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Direction Sensitive Approach for Context Based Mobility Model

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Abstract: *Next Generation Networks (NGN) has new paradigm that aims to provide seamless connectivity to users in distributed computations regardless of their location. To realize this aim, it is necessary to study, design and develop algorithms and procedures for handover management of NGN. Mobility models play key role in design and development of simulation tools that generate realistic mobile movements. Lack of realistic nature in the existing Mobility Models demands tailor made simulation tool with Context Based Mobility Model that generate realistic mobility patterns. This paper proposes a Direction Sensitive approach for Context Based Mobility Model to generate mobile movements from fixed source nodes to destination nodes possibly in the direction of the destination node that helps in generating realistic mobile movements*

1. Introduction

Next Generation Networks have a major impact on existing communication technology. A major goal of NGN is to facilitate convergence of all heterogeneous wireless networks like cellular networks, adhoc networks, Wi-Fi, WiMAX, vehicular networks, mesh networks, sensor networks etc. Generalized mobility is one of the significant characteristics of NGN [1,2]. To achieve generalized mobility in NGN environment, mobility management provides variety of functions and control operations [3]. These control operations and functionalities include handover management, location updating, authentication, authorization etc [4,5]. Seamless mobility can be achieved by vertical and horizontal handover control functions provided by mobility management of NGN. One can study and develop vertical handover concepts for mobility management in a sophisticated simulation environment. A Simulation environment can be created by using simulation tool that uses realistic mobility patterns to study and develop the above said concepts. Mobility models are essential in generating mobile movements for simulated environments. Existing simulation tools like NS2, Qualnet, etc. are not having mechanisms for generating realistic mobility patterns. A tailor made simulation tool that uses Context Based Mobility Model can generate realistic mobile movements [6]. This paper aims to develop direction sensitive approach that generates paths from source nodes to destination nodes that helps as an input to Context Based Mobility Model to generate realistic mobile movements**.**

2. Necessity of the Approach

Mobility Models can be categorized as individual and group. In individual mobility model category, the mobility of a node is computed individually and independently. Existing individual Mobility Models like Random Walk, Random Waypoint, Random Direction, Gauss-Markov, City Section and Urban Pedestrian generates mobility of a node randomly. In group mobility model, mobility is computed with respect to a reference node in a subset of group of nodes. Existing group Mobility Models like Reference Point, Nomadic, Pursue, Column and Exponentially Correlated Mobility Models are also focuses on mobility scenarios for adhoc networks and are not suits better for cellular networks [7,8]. This motivates to develop Context Based Mobility Model to generate realistic mobile movements in a simulation environment. In Context Based Mobility Model, for building Path Information Database at Path Guiding Routers/Servers, an approach is needed to generate possible paths from source nodes to destination nodes the generated paths may be successful and unsuccessful and need not be a shortest path [9]. There are adequate number of algorithms to generate shortest path between source nodes and destination nodes. But for building Path Information Database at Path Guiding Routers/Servers in Context Based Mobility Model, the existing algorithms cannot generate all possible mobile movements from different source nodes to different destination nodes. This gives a motivation to develop Direction Sensitive Approach for Context Based Mobility Model to that can generate possible paths, both successful and unsuccessful, for building Path Information Database at Path Guiding Routers/Servers.

2.1. Algorithm Design

The Direction Sensitive Approach is designed with two algorithms to find possible paths from source nodes to the destination nodes. They are: Path Generation Algorithm and Direction Sensitive Algorithm. First, Path Generation Algorithm generates paths for all pairs of nodes by invoking

Direction Sensitive Algorithm. Second, Direction Sensitive Algorithm is used to identify the suitable adjacent node for path from a source node S to destination node D.

The Path Generation Algorithm takes the map with N nodes and E edges as input and generates possible paths for all pair of nodes.

In Direction Sensitive Algorithm, a source node S, a destination node D, and Adjacent set for S Adj_S are considered as inputs. To generate the suitable adjacent node for path from S to D as output, consider the adjacent node set $Adj_S = \{A_1, A_2, A_3, ..., A_i, ..., A_n\}$. Among the n adjacent nodes select the suitable adjacent node in the direction of the destination node D with the following steps.

Algorithm: **PathGenerationAlgorithm(Map)**

Input: Map with N nodes and E edges
Output: Paths generated for all pair of nodes
Step 1: **For** i := 1 to N-1 do
    For j := i+1 to N do
        Path Set P=Φ;
        S := i; //S is source node
        D := j; // Destination node
        P := $P \cup \{S\}$;
        Repeat
            A := FindAdjacents(A);
            A := DirectionSensitiveAlgorithm(S,D,A);
            P:= $P \cup \{a\}$;
            If a == D then "Path generated"; return;
            S := a; // set source node as adjacent node
        Until (no adjacent node);

