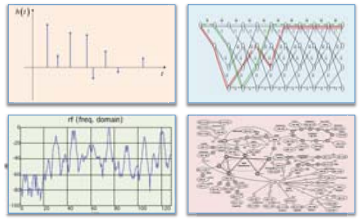


INTRODUCTION TO EECS II

DIGITAL COMMUNICATION SYSTEMS

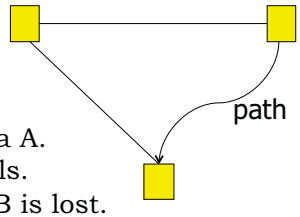
6.02 Fall 2012
Lecture #20

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)

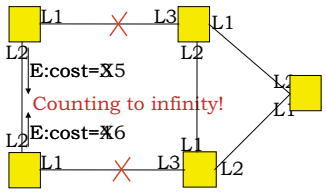
Routing Loop in Link-State Protocol



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



But what if A had advertised to B before B advertised to A?

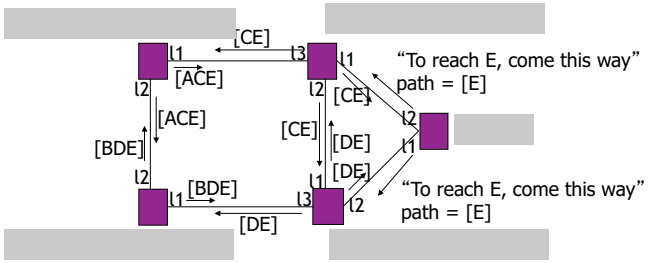
Suppose link AC fails.
When A discovers failure, it sends E: cost = INFINITY to B.
B advertises *E: cost=2* to A
A sets E: cost=3 in its table

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



- 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

6.02 Introduction to EECS II: Digital Communication Systems

Fall 2012