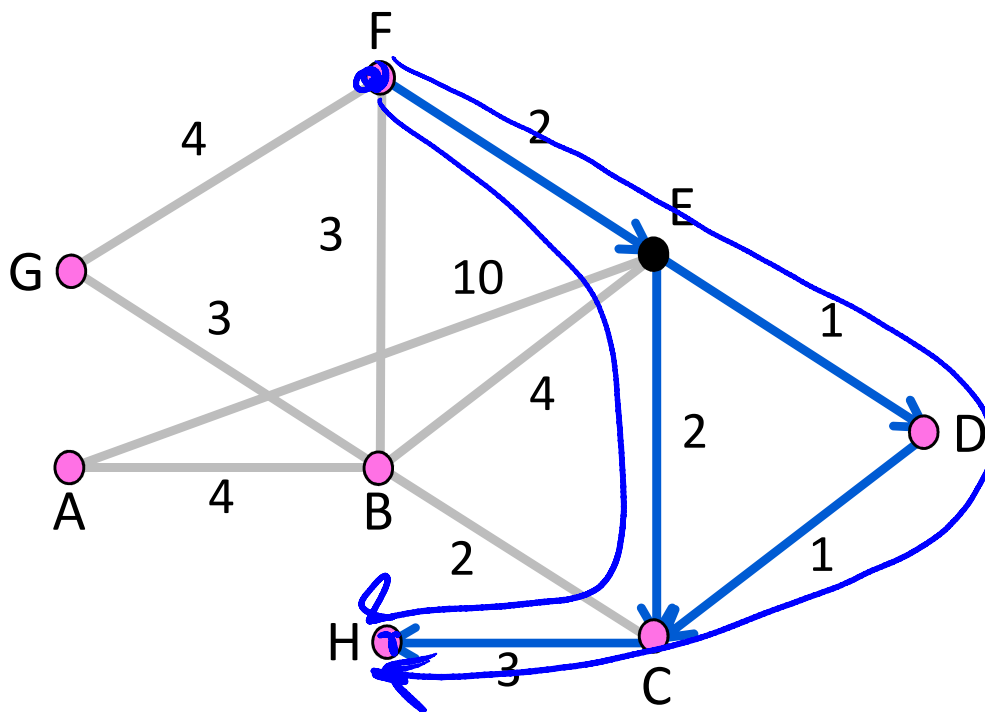
Node	Next hops
A	B, C, D
B	B, C, D
C	C, D
D	D
E	--
F	F
G	F
H	C, D

Forwarding with ECMP

- ✖ Could randomly pick a next hop for each packet based on destination
 - Balances load, but adds jitter
- Instead, try to send packets from a given source/destination pair on the same path
 - Source/destination pair is called a flow
 - Map flow identifier to single next hop
 - No jitter within flow, but less balanced

Forwarding with ECMP (2)

Multipath routes from F/E to C/H



E's Forwarding Choices

Flow	Possible next hops	Example choice
F → H	C, D	D
F → C	C, D	D
E → H	C, D	C
E → C	C, D	C

Use both paths to get to one destination

END

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