Panel 1

Last Time:

Network Layer

Routing

Optimization Principle
Sink Tree
Dijkstra's Shortest Path Routing
Flooding

Quiz on Monday!

Panel 2

Apply "shortest path" starting at node A
Panel 3

Adaptive Routing: Distance Vector Routing

Billman - Ford  Ford - Fulkerston
≈ 1954  ≈ 62

Original ARPANET routing alg.
was used by AppleTalk, Cisco Routers,
Novel IPX

Setup: Each router maintains table with one
entry per router on network. Each entry
has two parts:
- preferred out-going line to that dest.
- delay estimate for packets to it

Panel 4

Routing table for J

Each router maintains a

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>20</td>
<td>18</td>
<td>28</td>
<td>18</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>H</td>
<td>A</td>
<td>H</td>
<td>H</td>
<td>K</td>
<td>K</td>
</tr>
</tbody>
</table>

Table with n + 12 rows,
indexed by router label.
Panel 5

Each router knows the delay to each neighbor (via ping packet).

Panel 6

Consider a subnet with 6 routes named A, B, C, D, E, and F. Suppose that for distance vector routing the following vectors have just arrived at router C:

- from B: (5, 0, 8, 12, 6, 2) (i.e. the distance B-A is 5, B-B is 0, B-C is 8, B-D is 12, B-E is 6, and B-F is 2);
- from D: (16, 12, 6, 0, 9, 10); and
- from E: (7, 6, 3, 9, 0, 4);

The measured delays from C to its neighbors B, D, and E are 5, 9, and 6, respectively. What is C’s new routing table? Give both the outgoing line to use and the expected delay.
Panel 7

Distance vector routing problem:

Count-to-Infinity problem

Dist. vector routing: reach fast to good news but slow to bad news

Measure is # hops

A \(\infty\) \(\infty\) \(\infty\) \(\infty\) A is down

1 \(\infty\) \(\infty\) \(\infty\) \(\infty\) A goes up

1 \(\infty\) \(\infty\) \(\infty\) all know the good

1 \(\infty\) \(\infty\) \(\infty\) \(\infty\) news in 4-5

1 \(\infty\) \(\infty\) \(\infty\) \(\infty\) iterations

Panel 8

A \(\infty\) \(\infty\) \(\infty\) \(\infty\)

1 2 3 4 \(\infty\) does down

1 2 3 4

3 4 3 4 Bad news take

5 4 5 4 in quickly long

5 6 5 6 to propagate

2 6 4 6

\(\infty\) \(\infty\) \(\infty\) \(\infty\)

\(\Rightarrow\) Solution: "Split Horizon Hack"
Panel 9

Shortest Path Routing
Flooding
Distance Vector Routing

used - 1979 but replaced because of "count-to-infinity" problem

Replaced by

Link State Routing

Panel 10

Link State Routing
Each router must:

1. Discover each neighbor + network address
2. Measure delay to each neighbor
3. Construct packet with this info
4. Send packet out to every router on network
5. Construct shortest path to every other router

Monday more details...