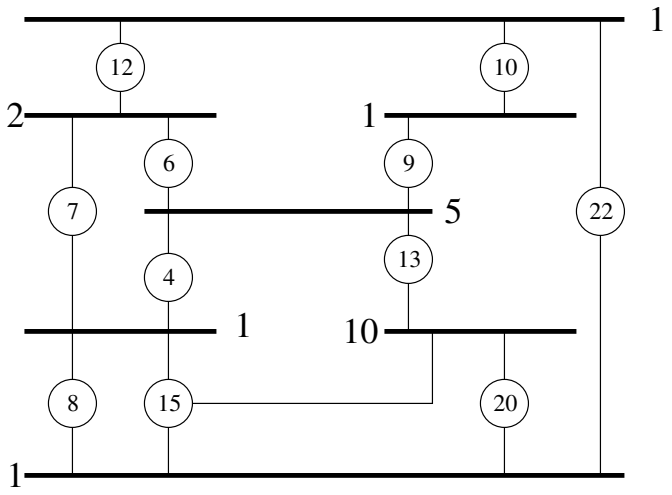
HW Solutions #5

ELEN E4710 - Intro to Network Engineering — Due 11/24/2004
Fall 2004 — Prof. Rubenstein

Homework must be turned in at the beginning of class on the due date indicated above. CVN students have one additional day. Late assignments will not be accepted.

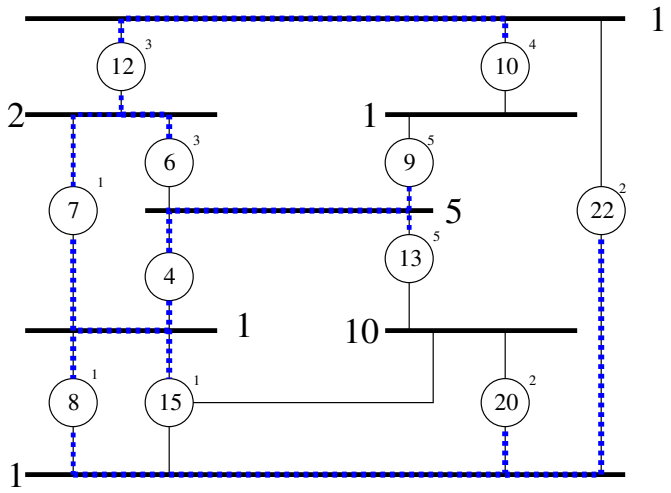


1. In the LAN above, switch IDs are indicated upon the switch, and wire weights, assigned by a network administrator, are depicted adjacent to the wire.

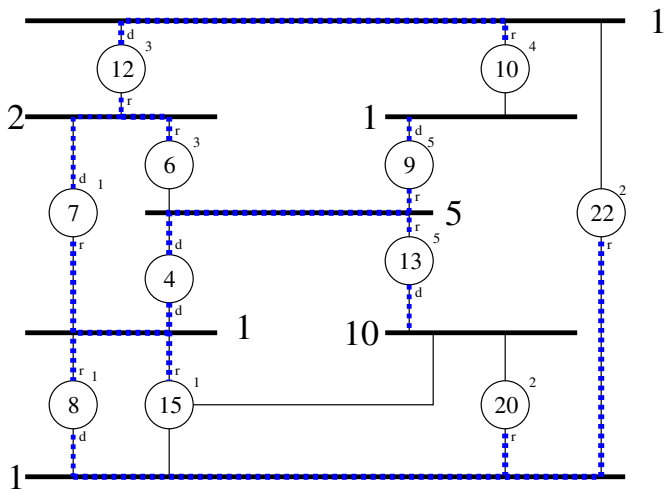
   (a) Perform the spanning tree algorithm to determine the interfaces (ports) of the switches that are turned on for forwarding.

   Ans)

   First, take the lowest IP node as the root. Calculate the SPT and the corresponding costs.

