Design and Implementation of Super-peer P2P Overlay Network Protocol and System for mobile IPTV

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***Abstract*— Recent researches of network structure are moving to high-level networks because there are already many research results of low-level network. Especially, current network services has been changed to the multimedia service using multicast routing such as IPTV(Internet Protocol Television) service. And then previous multicast services were provider oriented. So previous multicast structures were organized server/client model. But future multicast services will make user oriented services. Therefore there will be many service providers in the future. At this point, we study P2P network for supporting multi provider. So we research load balancing and contents lookup protocols in P2P network. In this paper, we propose network protocol and system based on super peer P2P for load balancing and efficiently service search. And we considered mobile environment for mobile IPTV.**

***Index Terms*— mobile IPTV, overlay, P2P, super peer**

I. INTRODUCTION

As the rapid development of the wireless communication technology, it is possible to support the wired-oriented service in wireless communication system. In addition, the change from analog to digital of broadcast technology results in IPTV service which is the broadcasting service that supports various services through IP based network. Especially, the recent spread of smart phone results in the increasing demand of IPTV service in wireless network, and so does the demand of various mobile devices such as tablet PC[1],[2]. So many users will make various contents, and provide services to others people.

At this point, we study P2P network for supporting multi provider. P2P is widely used for data transmission between users without central server. So it is suitable for user oriented systems that are provided services by others users.

In this paper, we propose network protocol and system for mobile IPTV for load balancing and service search[3][4]. First it is explain about P2P network. Next we study overlay network and ring structure. And we propose a new P2P network structure using super peer structure. After that, we implement it using iPhone SDK and C# language. Finally conclude this paper.

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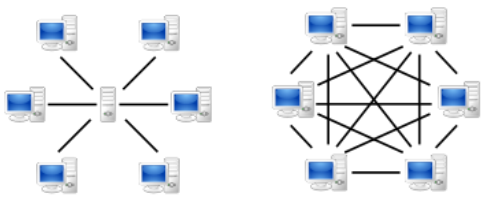
II. P2P(PEER-TO-PEER) NETWORK

Napster is a representative P2P system[5]. It is communicated between nodes without the centralization server. So contents provider is not needed heavy processing in server system. But it is tricky to manage, and retrieve data. Therefore there are many P2P protocols for enhancement of the weak points. The P2P protocols are separated unstructured and structured by retrieving and managing technology.



(a) Client/Server (b) Peer-to-Peer

Fig. 1. Structure of Client/Server and P2P Network

A. Structure of P2P

1) Unstructured P2P

Unstructured P2P manner bordering the central server or peer to send a query to search for resources, and peer-to navigate[6][7].

Of the initial resources to a central server that holds the address of the peer approach is used to tell Napster scalability of the week, but the problem was achieved. The central device adjacent without a search query flooding as a peer to peer approach Pure P2P model was used to find the problem of traffic was heavy.

To compensate, the proposed hybrid P2P model, a system with multiple super-peers configured with a hierarchical structure, then the super-peer resources efficiently between queries flooding to traffic to reduce the signal was used.

2) Structured P2P

This technique has the maximum number of searches O(logN) search data so that the number of peers without any impact on search efficiency can be increased arbitrarily. How to use these technologies Pastry, Tapestry, Chord ring based approach and addresses of the n-level space, how to use the Distribute CAN, and the existing Chord ring form of the address space is organized hierarchically and the Viceroy there is[8][9].

B. P2P Systems

1) Hybrid P2P

It is very simple structure. The central server of hybrid P2P network is managed meta-information only. Therefore it is not used central server when happened file transmission between with peers. So advantages of this structure are rapidly routing and reliability searching of data. The weak points are increasing load in central server and stopping network during central server broken. In conclusion, it is same to general client/server structure when peer connection and management.

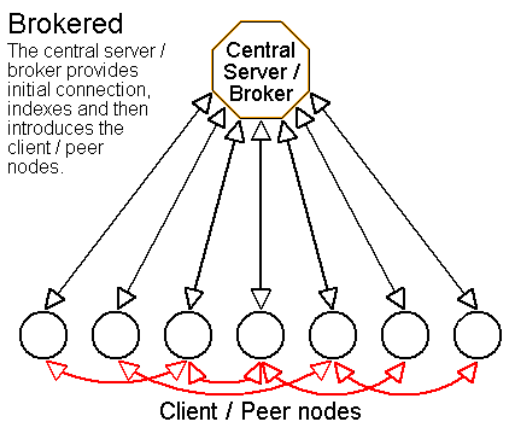


Fig. 2. Structure of Hybrid P2P

2) Pure P2P

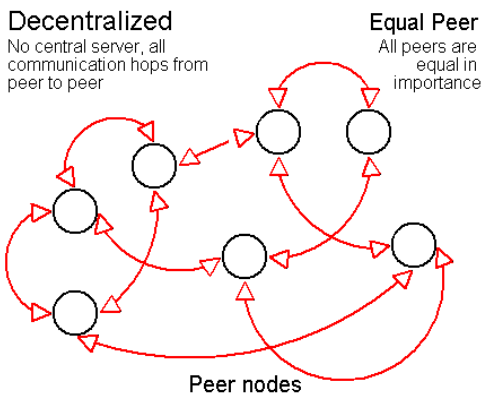


Fig. 3. Structure of Pure P2P

The mainly concept of pure P2P network is that all nodes are equal and decentralized structure. So all nodes have same role and not exist central server. So it is enhanced weak point of Hybrid P2P. But there are two weak points. It is difficult of routing and guarantee of reliability about searching result. But network shutdown is impossible because all nodes are used by server and client. However network management is very difficult.

