Design and Performance Analysis of Mobility Management for Multi Gateway Based Wireless Mesh Networks

K.K.B.S.Singh\(^1\), P.Prasanna Murali Krishna\(^2\), Dr.M.V.Subramanyam\(^3\)

\(^1\)PG Student, Department of ECE, Dr.SGIET, MARKAPUR.
\(^2\)HOD, Department of ECE, Dr.SGIET, MARKAPUR.
\(^3\)Principal, Santiram Engineering College, NANDYALA

Abstract: In order to reduce the overall network traffic incurred by mobility management and packet delivery herewith we propose efficient mobility management schemes based on pointer forwarding for wireless mesh networks (WMNs). In the proposed schemes, based on the user’s specific mobility and service patterns the optimal threshold of the forwarding chain length that minimizes the overall network traffic is dynamically determined for each individual mobile user. To evaluate the performance of the proposed schemes we will develop analytical models based on stochastic Petri nets. There exists an optimal threshold of the forwarding chain length, given a set of parameters characterizing the specific mobility and service patterns of a mobile user. The proposed schemes yield significantly better performance than schemes that apply a static threshold to all mobile users. Our pointer forwarding schemes outperform routing-based mobility management protocols for WMNs, especially for mobile Internet applications characterized by large traffic asymmetry for which the downlink packet arrival rate is much higher than the uplink packet arrival rate.

Keywords: mobility management wireless mesh networks

I. PROBLEM STATEMENT

Ant is a mobility management protocol that support sitar-domain mobility within a WMN. Although the use of MAC-layer events can help Ant speedup handoff, the signaling cost of location updates in Ant is considerably high, because a location update message has to be sent to a central location server every time a mesh client changes its point of attachment. This is especially a severe problem if the average mobility rate of mesh clients is high.

II. PROPOSED MODEL

Herewith we propose two mobility management schemes based on pointer forwarding for wireless mesh networks, namely, the static anchor scheme and dynamic anchor scheme. These schemes are per-user based, in that the optimal threshold of the forwarding chain length that minimizes the total communication cost is dynamically determined for each individual MC, based on the MC’s specific mobility and service patterns characterized by SMR. We will develop analytical models based on stochastic Petri nets to evaluate the performance of the proposed schemes.

We also compare the proposed schemes with two baseline schemes and with the WMM scheme. We will analyze, which scheme among dynamic anchor scheme and static anchor scheme is better in typical network traffic conditions as well as when the service rate of an MC is comparatively high such that the advantage of the dynamic anchor scheme is offset by the extra cost. Our schemes perform will be significantly better than the baseline schemes, especially when SMR is small.

Yinan Li et al proposed two algorithms to minimize the complexity of network traffic, which are based on pointer forwarding methodology. In their discussion they opted to random work model with single gateway, hence our proposed work will attempt to derive significant model that improves significant of traffic flows in the context of mobility. In our model we consider random way mobility with multiple gateway.

III. MODEL DESCRIPTION

In this paper we model the WMN with multiple mobile clients, one gateway, multiple routers with AP’s functionality (called “AP” hereafter) and their covering area (called “cell” hereafter). The case of more than one gateway can be easily derived from this paper.

Each AP has the functionality of AP, router and database for the subscriber information. The gateway is required to assign a unique IP address in its domain to a mobile client when it is powered up. This unique IP address of a mobile client can be the CoA when mobile IP is provided for the inter-domain roaming. The foreign agent (FA) and home agent (HA) can reside in the gateway. In the scenario here more than one gateway present, our scheme can be easily extended by placing the FA/HA at the intersection of the gateways and using different IP address pools for each gateway.

We use a 3-level hierarchical structure to illustrate our scheme, as shown in Fig.1. The three APs connecting to the gateway have superior status than their downstream nodes. They are required to collect the location information of the mobile clients in the cells of the subordinate APs. We name these APs “superior routers (SR)” hereafter.
The rest of the APs have equivalent status. SRs act as the delegates of the gateway and share the signaling traffic. In a smaller mesh network, if the gateway is not the bottleneck, these superior routers can be removed which yields only 2-level hierarchical structure. As discussed in, a WMN can be constructed in a tree-like structure. Each router has its own parent node and may have a number of children.

