DISTRIBUTED HASH TABLES / P2P NETWORKS

1. You are making your very own instant messaging service over a generic DHT Overlay Network.

   a) What would be the keys and values for this service in order to provide the basic functionality of instant messaging? Describe how you then would use `lookup()` and `put()` to achieve these.

      Answer
      1) Check if a user is logged into the system.
      2) Send an instant message to that user have them receive it right away.
      In order to log in a user does a `put` on their name (or basically a numeric hash of their name) with some information on how to reach them. The DHT nodes can then keep this information. When someone asks if a user is logged in, all it has to check is if it has that user at its node if it is responsible for it. Similarly, a user can do a `lookup` on the user name that it wants to contact, and then the DHT node just passes that message on if the user exists in the system.

   b) Now assume you want to implement chat rooms without modifying the above model. Assume that you know the names of all users in a chat room. How would you:

      1) Check if all the users in the chat are logged into the system.
      2) Send an instant message to all those users and have them receive right away.

      Note that by the ‘design’ nature of these questions, there are a wide variety of solutions that are acceptable, as long as you are able to provide strong justification of the engineering trade-offs made.
      1) You can do it inefficiently and just do a lookup on each user. You can also use chat room IDs, and do a `put` on the ID number and the value would be all the users in that chat room. Then when users leave the system we can always check who is online because the group ID would be updated (preferably using soft state).
      2) Send the message to the user with the smallest ID number, then have that user pass it on to the next user with the smallest ID. This message would then effectively be multicasted, since only one message is being forwarded to all.
MULTICAST

In the given network, the circles represent routers, S is the sender of a multicast message and G is the receiving group for this message. The numbers on each line represent the cost function of each link.

a) How will the payload packets for a multicast message for group G from source S propagate through this system?
b) Show explicit NMR signals, if any, sent in order to set up the multicast network?
c) For the PIM and SSM networks, show the path of the explicit join signals, if any, sent in order to set up the multicast network?

Complete the above question for each of the following systems.
1. Link State
2. DVRMP – RPF
3. DVRMP – RPB
4. DVRMP - TRPB
5. PIM (CBT)
6. SSM

a) (Solutions shown in orange)
b)&c) (Solutions shown in red)
Link State

DVRMP – RPF
PIM (CBT) and SSM