

Reliable Distributed Lookup Service Scheme for Mobile Ad-hoc Networks*

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Abstract

Mobile Ad hoc networking is an emerging technology and in these days many applications are being developed to run on these networks. In these networks lookup services are very important because all nodes do not have same resources in term of memory and computing power. Nodes need to use different services offered by different servers. Reliable and efficient scheme should be available for lookup services due to limited bandwidth and low computing power of devices in mobile ad hoc networks. Due to mobility and rapid change in network topology, lookup mechanism used in wired network is not appropriate. Service discovery mechanism can be divided into two main categories Centralized and Distributed. Centralized mechanism is not reliable as there is no central node in these networks. Secondly centralized mechanism leads toward single point failure. We can handle the service discovery mechanism by distributing server's information to each node. But this approach is also not appropriate due to limited bandwidth and rapid change in network. In this paper, we present reliable lookup service scheme which is based on distributed mechanism. We are not using replication approach as well due to low bandwidth of wireless networks. In this scheme service discovery mechanism will be handled through different lookup servers. Reliability is the key feature of our proposed scheme.

1. Introduction

Service discovery mechanism enables nodes to discover different services available in the network. In MANET, nodes do not have enough resources and need services offered by different servers to complete their tasks. If any node requires service then it should know about service availability in the network. Service lookup mechanism for wired network is not appropriate for mobile ad hoc networks. Service lookup mechanism should consider the mobility factor in MANET to work properly. Nine different scenarios can occur due to mobility and limited resources of mobile nodes in MANET. Lookup server can leave MANET, Lookup server can die expectedly, Lookup server can die unexpectedly, Service provider can leave MANET, Service provider can die expectedly, Service provider can die unexpectedly, Client can leave MANET, Client can die expectedly and Client can die unexpectedly. Lookup service mechanism in MANET should cater these scenarios to provide reliable services. Last three scenarios do not affect lookup service mechanism but first six scenarios are important for lookup scheme.

There are two major categories to handle service lookup mechanism, Centralized and Distributed. Centralized mechanism is very simple and easy to implement. Every server will register its services to centralized node. This centralized node will behave as a server. Node sends request

to cauterized server for services. Centralized mechanism leads towards single point failure. If centralized server wants to move or die due to shortage of resources then reelection of centralized server require a lot of bandwidth and during election nodes can not use services. Centralized mechanism does not cater all scenarios related to mobile ad hoc network. Fully distributed mechanism may handle all scenarios occurs due to mobility. In fully distributed mechanism all nodes have the information about servers. But this scheme does not work well due to limited bandwidth of mobile ad hoc networks. To maintain data on each node not only requires bandwidth but also requires resources in term of memory and computing power. Due to rapid change in network and limited bandwidth, it is very difficult to maintain table at each node.

Partially distributed mechanism is suitable technique for mobile ad hoc network. In this paper we presents reliable service lookup scheme based on semi distributed mechanism. In this scheme different lookup server will be available. Service providers' information will be divided into these servers depending on the distance between service provider and lookup server. Many backbone formation schemes have been developed and our scheme is based on those backbone nodes. In our proposed scheme, server's information will be distributed between lookup servers.

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2. Related Works

Many different schemes/ protocols have been developed for service discovery. Most of the lookup schemes work well under fixed environment and don't perform well under highly dynamic situation. Now we go through these previous works to get an idea about these schemes.

The Service Location Protocol (SLP) was originally an Internet Engineering Task Force (IETF) standards track protocol that allows networking applications to discover the network services. In order to discover services on the network, users of network applications have been required to supply the host name or network address of the machine that provides a desired service. [1]

In Salutation, a device talks directly to a Salutation Manager (SLMs), that may be in the same device or located remotely. Salutation Managers coordinate with one another and act like agents and perform every thing on the behalf of their clients. This framework provides call backs to notify the events like devices become unavailable. [2]

UPnP uses a special protocol known as SSDP (Simple Service Discovery Protocol) that enables devices to announce their presence to the network as well as discover available devices. A device joining the network sends out a message- telling the world about itself. If the directory service is present then it can record it or other devices may see this directly. [3]

Jini Lookup services uses well-defined protocols, devices can discover these key services. Every device must discover one or more such lookup services. Service providers are normally required to register their services to lookup services. [4]

[5] has presented backbone formation algorithm and distributed lookup scheme. This paper divides algorithm in two parts BBM (Backbone Management) Phase and DSD (Distributed Service Discovery) Phase.

