Optimization Bandwidth and Delay for Mobile Ad-hoc Networks (MANET) in Protocol Service Discovery

Irawan Dwi Wahyono
Electric Engineering
Universitas Negeri Malang
Malang, Indonesia
Irawan2712@gmail.com

***Abstract*— Optimization Protocol Service Discovery (PSD) is the research being developed in Mobile Ad-hoc Networks (MANET) due to some limitations and constraints that Service Discovery in MANET computing limitations, limited power, limited bandwidth, high mobility at each node and the central node coordination determination. In this study developed a protocol Service Discovery in MANET, namely optimization service package descriptor for the service request and service advertisement with classification tree models / taxonomy service and defined by the method of Breadth Bloom filter so that a small package size. As for the distribution of packets at the network layer using the Multipoint Relay (MPR) in the Optimized Link State Routing (OLSR). Methods protocol Service Discovery (SD) in this study is called MY-Protokol. For test results and analysis of data on the success of MY-Protokol in overcoming obstacles in MANET is to square scenarios for OLSR node bandwidth reduction of 13.44% and a decrease delay of 39.9%.**

Keywords— multipoint relay; optimized link state routing; protocol service discovery

I. INTRODUCTION

In the MANET network typically consists of mobile users with its functionality and usability of different, various types of equipment, different applications, multiple sensors, and some resources are used together. There are several ways to resolve the complexities of users by providing all the elements of service that can be shared and accessed automatically regardless of their location and ownership in a service discovery function on each node. There is a method in the form of architecture and service discovery framework which let the device / node to locate and retrieve services in MANET networks, as well as the existing resource advertise on mobile devices / nodes on MANET. This happens without forcing the user to enter the IP-address, password, user name, or other attribute values

This method is Konark [1], konark implemented at the application layer protocol regardless of the carrier for the distribution of data packets at the protocol layer routing. The downside of the method and framework konark is the length of the data packets defines service descriptor. The longer the distributed data packets causes overhead in MANET. Causes overhead in MANET can also be caused by the selection method of routing protocols for distribution of data packets as a carrier. Routing protocols there are two kinds of reactive and proactive. Therefore we need a method that can create a data packet length of service descriptor at the application layer protocol to be short and also can define the desired carrier routing protocols at the network layer protocol. To connect between the protocol in order to interact between application layer protocols and the network layer called cross-layer protocol [2].

In this study to provide an optimal solution in service discovery in a variety of applications ad-hoc network. However, this study specifically aimed to address the issue of limited bandwidth in Mobile Ad-hoc environment. This study makes a new discovery protocol design service which protocol works in the following way: service descriptors are classified in the form of a tree and are defined using a Bloom filter at the application layer protocol. Dissemination service done by piggybacking on the service information using a routing protocol network that is Optimized Link State Routing (OLSR), and distributed using intelligent local caching which a reduction in service requests that do not need to nodes in MANET.

II. LITERATURE REVIEW

A. Classification of service information model Tree / Taxonomy

Classification of service information in the form of a tree in order to make it easier to query the service information they want and can do advertisement message for the service. The example in the manufacture of tree-shaped classification for device discovery or resource contained in MANET environments shown in Fig. 1.

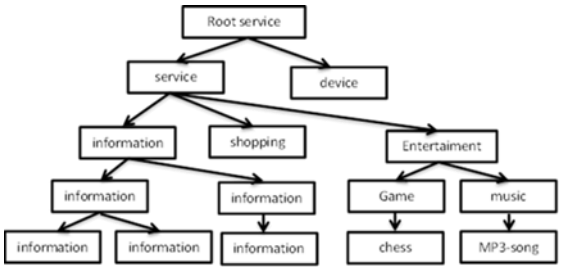

Fig. 1. Classification based Service Discovery

The process of discovery was first performed at the highest root and then descend down according to the specifications of each service information contained in each node. Root service in Fig. 1 is the highest in determining the root path of service to be searched while in apply path should be complete and detailed classification based Service Discovery in Fig 1.

B. Breadth Bloom filter

Bloom filter is a representation of a set of service descriptors S = {x1, x2,.,, , xn} the number n is an efficient way in the definition. Defining Bloom filter as follows: v is implemented as an array of bits m. All bits {1... m} is initially set to 0. Filter using the k value of its own, the hash function h1, h2,. , , , hk, with range {1, .. m} for each hash service descriptor x to array v. For every service descriptor x ∈ S, the output hash hi (x) is the position in the array v, v [hi (x)] are set to 1 for all the hash function i = 1, 2,... k. One location in v rated 1 to several times [3].

To check if there are service z in the Bloom filter, determined whether all hi (z) "is set to 1. If this is the case, then the service z is available. If all hi (x) is not 1, this service is not part of the filter, Bloom filters may produce false positives if the filter indicates that a service descriptor z ∈ S. The chance of getting a false positive lookup can be estimated using probability calculus [3].

Breath Bloom filter (BBF) is almost the same as the Bloom filter which differ only in the form of an array of hash function model in which the placement value k k value placed randomly by using MD5. As for the BBF that includes all the services in detail in the form of an array or a pointer. BBF declaration in the form of an array pointer.

