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Multihop Communication In Delay Tolerant Network

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Abstract — *Most routing protocols in DTN uses redundant transmission to reduce data transmission delay. Delay/Disruption Tolerant Network is designed for intermittently connected network where network partitions are frequent and very high delays are associated with some links. Due to lack of consistent connectivity, DTN routing usually follows store-carry-and-forward; i.e., after receiving some packets, a node carries them around until it contacts another node and then forwards the packets. Routing is one of the major issues affecting the overall performance of DTN networks in terms of resource consumption and data delivery. This paper contains survey on multihop communication in DTN.*

Keywords- *DTN, PROPHET,DIF, PIF*

I. INTRODUCTION

Today's Internet architecture and protocols are perfectly suitable for well-connected users, but may easily experience serious performance degradation and entirely stop working in more challenged networking environments. Such environments are ranging from mobile users experiencing frequent disconnections to communication services for remote areas, to vehicular network communication in large areas, sensor networks or wildlife monitoring and to space and underwater communications. These scenarios suffer with two problems: the first is that an end-to-end path between two communicating nodes may not exist at any single point in time and that communication delay may be significant.

II. DTN Architecture

The DTN architecture implements store-and-forward message switching by overlaying a new protocol layer called the BUNDLE LAYER. The bundle layer ties together the region specific lower layers so that application programs can communicate across multiple regions.Bundles are also called messages. The bundle layer stores and forward entire bundles (or bundle fragments) between nodes. A single bundle-layer protocol is used across all networks (regions) that make up a DTN. The layers below the bundle layer are chosen for their appropriateness to the communication environment of each region. The above figure shows the working of bundle layer and compares internet protocol layers with DTN protocols layers.

III. Routing in DTN

Routing is one of the key components in DTN. Based on different types of network condition, different routing protocols are required. To cope with intermittent connectivity, one approach is to extend store-and-forward routing to store-carry-forward routing. In store-carry-forward routing, a next hop may not be immediately available for the current node to forward the data. The difficulty in designing protocol for efficiently and successfully delivering messages to their destination is to determine, for each message, the best nodes and time to forward. If a message cannot be delivered immediately due to network partition, the best carriers for a message are those that have the highest chance of successful delivery, that is, the highest delivery probabilities.

Routing Protocols in DTN:

Routing protocols of DTN are classified in two categories:

1. Flooding based routing protocols
2. Forwarding based routing protocols.

IV. DIF & PIF

DIF & PIF are multihop routing protocol designed for DTN. Two algorithms are proposed namely DIF (Delay-Inferred Forwarding) & PIF (Probability Inferred Forwarding) to find the optimal forwarding path by minimizing the expected delay and by maximizing the expected probability using hop-count forwarding scheme .[1]

Algorithm 1: Calculation of $D_{i,d,k}$ in DIF

1. N ← the number of nodes
2. $I_{i,j}$ ← the mean intermeeting time of node i and j
3. Initialize $D_{min}=D_{i,d,k-1}$

for j in 1……….N do
    if $j \neq i$ and $j \neq d$ then
        if $I_{i,j}/2 + D_{j,d,k-1} < D_{min}$ then
            $D_{min} = I_{i,j}/2 + D_{j,d,k-1}$
        end if
    end if
end for
$D_{i,d,k} = D_{min}$

The steps of forwarding in the DIF algorithm can be listed as follows.

• Let the remaining hop count be k and the expected delay between the node i and the destination node d be $D_{i, d, k}$.

• Suppose that for the remaining hop count k − 1, the expected delay between the node j (that i meets with) and the destination node d is $D_{j, d, k-1}$.

• If $D_{j, d, k-1} < D_{i, d, k}$, forwarding the message to j will decrease the expected delay D; therefore, i will forward the message.

• If $D_{j, d, k-1} \geq D_{i, d, k}$, forwarding the message to j will either increase the expected delay D or keep it the same; therefore, i will not forward the message.