3) Super peer P2P

The super peer P2P network has advantages of hybrid P2P and pure P2P[10]. But implementation of this structure is very difficult. And it is not ensure access of all peers and super peer selection is difficult. However it can be used as efficient protocol in IPTV system if contents provider is designated as super peer.

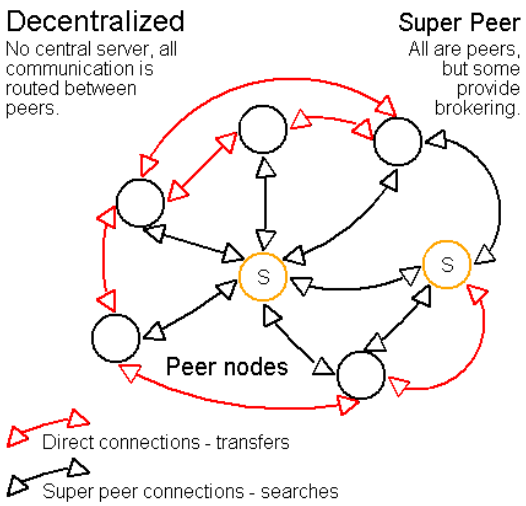


Fig. 4. Structure of Super peer P2P

III. OVERLAY NETWORK AND RING STRUCTURE

A. Overlay Network

The IP layer networks are widely researched but application layer networks is not enough researched now. Because we was provided simple services such as VoD(Video on Demand) and restrict several services until now. But future network services are growth rapidly. So it needs new network structure rather than IP layer network. Then the overlay network structure is appropriate way.

Overlay network is an alternative approach to IP layer network. An overlay approach has the following advantages[11][12]. First, overlay network is easy to deploy. It does not require changes at the network layer. Second, the construction of a logical structure hides routing complications such as link failure instances, which are left to be taken care of at the routing layer. Third, intermediate nodes do not have to maintain per

group state for each multicast group. Maintaining per group state has always been a problem in multicasting even in the internet. Finally, overlay network can exploit the capabilities of lower layer protocols in providing reliability, congestion control, flow control or security according to the needs of the application. Through overlay network, the various services are managed efficiently.

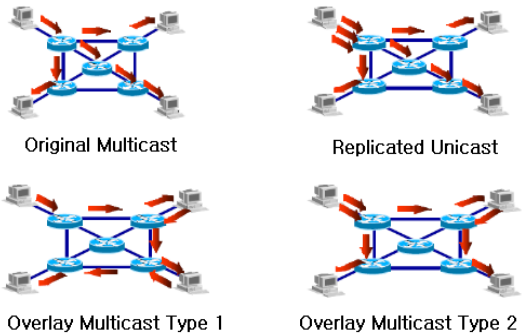


Fig. 5. Comparison of Overlay and Original Network

B. Ring Structure

The service-oriented overlay network is very efficiently for management of variety services that is connected by P2P. At this point, construction of overlay network is very important.

The ring structure is constructed circular. Each node has information of previous and next node. This structure is widely used in P2P that can't manage nodes centrally.

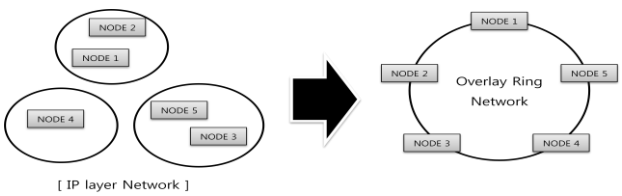


Fig.6. Comparison of IP layer and Overlay Ring Network

IV. PROPOSED NETWORK PROTOCOL

The proposed protocol and system is separated two parts. First, how to it is communicated between super peers. Second, how to contents are searched between super peers and mobile peers. The mainly concept of this protocol is as follows. All mobile nodes are communicated just through super peers. Because battery saving is very important in mobile device. So we use super peer server to decreasing battery loss during contents transmission in mobile nodes.

A. Structure of proposed protocol

We proposed ring structure. It didn't consider IP level network. And it is generated by overlay ring structure using P2P network.