C. Calculations False positive

Parameters in false positives, m is the length in bits of the Bloom filter, n is the number of service descriptors included in the filter, and k is the number of hash functions are used, the possibility of false positive is given by equation (1) [4].

$$P_{fp} = (1 - e^{-\frac{kn}{m}})^k \quad (1)$$

Note that the number of services is the only value that can be varied while the application is running. It is therefore important to have a thorough understanding of the target application and to set the parameters k and m to minimize the possibility of false positive query.

There are two ways to reduce the possibility of false positives:

- Changing the number k hash functions.
- increasing the size of the Bloom filter itself,

The optimal value of k can be calculated by taking the derivative of equation (1) and then found that the optimal number of hash functions, k opt, to the width of the filter m and n is the number of service descriptors are [3]:

$$k = \frac{m}{n} = \ln 2 \Rightarrow k_{opt} = [k] \quad (2).$$

When designing a service discovery protocol based on Bloom filter, equation (2) is important to choose the best number of hash functions. This value is given by the expected number of services that will be saved and the width of the filter associated with the transmission protocol and the limitations of the medium of radio.

III. RESEARCH

A. System Design

In this study, the architectural design of the system will be created to implement the protocol in NS-2 called MY-Protocol. The components contained in the My-protocol shown in Fig. 2 where MY-protocol implemented in NS-2, there are two major parts of NS-2 and MY-Protocol.

For how the system is implemented in NS-2 is shown in Fig 2. MY-Protocol which interact via OLSR as a carrier of the package to be simulated in NS-2. OLSR serves to do a broadcast packet by utilizing the technique of MPR flooding. At MY-Protocol there are 4 main components:

- Breath Bloom Filter or BBF serves as the conversion of all data service
- Service Function serves as handle service requests and service advertisement of external node or from the local node.
- Message Creator function to create a new message prior to broadcast in MANET which Advertisement Service (SA) and Service Request (SR)
- Repositories which perform the data storage service

On the Component Repository there are 3 for the function block are:

- Local Service or also called local service node contains a list of services which is owned by the local node.
- External Service node contains a list of services on the external / foreign
- Request service provides service request came from the node itself

Working Principle of MY-Protocol as follows:

Condition 1: If a node wants to find out which service S description form of text, then make a service request node by using Breath Bloom filter (BBF) by converting service description into a small package in the form of BBF. Service request form that has been made into a B BBF (SR). B (SR) and then performed a query service contained in the External Service repositories, if the service is not found then the node create a new message request again that contains all request services that are in Request service repositories into a single service request by utilizing the BBF became B (SR), then the node sends the service request over the network by leveraging MANET routing protocol OLSR MPR flooding techniques.

Condition 2: If the receiving node B (SR) of external nodes then performed with local repositories query that lists service at the local node. If found service S, the node immediately responded by doing Advertisement Service. Service Advertisement created using BBF consisting of all services contained in the Local Services repositories into B (SA) is then sent to the network using a routing protocol OLSR MPR flooding techniques.

Condition 3: If a node wants to do the advertisement of a service, service description S immediately added to the Local Service Repository, then create a service advertisement consist of all services contained in the Local Service repository by using BBF be B (SA) is then sent to the network MANET, At the time of receiving service advertisement node B (SA) of the network, the node immediately adding, updating and querying the External Service repositories.

B. My Protocol in BBF

Breath Bloom filter is a hash function which each hash function used to model a folder such as service descriptors form the shape of a pseudorandom number in the range 1 ... m. The yield on the k different hash functions have to stand alone. One way to implement the hash function is to use a hash function modulo series. Another approach is to use a cryptographic hash function such as MD5 [4].

Genesis if MD5 is not considered secure for several cryptographic purposes, but it has the desired properties, namely as a base hash function Bloom filter. MD5 is deterministic and uniform, and also has excellent impact resistance. MD5 also exist as open source code for many programming languages, and relatively rapid implementation. Because of its quality, the possibility of false positives can be completed using equation (1).

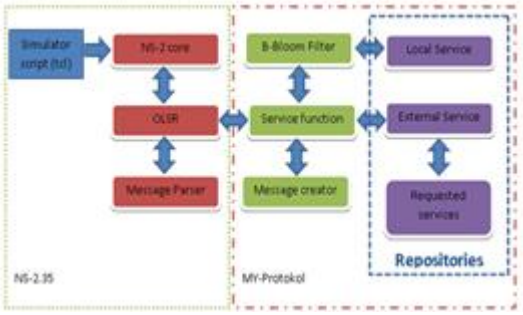

Fig. 2. System Design.

MD5 cryptographic hash function, especially trying to hinder / slow down, making computing more slowly than general-purpose hash function. However, the process MD5 only run on service advertising and service request and not when matching service as a match made the filter itself. Furthermore, only one operation is needed to generate MD5 input for all k different hash functions.