This kind of modeling has its benefit for the routing where only the traffic flows between the gateway and each mobile client are considered. This model shows its limitation when the mobility management is taken into account. The tree structure is extracted from the real geographical topology based on the criterion of the shortest path from each AP to the gateway, which cannot be used to obtain the optimal path between any two geographical neighboring APs. The routing of previous schemes strictly follows the tree structure even when there exist shorter paths. Unlike other WMN models, our scheme allows the communication along the paths which are not in the tree. We assume that most of the time, geographically adjacent APs have shorter communication paths other than the only path along the tree.

Therefore, this structure embodies a mesh topology. We consider that the routing in the backbone (APs, superior routers, and the gateway) has been set up. Since the backbone nodes in WMNs are mostly stationary, this assumption is reasonable. The remaining problem is on ensuring a mobile client to move around in this area without incurring high packet loss, long handoff latency, and high signaling cost to the system.

In other words, the scalability problem makes it infeasible. Moreover, this approach highly depends on the routing protocols. Another problem of this approach is pointed out in, which is, when update messages are lost due to physical reasons such as radio black-out, the routing entries indifferent routers might be inconsistent.

Maintenance signaling might be an addition to guarantee the consistency. For the hierarchical tunneling approach, if the numbers of hierarchical levels are not small enough, the encapsulation/decapsulation will cause the delay performance intolerable. However, if the numbers of hierarchical levels are small enough, the signaling cost of handoff and handoff latency may be instead intolerable. Our scheme achieves the advantages of both previous approaches.

Tunneling the downstream packets in the backbone lower the routing requirement for each intermediate APs. Without the multiple-level registration procedure in the hierarchical tunneling approach, our scheme achieves shorter handoff latency.

Consequently, the packet loss problem is greatly alleviated. A simple buffering technique can eliminate the packet loss without the out-of-order problem of packet forwarding. On the other hand, applying the per-host routing only between geographical neighboring APs does not require each AP to maintain too many intermediate routing entries. This “pointer forwarding” method significantly reduces the location update to the gateway despite the extra periodic location update which is introduced to control the triangular routing problem. The delay of downstream packets is controllable due to the controllable triangular routing.

We now discuss the average path length. In the literature, the maximum number of hops is not recommended to be large, with 4 or 5 preferred. The average number of child rank should be relatively small in order to avoid the performance bottleneck. Table I shows the typical value set of the average path length.

If there are normal routers (without AP functionality) in the network, the handoff between parents and children becomes less possible. Therefore, the average path length for the previous schemes will be larger. The gain of M3 will be higher.
V. ACCESS TIER COVERAGE

The first performance metric, coverage area, is the probability that an arbitrary client device connects to the mesh network. In this section, we define the coverage area metric and examine the coverage area of networks with regular and random topologies. We also compute lower bounds for coverage area and then study the impact of mesh node perturbation on coverage area. A client device connects to a mesh node if the average signal strength received from the mesh node is above a threshold, $T_{\text{min}}$. Therefore, to find the coverage area of a topology, we calculate the equivalent probability that it is not the case that a client location is unable to connect to any nearby mesh nodes:

$$\text{Coverage} = 1 - \prod_{i \in V} (1 - Pr_{d_i}[X > T_{\text{min}}])$$

Where $i$ represents each mesh node in the network and $Pr_{d}$ is found with Equation VI.

VI. WORST-CASE COVERAGE

To further study these coverage holes, we next consider the worst-case coverage probabilities. For the regular grid scenario, the worst coverage is at the center of each regular polygon (square, triangle, or hexagon).

VII. CONCLUSION

In this paper, we propose two mobility management schemes based on pointer forwarding for wireless mesh networks, namely, the static anchor scheme and dynamic anchor scheme. The proposed schemes are per-user based, in that the optimal threshold of the forwarding chain length that minimizes the total communication cost is dynamically determined for each individual MC based on the MC’s specific mobility and service patterns characterized by SMR.

REFERENCES


Fig. 3. Coverage area as a function of mesh node density for three regular topologies and random networks.