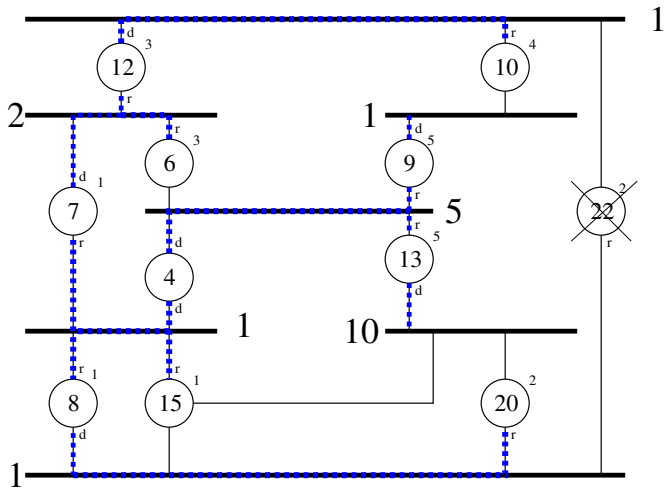


   Second, label the ports which lead to the root as r.



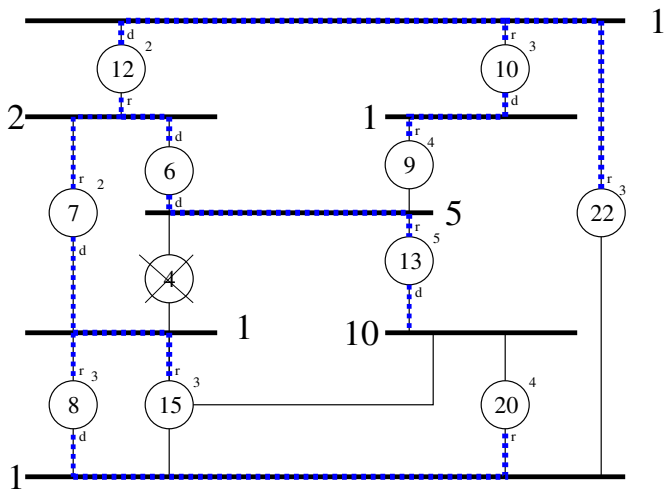
Finally, we can turn off switch $6, 9, 10, 13, 15, 20, 22$. ∎

(b) Suppose the switch with ID 22 is removed. Redraw the spanning tree after this modification.
Ans)
After we removed switch 22, the spanning tree remains almost the same as part a).



∎

(c) Suppose the switch with ID 4 is removed. Redraw the spanning tree now.
Ans)
We take a new root node. Reconstruct a spanning tree with new labels.



2. Prove the spanning tree algorithm used on LANs guarantees a single path between any pair of nodes.

   (a) First show that a path exists. Show this by showing every node can reach the root. Then, given this, describe a path between any pair of switches.

   Ans)

   After we perform the spanning tree algorithm, each node is accessible from the root by traversing the 'D' interfaces. Each node can also reach the root by following the 'R' interfaces. As a result, there exists at least one path between any pair of nodes, which goes through the root node. ∎

   (b) Show the path is unique. Show this by contradiction: assume there are two nodes with 2 paths between them (i.e., a cycle of switched). Use the fact that no switch can have both interfaces marked 'R', and at most one switch can have an interface marked with both 'D's. Show first that the root cannot lie on the cycle formed by these paths. Then show that a cycle without a root node violates a distance property.

   Ans)

   Assume there are two nodes with 2 paths between them. We have the following two cases:

   Consider the case when the root is on this cycle. All interfaces of the root are 'D' types. Starting from the root, all routes take a 'D' interface followed by an 'R' interface, and so on. Therefore, on the cycle, there exists some node which has both interfaces marked 'R' - but it's impossible.

   Consider the case when the root isn't on this cycle. Because we have the property that each time you take an 'R' edge followed by a 'D' edge, you move toward the root, and hence the distance measure must decrease by taking such paths. If you have a cycle but never get to the root, this distance cannot increase indefinitely - this is a contradiction.

   ∎

3. Draw the trie structure that maps addresses to the interface corresponding to the longest matching prefix in the table below:

prefix	interface
0	2
1	2
01	1
111	1
011	3
0110	1
1011	3

Ans)