Design MY-protocol Service Discovery (MSD) using MD5 in the following manner: k hash functions, which is the BBF, which is built from each group k r output bits of hash MD5 128 bits in operation. Each set of sub-bits of the MD5 output can be used as input for its own function. Each function k is set a bit in the filter v.

IV. RESULT

A. Performance measurement MY-Protocol

In testing MY-Protocol there are 4 parameters are:

- Breadth Bloom filter is the implementation Bloom filter testing to verify that the implementation conforms to the basic mathematical theory.
- Delay namely the evaluation delay (time consumed) to perform service discovery on MANET network.
- Bandwidth is the number of bytes in the node generated during the process of service discovery and tested using different network topologies.
- To measure the above parameters by taking advantage of the two scenarios is static. Static scenarios are easily made and repeated and flexible also measured when the different features of the protocol.

To do that all measurements were taken using a simulator that is the Network Simulator NS-2:35 with default parameters used in Table 1

TABLE I. THE DEFAULT SETTING FOR TESTING IN NS-2:35

Parameter	Value
Simulator	NS-2.35
OS	Ubuntu 12.04
Transmission Range	100m
MAC	802.11
Reflection Model	Two Ray Ground
Movement Model	Random Waypoint
Routing Protocol	OLSR/AODV
OSLR setting	Default
AODV setting	Default

B. Scenario Bandwidth Measurement

A set of static different topologies used to measure bandwidth. Topology consists of nodes squared oriented node {4, 9, 16.., 64}. Fig. 3 shows the setting for a 16-node test. All topology has two services, which is located on node 0 and 1. Services are randomly requested by another node at intervals of 5s during the running of the 1500s. For each of static topology, 20 simulation is run and the interval 95% estimated and presented in the figures. MY-protocol configured both without caching overhead discovery to uncover the right, and with 300s caching. Service descriptors has a length of 10-15 characters.

Based on the analysis of the graph in Fig. 3 obtained that bandwidth reduction in MANET network obtained of 13, 44% by using MY-Protocol.

C. Scenario Delay Measurement

The number of hops between nodes that perform service requests and service providers is a factor that has the greatest influence on the delay / delay service discovery. To perform and measure the time delay, the method chosen topology is static network node. Nodes are connected in a chain node 2 to 16, generating 1-15 hops as in Fig. 4. The only service in the network located on node 0 and requested by the node at the end of the chain with an interval of 10s.

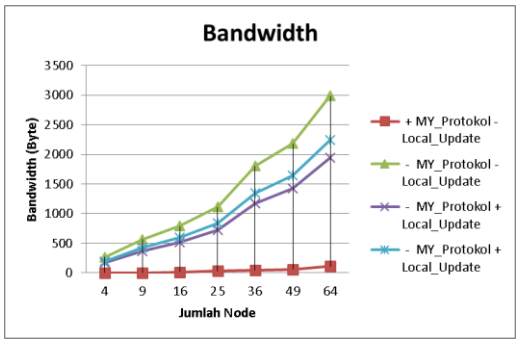

Fig. 3. Graphs Bandwidth Service Discovery.

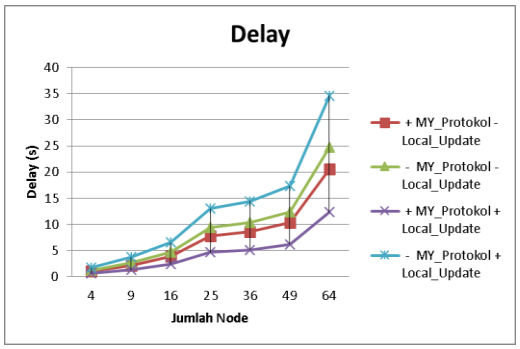

Fig. 4. Graphs Delay Service Discovery.

A delay between the service request and acceptance are successfully measured for 100 requests. In the simulation, utilizing local caching with time limits 300s timeout. Simulation on two conditions which the Service Discovery is done by using MY-Protocol and do not use MY-Protocol as a comparison.

Based on the analysis of the graph in Fig. 4 obtained that delay efficiencies gained by 39,9% by using MY-Protocol.

V. CONCLUSIONS

Based on the results of trials that have been done can be some conclusions as follows:

1. To make the service descriptors that are defined in an efficient way and must be scalable in the form of packages can be done using Breath Bloom filter (BBF) to support the Service Discovery efficient process service requests and service advertisement in MANET.

2. The process of service discovery using repositories on a node that is local service, external service and request service on local intelligent caching for deployment / distribution package service request and service advertisement that is efficient in saving bandwidth and delay reduction in MANET.

3. MY-Protocol can work well with the existing routing protocols are reactive and reactive to save bandwidth and avoid flooding in MANET network.

4. Type Bloom filter is selected Breath Bloom filter in the form of data pointer / array in accordance with the detailed service pendiskripsian shaped tree

5. To get a small possibility of false positives on Breath Bloom filter (BBF) then the value of k is 4 with a length of 128 bits.

6. MY-protocol Service Discovery using OLSR routing protocol can reduce bandwidth in the discovery of 13,44% and decrease delay of 39,9%.

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