Improvement of Peer Search Time and Control Messages with Rendezvous Peer in P2P Virtual Network

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ABSTRACT

Peer to Peer (P2P) utilizes the resources of an offered service without the need for a central server or preexistent server-client, making it a desirable network environment for data exchange based on direct connection between peers.
Proposed by Sun Microsystems, JXTA(Juxtapose) is a typical P2P system and distributed computing model that does not require central service resources and is flexible to deal with various network configuration changes.
Meanwhile, Mobile Ad-hoc NETwork(MANET) is a typical wireless network configured with mobile nodes and without an infrastructure, where a network is established by direct connection or through other peers in the propagation area. Thus, MANET maintains the latest path information by establishing paths and changing path information for communication between peers in a highly mobile wireless network.
Accordingly, this article proposes the JXTAMANET method for wireless networks to enable JXTA to be applied to MANET. NS2 is used to evaluate the performance and the proposed architecture is shown to produce better results than a conventional flooding method.

Keywords: *P2P, Rendezvous, Virtual Network, MANET, NS2, JXTA.*

1. INTRODUCTION

With the recent popularization of cellular phones, notebooks, and PDAs (Personal Digital Assistants), the demand for a ubiquitous computing environment that allows people to use services and resources anytime and anywhere has also attracted serious attention,. Thus, a ubiquitous network is considered the next generation information network that will include wired and wireless networks and provide access to all information and services under the 3As (anytime, anywhere, any device) [5], making it an important research area for information communication networks.

The JXTA network system based on P2P has many path variations and phase variations in a wireless network. Therefore, this paper proposes JXTAMANET techniques that combine MANET [9] and JXTA [2].

The rest of this paper is composed as follows: Section 2 covers related work, and then section 3 presents the proposed JXTAMANET. Section 4 explains the simulation environment and results, and conclusion is given in section 5.

2. RELATED WORK

2.1 P2P Overview

P2P enables direct communication between peers without a central server [1]. Thus, P2P networking offers better reliability and availability over the server-client function, and is considered as the new computing model for the Internet that allows resources and services to be shared through direct communication between systems. As each computer has an

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equivalent capability, any computer can start the communication, and share data and peripheral devices in the connected network from and equivalent standpoint.

Fig. 1 shows direct communication of Peer to Peer system.

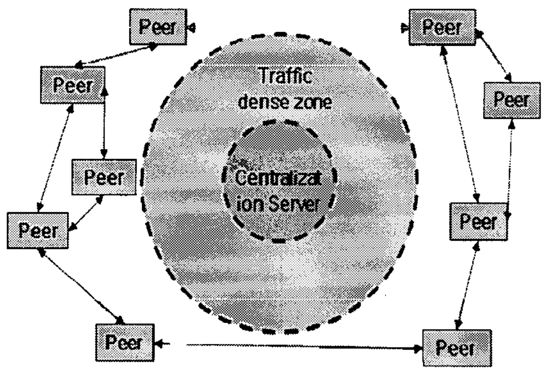

Fig. 1. Peer to Peer system

2.2 JXTA Overview

JXTA is a typical distributed computing model proposed by Sun Microsystems. Since most applications are limited to a single platform, and cannot share and transfer data with other applications, JXTA was proposed to solve this sort of problem. Thus, interoperability, platform independence, and ubiquity are known as the major characteristics of JXTA.

The protocol used for communication between peers is defined using XML and made from a common function library. JXTA is also designed for any program language (Java, C++, Perl), any operating system (Linux, Windows, UNIX), and any protocol (TCP/IP, HTTP, Bluetooth, HomePNA) [2].

The JXTA organization and query method are shown in Fig. 2.