Algorithm 2: Calculation of $P_{i,d,k}$ in PIF

N ← the number of nodes
$I_{i,j}$ ← the mean intermeeting time of node i and j
$M_{i,j}$ ← the meeting probability of node i and j
T ← the time slot width
Initialize $P_{max} = P_{i,d,k-1}$
for j in 1………N do
    if $j \neq i$ and $j \neq d$ then
        $M_{i,j} = 1 - \exp(-T/I_{i,j})$
        if $M_{i,j} \times P_{j,d,k-1} > P_{max}$ then
            $P_{max} = M_{i,j} \times P_{j,d,k-1}$
        end if
    end if
end for
$P_{i,d,k} = P_{max}$

The steps of forwarding in the PIF algorithm and thus can be listed as follows.

• Let the remaining hop count be k and the expected probability between the node i and the destination node d be $P_{i,d, k}$

• Suppose that with the remaining hop count k − 1, the expected probability between the node j (that i meets with) and the destination node d is $P_{j, d, k-1}$.

• If $P_{j, d, k-1} > P_{i, d, k}$, forwarding the message to j will increase the expected probability; therefore, i will forward the message.

• If $P_{j, d, k-1} \leq P_{i, d, k}$, forwarding the message to j will decrease the expected probability or keep it the same; therefore, i will not forward the message.

Network coding is a packet delivery scheme for distributed networks. It differs from the classical "receive and forward" paradigm as information packets are encoded at intermediate nodes in the network and subsequently forwarded according to a store, code, and forward approach. The strength of this strategy consists of the coding phase which improves the dissemination efficiency and reduces the number of transmissions required to deliver the data. Although network coding schemes require some data processing at intermediate nodes to code/decode packets, it has been proven that simple coding operations, e.g., linear coding, are sufficient to

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V. Network Coding

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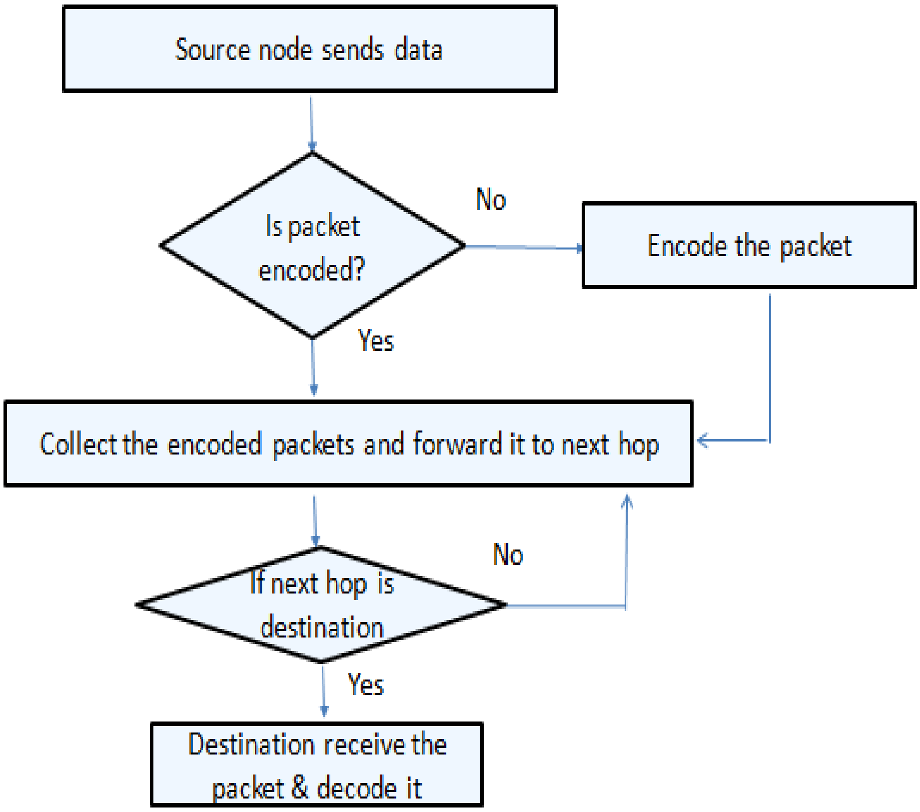

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