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Due until 6 July 2007

Exercises of lecture
Mobile Ad Hoc Networks
Summer 2007

Sheet 10

SECTION 1:
DSDV and Mobility Models

1. DSDV modifies the conventional *Bellman-Ford routing algorithmn* and introduces sequence number to avoid count-to-infinity problem (or to ensure loop-freedom). Based on the MANET shown in Figure 1, construct the route table advertised by node D. This route table should contain the information on destination sequence number.

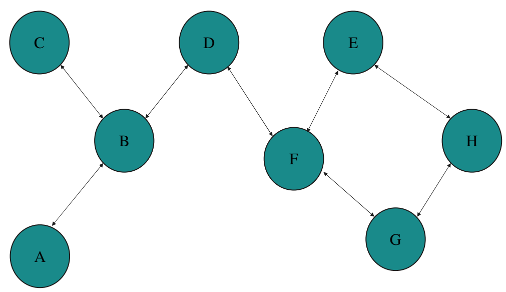

Figure 1: Topology at time, t

2. Due to node mobility, the network topology in Figure 1 changes to that illustrated in Figure 2. Based on DSDV, how does this change update the route table of each node as the results of

   (a) link addition by node A, and

   (b) link-break detection by node B?

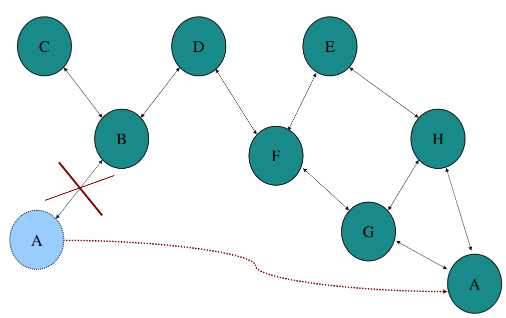

Figure 2: Topology at time, $t + \delta$

3. Suggest the mobility models that you could think of other than those found in the lecture notes.

Solutions:

1. You can construct the route table based on *Bellman-Ford algorithm*. The metric is hop count. Figure 3 shows an example answer for the route table of node D with destination sequence number for each entry:

Destination	Next Hop	Metric	Seq. No
D	D	0	S406_D
A	B	2	S128_A
B	B	1	S564_B
C	B	2	S710_C
E	F	2	S392_E
F	F	1	S076_F
G	F	2	S128_G
H	F	3	S050_H

Figure 3: Route Table (Node D)

2. It involves two procedures:

   (a) Link addition: First, node A broadcasts routing table with newly incremented sequence number of EVEN number, e.g. S130_A. Node F and H receives it and inserts the entry: $< A, 1, S130\_A >$. Then, they propagate new route info by broadcasting their own table to the neighbors. Their neighbors update their routing tables with $< A, G, 2, S130\_A >$ or $< A, F, 2, S130\_A >$ and this propagation of information continues to all nodes including node D.

   (b) Link detection: When Node B notices link break to node A, it updates hop count for node A to be infinity and increments the sequence number of node A by one to an ODD number, e.g. S129_A. (Note: In DSDV, only cases in which the sequence number is not set by the destination itself can be in ODD number.) Then, node B sends updates with new route information $< A, infinity, S129\_A >$ to its neighbors. These neighbors updates their route table for all entries by comparing the sequence number. The propagation continues to whole network.

   Loop-freedom in DSDV: Before Node B broadcasts the update info about the link break, if Node B receives route info from Node D with $< A, 2, S130\_A >$, Node B knows that it is a stale info because of lower sequence number.

   You can find a good explanation on the basic operation of DSDV in this reference document.

   (c) Extra: The main advantage to DSDV is that it maintains a loop-free fewest-hop path to every destination in the network. However, this protocol also contains both periodic and triggered route updates. While the triggered updates tend to be small (allowing quick discovery of invalid links), each node's periodic update includes its entire routing table. This means the overhead associated with those updates grows as $O(n^2)$, effectively limiting the number of nodes in the network because the need of bandwidth and the size of tables grow simultaneously with mobility and number of nodes. As a result, heavy routing overhead will degrade the performance of the network.

3. Other mobility models:
    (a) Parasitic mobility
    (b) Virtual-track based Group Mobility Model (Military or Urban)
    (c) Variation of Random Waypoint Mobility models
    (d) Social network based