Algorithm: **DirectionSensitiveAlgorithm(S,D,Adj$_S$)**

Input: Source node S
Destination D
Adjacent Set for S. (Adj_S)
Output: Suitable adjacent node for path to the destination
Step 1: Find the adjacent set $Adj_S = \{A_1, A_2, A_3, ..., A_n\}$
Step 2: For each A_i in Adj_S do
Identify an adjacent node A_L such that $\overline{SA_L} = MAX\ \{SA_1, SA_2, SA_3, ... SA_n\}$
Step 3: Consider a Circle $O_{\overline{SA_L}}$ with the radius $\overline{SA_L}$
Step 4: On the circumference of the circle $O_{\overline{SA_L}}$ identify the other adjacent nodes by projecting to get projected adjacent set $Adj_{S^1} = \{A_1^1, A_2^1, A_3^1, ..., A_i^1, ..., A_n^1\}$
Step 5: On the circumference of the circle $O_{\overline{SA_L}}$ identify Destination Node Intersect or D_i, a point at which the straight line from S to D intersects.
Step 6: Now the circumference Set C contains the point on the circumference of the circle $O_{\overline{SA_L}}$
$$C = \{A_1^1, A_2^1, A_3^1, ... A_i^1, ..., A_n^1, A_L\}$$
Step 7: From each point in circumference set C calculate the distance to Destination Node intersection D_i.
Step 8: Identify the point in circumference set C with shortest distance to D_i.
Step 9: Return the adjacent node with respect to the point in circumference set C with shortest distance to D_i.

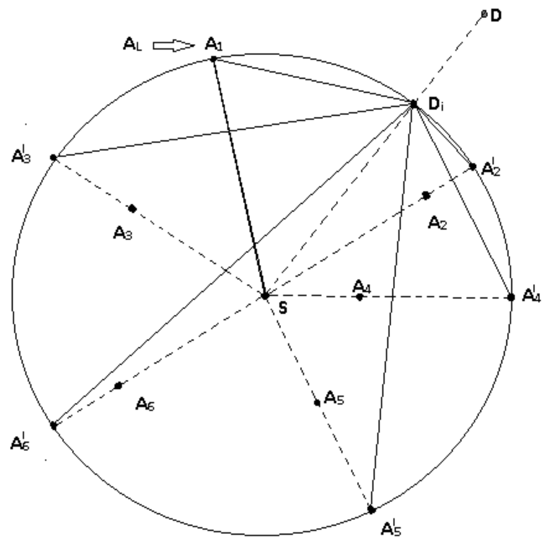

Fig. 1. Illustrative Example for Direction Sensitive Approach

2.2. Illustation for Direction Sensitive Approach

The Direction Sensitive Algorithm is illustrated with the following example. The adjacent set AdjS = {A1, A2, A3, A4, A5, A6}. Among the 6 adjacent nodes the node A1 is at longest distance with respect to other adjacent nodes.

$$\overline{SA_1} = MAX\ \{SA_1, SA_2, SA_3, SA_4, SA_5, SA_6\}.$$

A circle $O_{\overline{SA_1}}$ is drawn with a radius of $\overline{SA_1}$. By projecting the adjacent nodes A2, A3, A4, A5, A6 to intersect the circumference of the circle $O_{\overline{SA_1}}$ to generate projected adjacent set $Adj_{S^1} = \{A_2^1, A_3^1, A_4^1, A_5^1, A_6^1\}$. The straight line from S to D intersects the circumference of the circle $O_{\overline{SA_1}}$ at Destination Node Intersection, Di. The points on the circumference of the circle $O_{\overline{SA_1}}$ forms a set $C = \{A_1, A_2^1, A_3^1, A_4^1, A_5^1, A_6^1\}$. Calculate the distances from each point in circumference set C to Di

$$\overline{D_iA_2^1} = \min\{\overline{D_iA_1}, \overline{D_iA_2^1}, \overline{D_iA_3^1}, \overline{D_iA_4^1}, \overline{D_iA_5^1}, \overline{D_iA_6^1}\}$$

. The point A_2^1 in circumference set C is with shortest distance to Di. The adjacent node A2 is returned with respect to the point A_2^1. So the source node S has to choose A2 adjacent node to reach destination node D. The pictorial representation of the above illustration is shown in figure Fig.1.

3. ANALYSIS FOR THE APPROACH

The Direction Sensitive approach is designed for generating path from source node to destination node. Unlike many shortest path algorithms the path generated in this approach need not be the shortest path, but the path successfully reaches the destination. Context Based Mobility Model uses the generated paths to build the Path Information Database at Path Guiding Servers/Routers. If there is no path from the source node to destination node even then the unsuccessful path is generated that helps to build the Path Information Database. The Path Information Database in Path Guiding algorithm of Context Based Mobility Model guides the mobile nodes in generating realistic mobility patterns.

4. CONCLUSIONS

Developing Direction Sensitive Approach for Context based Mobility Model to generate realistic mobility scenarios helps in simulating handover schemes and location management activities in NGN. One can develop distributive and dynamic computation algorithms for NGN by inputting the generated possible paths with this approach for building Path Information Database at Path Guiding Servers/Routers.

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