Homework 5 Solutions

Networking

Problem 1:

```
88 42 30 00 38 f9 d3 90   56 5a 64 a5 c3 69 52 4d
64 a5 c3 5e ac 95 30 ca   00 00 9b aa 00 20 56 00
00 00 c2 99 19 cd bf 61   68 9f 82 f0 08 f3 66 63
…
00 20 17 00 00 00 aa aa   03 00 00 00 08 00 45 00
05 dc f1 af 40 00 35 06   00 8d 11 fd 31 c9 0a 00
```

Each byte in the hex-dump corresponds to two hex digits. Thus, the first two bytes of the frame are frame control. We expand them into binary:

and then reverse each byte

```
0001 0001 0100 0010
```

The first two bits are the version (00), the second two bits are the type (01), which incidentally is a data frame, and the next four bits is the subtype. The next byte contains flags. The one that interests us are the first two bits (01), which means To DS is zero and From DS is one. This package come from the distribution system and goes to a recipient in the BSS. The only other flag set is the Protected Flag. The next two bytes `30 00` are the duration field. After reversing the bits, we get `0000 1100 0000 0000`, which incidentally gives us a duration of 48 microseconds.

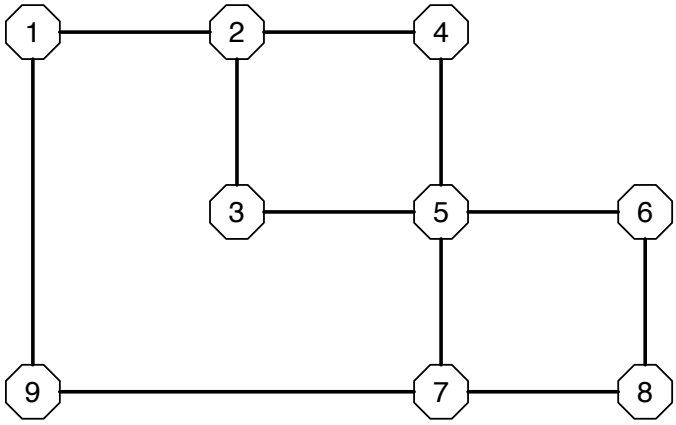
According to the DS fields, we can now interpret the addresses: 38:f9:d3:90 is the receiver, 64:a5:c3:69:52 is the access point (a.k.a. transmitter), and 64:a5:c3:5e:ac:95 is the sender, i.e. the router. You might notice that receiver and access point are manufactured by Apple.

Problem 2:

If B can overhear A's RTS, it will put the end of A's transmission time in its NAV vector assuring that B will not disrupt A's sending of the frame.

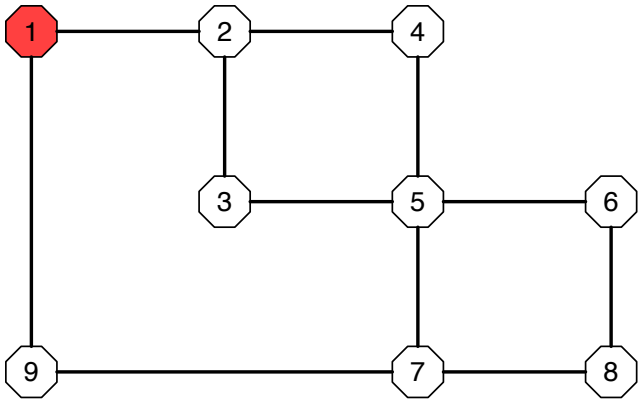
If B cannot overhear A's RTS, it still has to hear AP's CTS, because if it cannot receive any transmissions from both A and AP, it cannot interfere with any transmissions between them. Thus, B has to hear AP's CTS and then it would puts the end of A's frame transmission time into its NAV again preventing it from interfering. Thus, the only possibility for B to interfere with A's transmission to the AP is sending out its own RTS while A's RTS is still being received. Whit the right timing this will prevent the AP from receiving either RTS and B has interfered with A's transmission.

Problem 3:



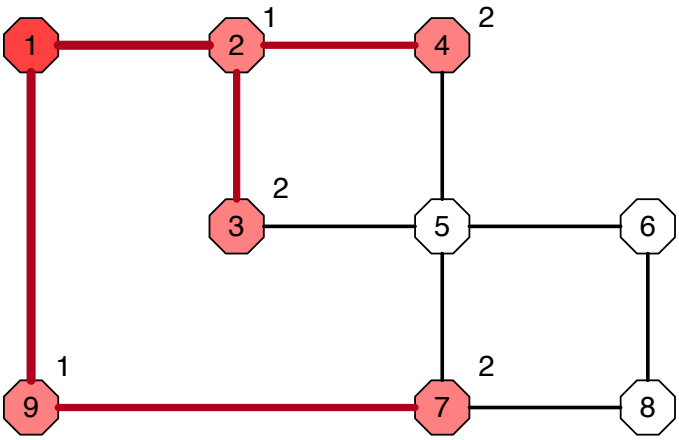
Phase 1: Select root by flooding.
All nodes pass their ID's to neighbor, which are forwarded if they are smaller than any ID seen.