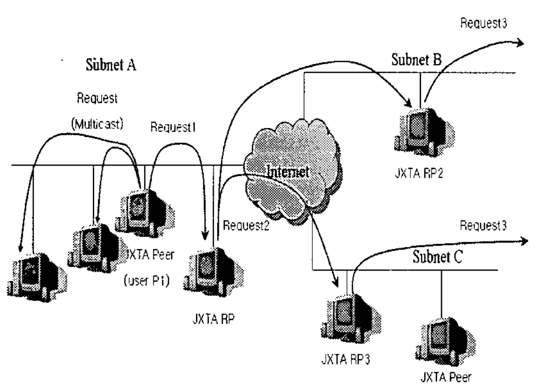

Fig. 2. JXTA organization and query method

2.2.1 Rendezvous Peer

A Rendezvous Peer (RP) [7] saves and manages the request messages of its peers in a cache. An RP also sends Discovery Requests to other peers for resource discovery.

Each peer identifies an RP to participate in the peer group. If a peer group does not have an RP, a peer can become the RP for the peer group. A peer group may have one or more RPs, and sends Discovery Requests or a service search to the RP. If the RP has the requested information, the RP sends a reply message. Conversely, if the RP does not have the requested information, it sends Discovery Request messages to other RPs. This procedure continues until the peer request is answered.

2.2.2 SRDI

The RPs in a JXTA network manages an index on the peer request messages. Thus, when peers send the RP a new request message, the RP uses a shared resource distributed index (SRDI) mechanism to save the information in the request message [2]. When a peer sends a request message, the message includes an advertisement name or ID key, and this is saved by the RP using the SRDI mechanism. Thus, the RP uses the SRDI mechanism to save the minimum information based on an index of request messages. Other RPs also save the index of the new RP.

Fig. 3 shows the reply procedure of the SRDI mechanism.

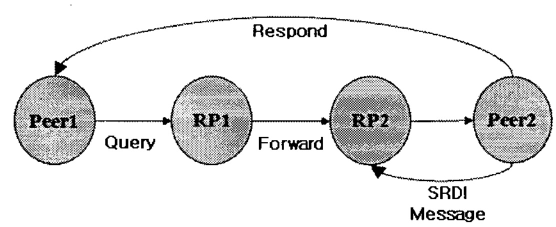

Fig. 3. Distributing and querying for SRDI resource entries

2.3 MANET Overview

MANET is a typical wireless network that allows direct connection through mobile nodes in the propagation area without an infrastructure [6]. As all MANET nodes are mobile, the network phase changes dynamically, yet each node has a limited data transfer radius, low bandwidth, and high error ratio. Plus, due to battery limitations, each node has a restriction on efficient data transfer [3]. Nonetheless, MANET is still useful in temporary situations and limited areas, such as disaster relief, on the battlefield, and exhibition halls.

3. JXTAMANET

This section introduces the proposed JXTAMANET. As a wireless network, like MANET, involves many path and phase variations within the network, the loads of the mobile nodes are increased due to periodic flooding from beacon signaling to maintain connections with other nodes. Thus, to decrease this flooding load, the JXTAMANET method is proposed for an easier service search.

Fig. 4 shows the communication method of JXTAMANET.

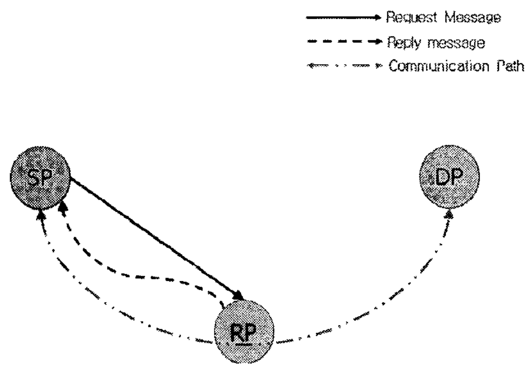

Fig. 4. Communication method of JXTAMANET

3.1 Activation of RP

In the JXTAMANET search procedure, the Source Peer (SP) searches for the Destination Peer (DP) using a broadcast in the 1 Hop areas. If the SP finds the DP in the 1 Hop areas, the DP immediately sends a Reply message to the SP.