3. Proposed Scheme

In this section we describe reliable lookup scheme based on distributed mechanism. In this scheme we handle all the scenarios related to mobility. The main feature of this scheme is reliability. We divide network nodes into two parts, Lookup servers and nodes adjacent to lookup servers. We use the concept of Dominating set property of graph. Dominating set of graph is a subset of vertices such that every vertex is in the subset or adjacent to the subset. Any backbone formation mechanism can be used to divide graph into two parts.

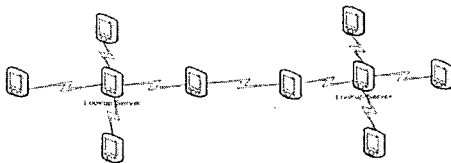


Fig 1. Lookup servers are the member of DCS.

There can be three types of nodes in the network. A node can be Lookup server or Service provider or Client. The purpose of the lookup server is to provide the information to clients about service providers. Each client will send message to lookup server to find service provider in the network. The purpose of service provider is to provide services to clients. One node can be Lookup server, Service Provider and client at the same time.

Due to connected set property there must be at least one lookup server for each node in one-hop distance. Each service provider, directly connected with lookup server, will register itself with lookup server. Service provider may register with more than one lookup server depending on network topology.

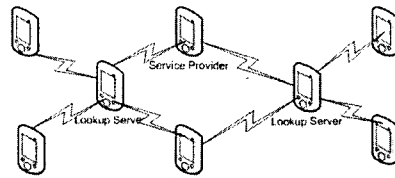


Fig 2. Service provider can be part of more than one lookup servers.

Whenever service provider wants to move then it updates lookup server by sending a leaving message. After receiving leaving message from service provider lookup server updates its list. Any service provider can join the group at run time. When service provider will join the group then it registers itself by sending joining message to lookup server. By using leaving and joining message service provider mobility can be maintained in the network.

Whenever any client requires services it sends request message to attached lookup server. If lookup server has information about service provider then it sends reply message to client. If attached lookup server does not have information about service provider then it sends message to next hop for service discovery by multi casting or broad casting. [5] has proposed backbone connectivity mechanism to send message from one backbone node to another backbone node.

If lookup server wants to move then it will start election for new lookup servers and after electing new server, lookup server will move. Election would start between nodes those are directly connected with lookup server. Remaining part of the network will be in working condition during election.

Nodes, attached with lookup server, send periodic message to lookup server. Each attached node has its specific time slot to send message. Lookup server sends acknowledgement after receiving periodic message. If any node does not receive acknowledgement message then it repeats its message. After two consecutive messages if it does not receive any acknowledgement message then it sends election start message.

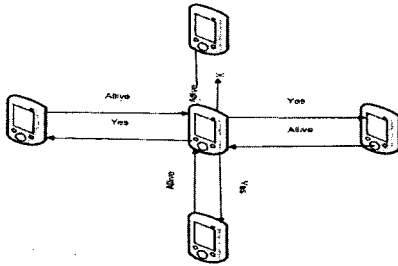


Fig 3. Clients check lookup server availability.

If lookup server does not receive periodic message from service provider then lookup server checks service provider availability by sending message. If service provider is not available then lookup server updates its list.

4. Performance Analysis

In our simulation environment we use Glomosim [10] and customized C++ program. We perform each simulation for 50 seconds based on 30 nodes. Nodes are uniformly distributed in the area and any node can contact to another node with in 4-hop distance. Fig4 shows the probability of lookup failure. In our proposed scheme, reliable distributed mechanism, probability of lookup failure is very low due to distributed mechanism and periodic checking mechanism of lookup server and service providers.

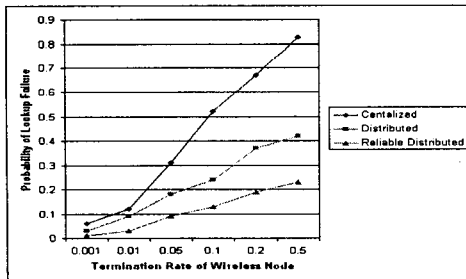


Fig 4. Performance comparison (Lookup failure)

5. Conclusion

In this paper we present reliable distributed lookup service scheme to maintain lookup service information. In our scheme we use distributed mechanism to maintain lookup services information. In our scheme lookup servers are responsible to check availability of service provider periodically and all other nodes check lookup server viability periodically. We analyze and compare performance of our reliable scheme with centralized and simple distributed mechanism by simulation. Our simulation results show that

lookup failure probability is very low in reliable distributed mechanism as compare to centralize and simple distributed mechanism.

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