Post Disaster Communication Network Analysis using ONE Simulator

In this document, we observed extensive post disaster communication network analysis based on latency aware four tier planned hybrid architecture using customised Opportunistic Network Environment Simulator and it shows high promise for the success of the architecture in real-life scenario as well. We are customizing ONE simulator; specifically designed for DTN for the simulation of post disaster communication network using distinct type of module for different technologies (e.g Wireless Tower, Sat Phone), for routing stratiges as well as our derived mobility model(e.g postoffice cluster mobility model). Three major modifications were required in the simulator to fulfill the desired needs. First was to implement a mobility model required in a post disaster scenario, second to incorporate the satellite phone module and third was to restrict the message transfer to decrease the load on the network.

Simulation Setup:-

Simulation was carried out using customized ONE Simulator for the area of Sundarban, India; an area of 225sq.km was divided into 19 SPs with a density of 10 smart phones per SP, each having a data rate of 8Mbps and coverage range of 10m and following the Post Office Cluster movement model. These nodes followed the Epidemic routing strategy for message transfer. These nodes only interacted with either other smart phones or the DB at the centre. The velocity of DMs was restricted to 10 km/hr. These DMs moved between the group centre SP to the other SPs in a pre-defined time setup. The pause time at each SP was fixed and the DM only paused at a SP once in a turn. The DMs were restricted to interact only with the group DBs and take messages only if it was entitled for some device outside the cluster it is presently in. The WTs at the group centres had a coverage range of 9 kms. We have consider two traffic model -(i)In first case all the message transmission from on-field smart phones to MCS (50% are Normal (NM) and 50% Emergency Message(EM) (ii)In second case 80% message transmission from on-field smart phones to MCS and 20% message from MCS to DTN(40% NM, 40% EM and 20% from MCS).

The simulation was run for two values of AT; 160 minutes and 200 minutes. The first required a total of 8 WTs and 11 DMs in both the stages, while the latter required 7 WTs and 11 DMs in 1st stage, 12 DMs in 2nd stage. The data-rates for each type of devices had been set based on lab-based experimental values. Simulations were run in 2 stages: (i)Stage1: shelters points minimally connected via pathways (ii) Stage2: shelter points with 30% redundant pathways .Location of WTs and mule trajectories were slightly modified in Stage2 to utilize newly recovered pathways.

Results and Discussion:

2nd stage graph requires few movements in deployment location of WT as shown in figure 2 with better improvement than previous one (figure 1).