However, if the SP does not find the DP in the 1 Hop areas, the SP uses a Unicast to request its Rendezvous Peer (RP) to search for the DP. Upon receiving this request form the SP, the RP checks its cache table and, if the DP with the desired information is found to exist in the table, the RP delivers the DP information to the SP using a Reply message. The SP and DP are thus able to communicate successfully through the RP.

In the case the RP within the area of the SP does not include information on the particular DP, the RP requests the DP information from its neighbor RP, This request information delivery continues up to a maximum of 7 Hops.

3.2 Resource and service search

When the Source Peer is searching for a Destination Peer offering certain resources and services, JXTAMANET accomplishes the connection using the following 3 steps:

Step 1: DP search in 1 Hop area

First, the SP (Source Peer) attempts to find the DP (Destination Peer) using a broadcast in the 1 Hop area. If the DP exists in the 1 Hop areas, the DP sends a Reply message to the SP. As a result, the SP and DP can communicate with each other. Fig. 5 shows the procedure used to find the DP in the 1 Hop areas.

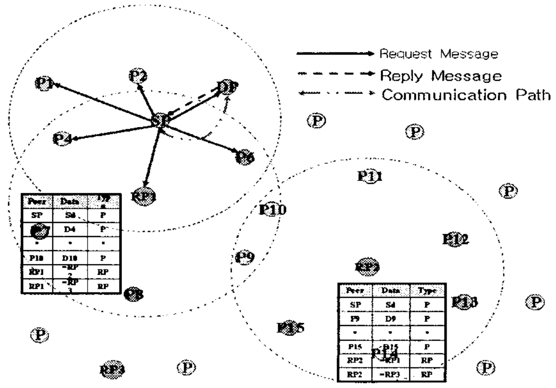

Fig. 5. DP search in 1 Hop area

Step 2: DP search using local RP

If the DP is not within the 1 Hop area of the SP, the SP uses a Unicast to request the local RP (RP1), located in the area of the SP, to search for the DP. Upon receiving this request from the SP, RP1 searches its cache table for information on the DP. If the desired information exists in the cache table, RP1 delivers a Reply message with the necessary information to the SP. As a result, the SP and DP are able to connect through RP1. Fig. 6. shows the procedure used to find the DP through RP1.

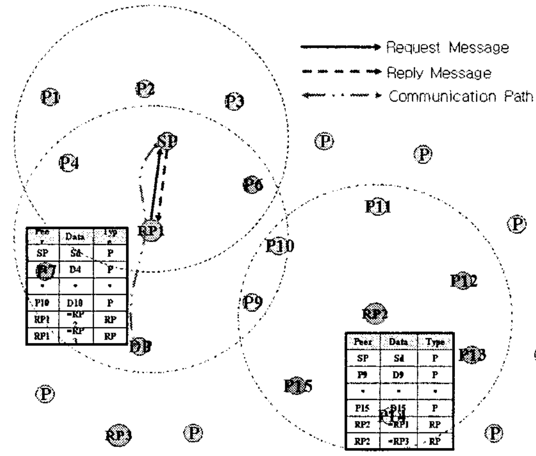

Fig. 6. DP search using local RP

Step 3: DP search using neighbor RP

If the local RP (RP1) does not have information on the requested DP, it sends a search message to a neighbor RP.

RP1 establishes a path through pre-registered RPs, since it has information on each peer within a designated number of Hops. As a result, the SP and DP are able to communicate through the RPs.

Fig. 7 shows the search procedure for the DP using a neighbor RP. When RP1 does not have information on the requested DP in its own cache table, it delivers a service request message to the neighboring RP2 and RP3. Upon receiving the Service Request Message., RP2 and RP3 look for the DP in their respective cache tables. RP2 sends a Reply message to the SP through RP1. As a result, the SP and DP are able to communicate successfully.