At the end, all nodes know that 1 is the root and so does 1.



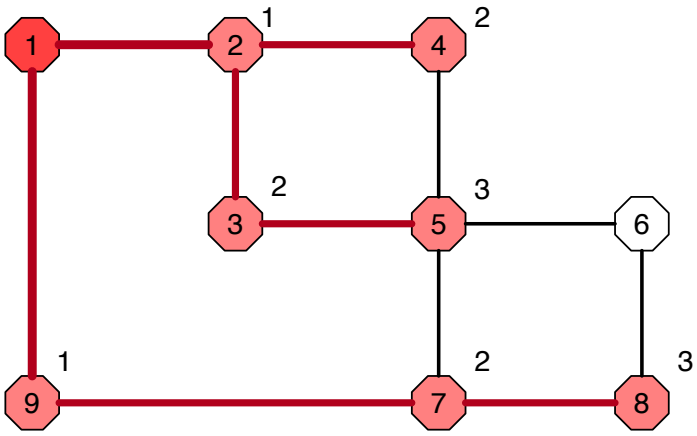
Phase 2: Round 1:

Node 1 sends join messages to its neighbors Nodes 2 and 9, who join.



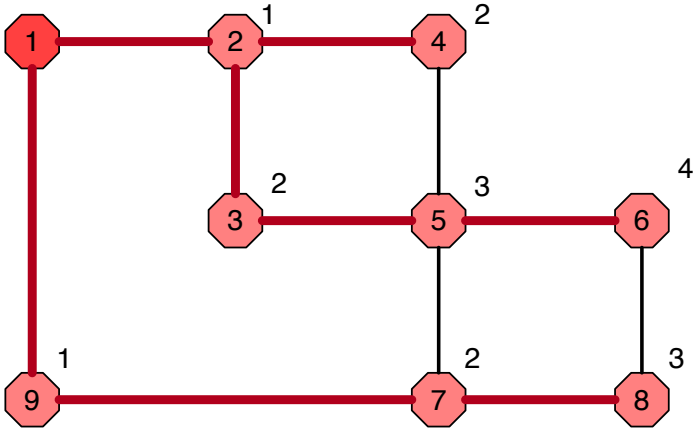
Phase 2: Round 2:

Node 2 sends join messages to Nodes 3 and 4, which join.
Node 9 sends a join message to Node 7, which joins.



Phase 2: Round 3:

Node 4 sends a join messages to Node 5.
Node 2 sends a joni message to Node 5.
Node 7 sends a join message to Node 5 and to Node 8.
Node 5 has received three Round-3 join messages and connects to Node 2 because Node 2 has the lowest ID.
Node 8 joins Node 7

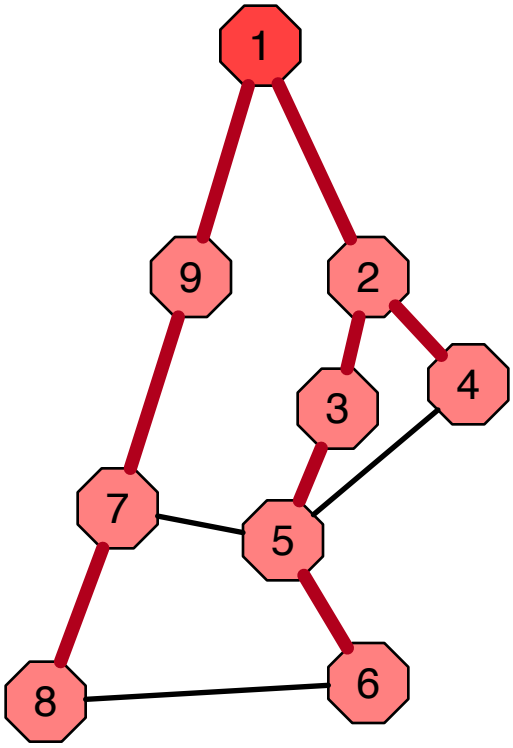


Phase 2: Round 4:

Node 5 sends join messages to Nodes 4, 6, and 7, but not to Node 3 as the connection to Node 3 is a spanning tree node.
Nodes 4 and 7 ignore the message as they are already part of the spanning tree.

Node 8 sends a join message to Node 6.

Node 6 has received two join messages and breaks the tie by lowest ID, so that it joins with Node 5.



Result: A spanning tree with root 1.