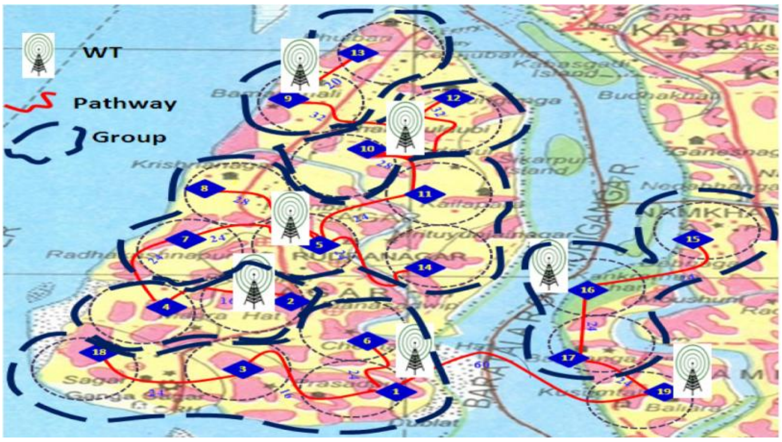

Figure 1: 1st stage graph with AT 200

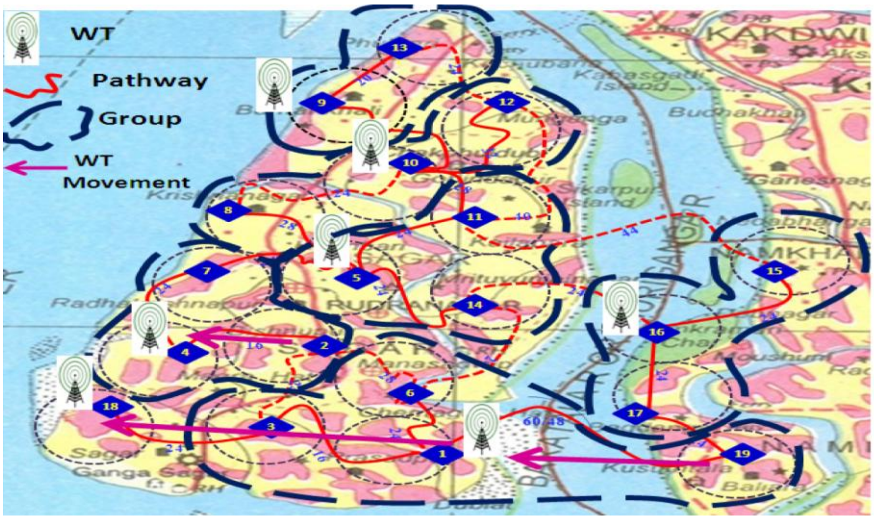

Figure2: 2nd stage graph at AT 200 with group modification & WTs movement

Figure 3 suggests that the decrease in AT results in an increase in the delivery probability. We have also seen from the Figure 5 that in low load (26000 packets in 37 hrs simulation time) our architecture provides higher delivery probability compared to high load (70000 packets in 37hrs simulation time) irrespective of variation of AT.

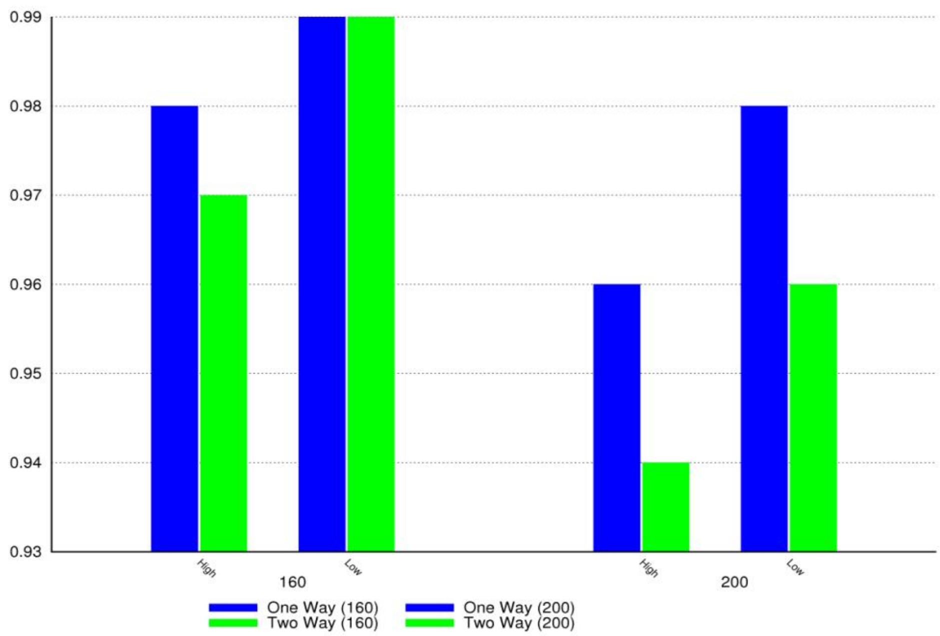

Figure 3: Latency vs. Delivery Probability

Figure 4 and 5 show the variation of cumulative delivery probability with time for the two ATs, for a low load scenario. We can observe that there is negligible impact on the delivery of the emergency messages on changing AT, because of the presence of sat-phones. But the rest are more relied on the number of WTs for long distance transfer. Since, there are more WTs incase of low AT, hence it shows higher delivery probability.