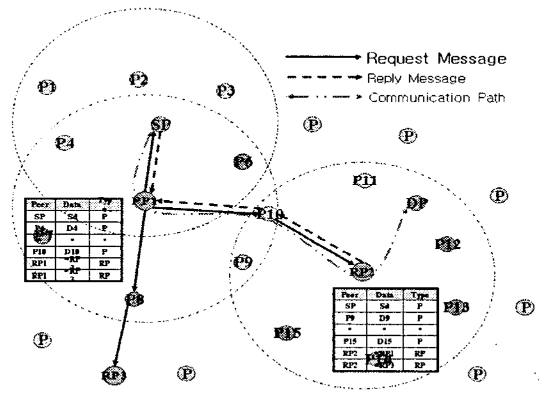

Fig. 7. Information request and delivery to neighbor RP

4. SIMULATION

4.1 Simulation Environment

The performance of the proposed JXTAMANET was analyzed based on a simulation using NS2 [4], with a 3.0GHz CPU, 1G RAM, and Linux environment as the hardware, and AODV-UU [8]. The test simulation was performed from 5 to 50 peers by 5-peer increments, and used randomly arranged peers within an 800x1000m area. The duration of the simulation was set at 125 seconds, the initial electricity power was set at 20 Joules (rxPower: 1.395Watts, txPower: 1.660Watts), and the time allowed for the SP to search for the DP was set at 8 seconds. Each RP broadcast self-information every 3 seconds, the RP ratio was determined as 20%, and no peer mobility was set.

The performance evaluation compared the results when using the conventional Flooding method and JXTAMANET with and without locality.

Table 1 shows the entire simulation environment when using the JXTAMANET method.

Table 1. Simulation Environment

OS	Linux
Hardware	Pentium 4, 3.0GHz, RAM 1G
Simulation model	NS-2
Routing protocol	AODV-UU
Network topology	800 x 1000 meter
Number of nodes	5 – 50 nodes 5 peer increments
Initial energy	20J
Energy consumption	RxPower : 1.395w TxPower : 1.660w
Rendezvous Peer ratio	20%
Research Model	1) Flooding 2) Locality Flooding 3) JXTAMANET 4) Locality JXTAMANET

4.2 Simulation Results

4.2.1 Control Message Analysis

Fig. 8 shows a graph of the control messages for 4 cases: Flooding, Locality Flooding, JXTAMANET, and Locality JXTAMANET. The number of control messages with the Flooding method dramatically increased when increasing the number of peers, whereas there was hardly any increase in the number of control messages with the proposed JSTAMANET method.

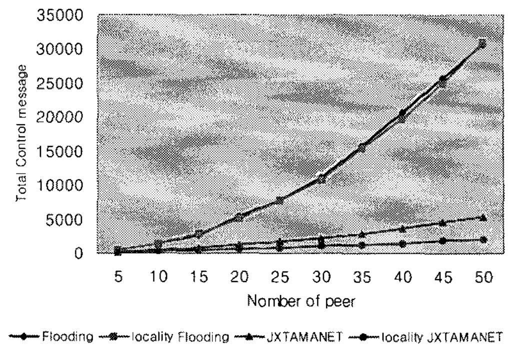

Fig. 8. Number of Control Messages

In the case of Flooding, Fig. 9 and Fig. 10 show the amounts of peer-find request messages, forwarding of peer-find request messages, peer-find answer messages, and forwarding of peer-find answer messages, For the Flooding method, the number of peer-find request messages was the highest with and without locality.

