## Question 3 - RPR

1. The average distance for a message from a station chosen at random, uniformly from stations 1,2,…,x. Is no different than the average distance from any station to any station, and remains:
2. Divide the stations into two groups any station which is required to go through all the stations to reach station . Group any station which is not required to go through all stations to reach .

For a messages :

Average distance is the same as found in a.

Probability is the likelihood of selecting a station from group multiplied by the likelihood of selecting a *different* station from

For messages :

Average distance is farthest distance to travel minus shortest distance to travel divided by 2.

Probability is the likelihood of selecting a station from group multiplied by the likelihood of selecting a station within .

For messages :

Average distance is farthest distance to travel minus shortest distance to travel divided by 2.

Probability is the likelihood of selecting a station from group multiplied by the likelihood of selecting a station within .

In total the average distance is:

1. The efficiency is

The efficiency for this is:

1. This question now is very similar to the one we saw in the recitation, we can put a “mock” station which will not be counted on cross line and it becomes very similar

For messages we get an average distance of , with probability of

For messages we get an average distance of , with probability of

For messages we get an average distance of , with probability of

For messages we get an average distance of , with probability of

Overall average distance is

1. The utilization therefore is:

## Question 4 – Bitmap

1. The time to transmit a message is given by the equation

Bitmap transmit time is as shown in the recitation

In average of the stations wants to transmit. The propagation time for all windows is the number of windows desired to transmit multiplied transmission time, with the propagation time added for a single window. In total we get that time to send a window of data is:

Utilization is:

1. As we can see if the rate increase by 2 the overall utilization will decrease! This is due to the fact that the denominator will increase causing the overall fractions to decrease.
2. If a station transmits and another station registers a for that station, it will wait for the transmission to complete, causing overall utilization to decrease. This is caused by adding the probability multiplied by the stations and wait time.