A Hybrid Data Forwarding Approach For Opportunistic Networks

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ABSTRACT

Opportunistic networks is one of the recent paradigm of mobile Ad hoc networks. It is a network of wirelessly connected nodes. Nodes are connected only for a shorter period of time. In this research we developed a hybrid-data forwarding approach Spray with Probability Routing Protocol(SPROP) routing which utilizes the Spray and Wait routing forwarding strategy that is "sprays" a number of copies into the network, and then "waits" till one of these nodes meets the destination, and exploits an important social features of it and apply the PRoPHET routing forwarding strategy, to the spraying phase.

According to the Simulation results, SPROP increases the delivery ratio and decreases the average latency, compared to PRoPHET and Spray and Wait routing forwarding strategies.

Figure 1: Example of communication in Opportunistic Network

OBJECTIVES

The random way-point mobility model is popular to use in evaluations of mobile ad hoc protocols, real users are not likely to move around randomly, but rather move in a predictable fashion based on repeating behavioural patterns such that if a node has visited a location several times before, it is likely that it will visit that location again. So here we used that concept to achieve following objectives,

- The main objective of this research is to propose a hybrid forwarding algorithm that can maximize the message delivery ratio, and reduced packet duplication and the average latency in to the network.
- And the other objective is understanding the background of PRoPHET routing and Spray and Wait routing to extract related information to the new protocol.

METHODOLOGY

Experimental Setup

- Simulator: The ONE
- Wireless technology : Bluetooth
- Transmission range : 10m
- Transmission speed : 250 kbps
- Map Size
  - ✓ Width : 4500m
  - ✓ Height : 3400m
- Simulation time : 5000 seconds
- Simulation configuration consists of
  - ✓ Varying message size
  - ✓ Varying time-to-live time
  - ✓ Varying buffer size

SPROP Routing

- The source node **a** and the encountered node **b**, and their delivery probabilities Pa,b ϵ [1, 0].
- Node **a** wants to send the message to the destination node **d**.
- If node **a** encounters node **b,** node **a** checks that encountered node b is destination node or not.
- If it is destination node, then node **a** hands over the messages to the node **b**.
- If it is not, then node **a** checks if Pb,d > Pa,d , that is node **b** has more chances to meet destination node **d** than meeting the destination node to node **a** .
- If it is true, then node **a** will hand over half of its copies to node **b** and update both nodes, their delivery predictabilities and the summary vectors.
- Otherwise, node **a** will not give any copy to node **b**. After that nodes **a** and **b** will both act like source nodes and hand over half of their copies to encountered nodes, if they are satisfied with the above condition.
- The process continues to find the destination node until the source node have one copy. It is the final stage of the spray phase. After that these nodes enter the wait phase. That means nodes opt for the direct transmission to find the destination node.

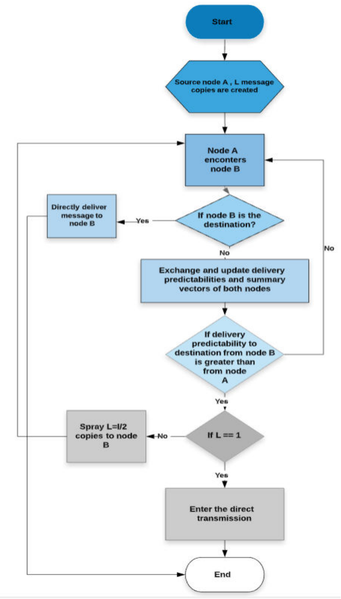

Figure 2 : Flow chart of the proposed SPROP routing

RESULTS

Performance Metrics

$$Delivery\ Probability = \frac{Number\ of\ message\ received}{Number\ of\ message\ sent}$$

$$Overhead\ Ratio = \frac{Number\ of\ message\ forwarded - Number\ of\ message\ received}{Number\ of\ message\ received}$$

$$Latency\ Average = \sum_{i=1}^{n} \frac{Time\ when\ message\ received - Time\ when\ message\ produced}{Number\ of\ message\ received}$$

Results

Varying message sizes

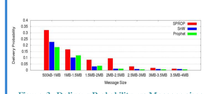

Figure 3: Delivery Probability vs Message sizes

Increasing value of message size gives impact to decrease of delivery probability. It is since where unsuccessful to relay message to other nodes.

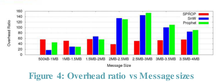

Figure 4: Overhead ratio vs Message sizes

Increasing value of message size gives impact to tend for increasing overhead ratio. It is since where unsuccessful to relay message to other nodes because of buffer already full due to of those message.

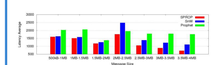

Figure 5: Latency Average vs Message sizes

Result of experiment describes increasing value of message size gives impact to decrease the latency average.

Varying time-to-live time

Figure 6: Delivery Probability Vs Time To Live

Increasing value of time to live gives impact to increase the delivery ratio. TTL helps limiting number copies of message in network.

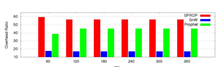

Figure 7: Overhead Ratio Vs Time To Live

Increasing value of time to live gives impact to decrease the overhead ratio.

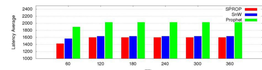

Figure 8: Latency Average Vs Time To Live

Increasing value of time to live gives impact to increase the latency average. It is since lifetime of message increase the message have to wait longer in buffer before it is either delivered toward destination node or dropped message when lifetime expired.

Varying Buffer size

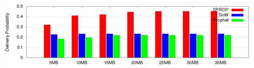

Figure 9: Delivery Probability Vs Buffer Size

Increasing value of buffer size gives impact to increase of delivery probability. It means if the network has high buffer size then many messages can stored on buffer.

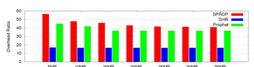

Figure 10: Overhead Ratio Vs Buffer Size

Increasing value of buffer size made value of overhead ratio decreasing. It is because when buffer size of network increases then messages dropped is less then delivery probability will increase.

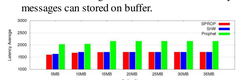

Figure 11: Latency Average Vs Buffer Size

Increasing the value of buffer size make the latency average is higher also.

CONCLUSION

- In this research, we propose the Spray with Probability Routing Protocol (SPROP) for opportunistic networks. In SPROP, a delivery probability function is set up to direct the different number of copies to the destination during the spray phase; and the last one copy is directly delivered to the destination node in the wait phase. We evaluate the proposed SPROP routing under the ONE simulator in different scenarios, simulation experiments show that the proposed SPROP outperforms the other routings (Spray and wait, PRoPHET) in terms of the delivery probability, the overhead ratio and latency average.
- Compare with other algorithms, the proposed routing SPROPs' overhead ratio is relatively high, but its other two performance merits make up the shortcoming. The analysis shows that the proposed SPROP specially adapted for the frequently disconnected opportunistic network.

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