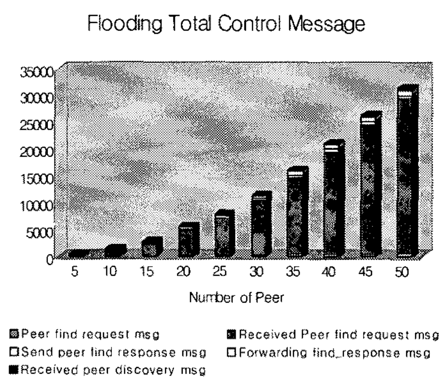

Fig. 9. Flooding Control Messages

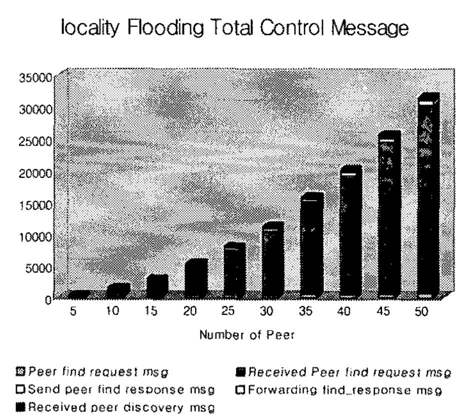

Fig. 10. Locality Flooding Control Messages

Fig. 11 and Fig. 12 show the control messages for JXTAMANET (neighbor-find overhead, RP advertisement overhead, service request overhead, and peer-find overhead). While the number of peer-find messages was highest without locality, the number of neighbor-find messages was highest with locality.

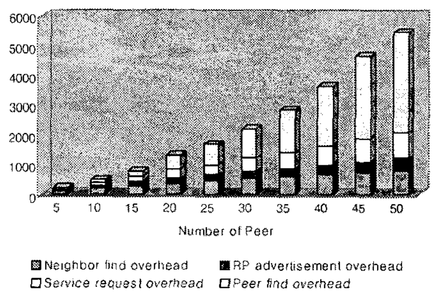

Fig. 11. JXTAMANET Control Messages

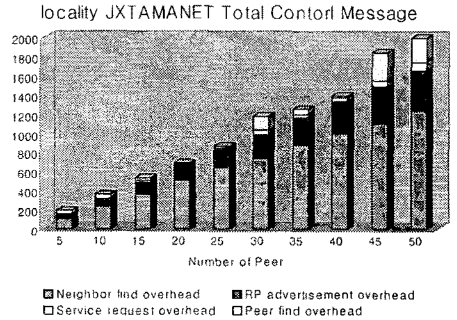

Fig. 12. Locality JXTAMANET Control Messages

4.2.2 Peer Search Time Comparison

Fig. 13 shows a graph of the average peer search time. When increasing the number of peers, the search time with the Flooding method showed the highest increase, whereas the locality JXTAMANET method hardly showed any increase. Thus, the peer search times were as follows, in a descending order: Flooding, locality Flooding, JXATMANET, locality JXTAMANET.

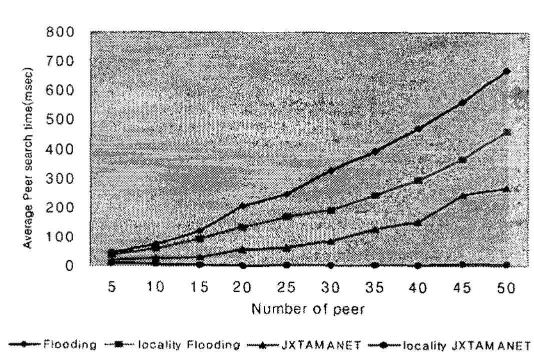

Fig. 13. Peer Search Time

5. CONCLUSION

This article proposed JXTAMANET to enable JXTA, a typical platform for a P2P network, to be applied to MANET. In simulations using NS2 and AODV_UU, the performance of JXTAMANET was compared to that of the conventional Flooding method.

Simulations according to the existence of peer were classified into Flooding, Locality Flooding, JXTAMANET, and Locality JXTAMANET. The simulations compared the number of control messages and the peer search time.

For the number of control messages, the JXTAMANET method showed a better performance than the conventional Flooding method. Meanwhile, for the peer search time, the locality JXTAMANET method showed almost no increase in the peer search time, despite an increase in the number of peers.

As a result, the proposed JXTAMANET showed a better performance than the conventional Flooding method.

Further studies are underway to examine the interaction between JXTA and JXTAMANET.

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