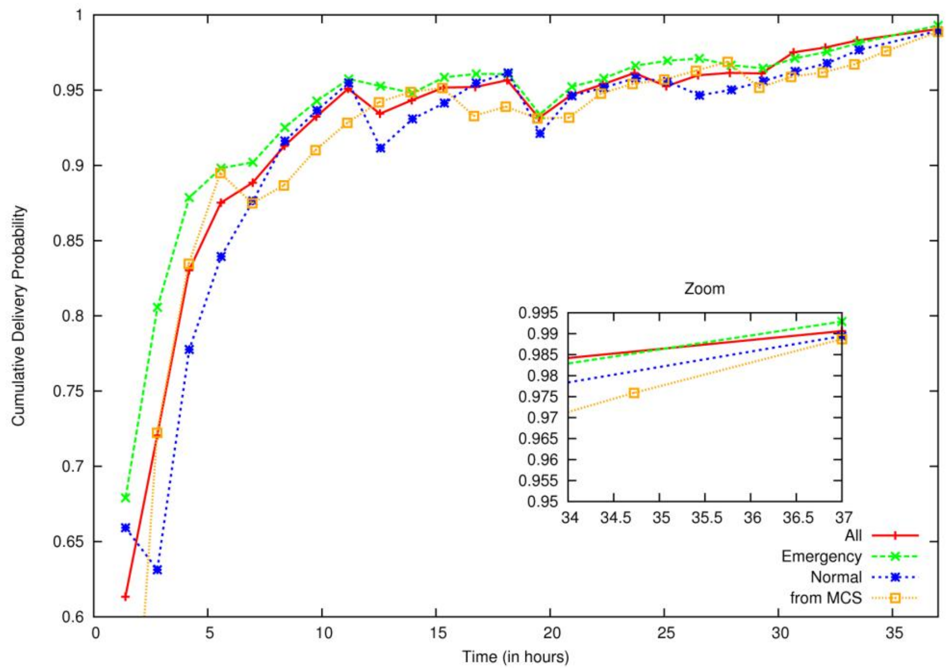

Figure 4: Time vs. Delivery Probability in 160AT with Low Load (Two Way Message)

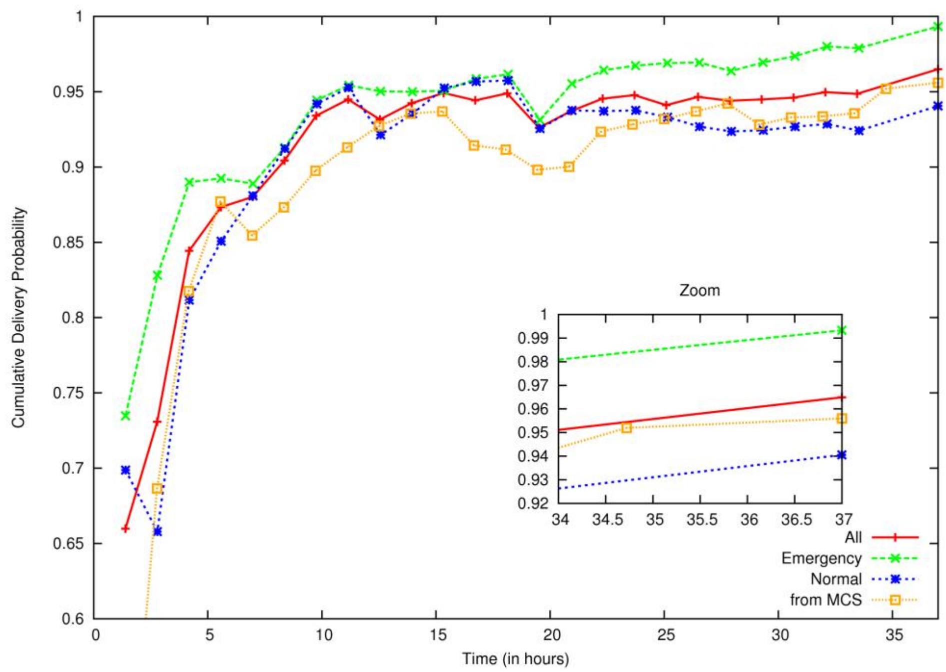

Figure 7: Time vs. Delivery Probability in 200AT with Low Load(Two Way Message)