6.02 Fall 2012
Lecture #20
Failure-resilient Routing

Failures
- Problems: Links and switches could fail
  - Advertisements could get lost
  - Routing loop
    - A sequence of nodes on forwarding path that has a cycle (so packets will never reach destination)
    - Dead-end: route does not actually reach destination
  - Loops and dead-ends lead to routes not being valid
- Solution
  - HELLO protocol to detect neighbor liveness
  - Periodic advertisements from nodes
  - Periodic integration at nodes
  - Leads to eventual convergence to correct state (see Chapter 18)

Routing Loop in Link-State Protocol

B to D is via A.
Link AD fails.
A’s LSA to B is lost.
A now uses B to get to D.
But B continues to use A.
Routing loop!
Must wait for eventual arrival of correct LSAs to fix loop.

Distance-Vector: Pros, Cons, and Loops
- Simple protocol
- Works well for small networks
- Works only on small networks

Suppose link AC fails.
When A discovers failure, it sends E: cost = INFINITY to B.
B advertises E: cost=2 to A
A sets E: cost=3 in its table

Now suppose link BD fails.
B discovers it, then sets E: cost = INFINITY.
 Sends info to A, A sets E: cost = INFINITY.
Fixing “Count to Infinity” with Path Vector Routing

• In addition to (or instead of) reporting costs, advertise the path discovered incrementally by the Bellman-Ford update rule.

• Called “path-vector”

• Modify Bellman-Ford update with new rule: a node should ignore any advertised route that contains itself in the advertisement.

Path Vector Routing

E: l1; cost=2; path=[CE] E: l1; cost=1; path=[E]

E: l2; cost=2; path=[DE] E: l2; cost=1; path=[E]

• For each advertisement, run “integration step”
  – E.g., pick shortest, cheapest, quickest, etc.

• Ignore advertisements with own address in path vector
  – Avoids routing loops that “count to infinity”

Summary

• The network layer implements the “glue” that achieves connectivity
  – Does addressing, forwarding, and routing

• Forwarding entails a routing table lookup; the table is built using routing protocol

• DV protocol: distributes route computation; each node advertises its best routes to neighbors
  – Path-vector: include path, not just cost, in advertisement to avoid “count-to-infinity”

• LS protocol: distributes (floods) neighbor information; centralizes route computation using shortest-path algorithm