TABLE I
PROTOCOL HEADER

Message	Description
0x01	Join message
0x02	Set prev information
0x03	Chainge prev information of join node to prev information of boot node
0x04	Chainge next information of next node of boot node to information of join node
0x10	Search request message(super peer)
0x20	Received search result
0x31	Leave message to next node
0x32	Leave meesage to prev node
0x40	Maintenance message
0x50	Contents lookup request(mobile node)

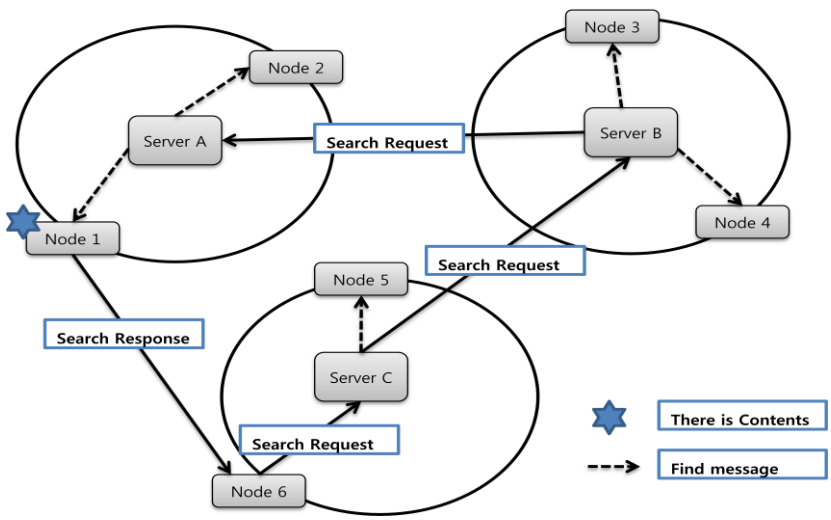


Fig. 7. Structure of Proposed Network Protocol

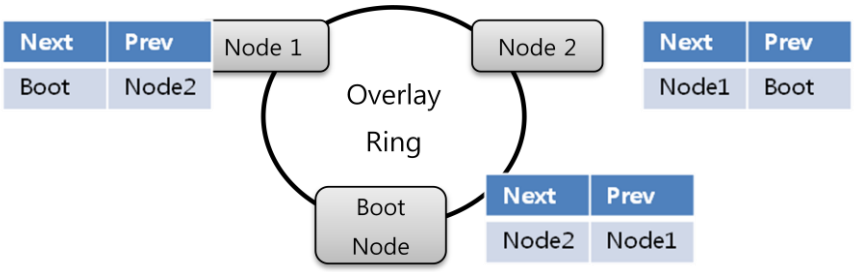


Fig. 8. Link information of each node on Overlay Ring

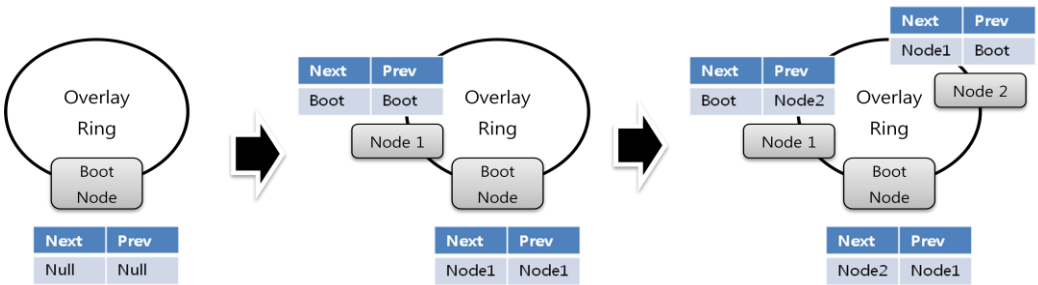


Fig. 9. The process of Member Join

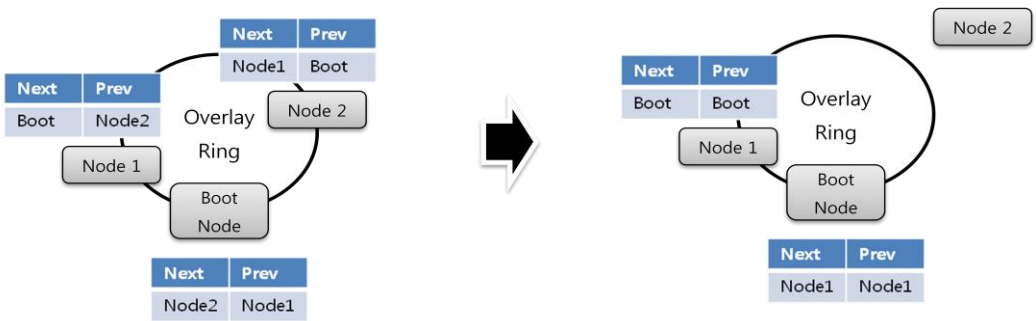


Fig. 10. The process of Member Expire

B. P2P Network between with Servers

1) Node Link

Figure 8 shows information of each node. Each node has information of next and previous node. Through that, all nodes are linked in one ring.

In other rings, it is happened same information. Therefore ring structure of all overlay rings is extension of one ring.

2) Member Join

Figure 9 shows process of member join.

First, there is boot node on the ring. Next, the node1 join through boot node. The node1 send join message to boot node and update next and previous information of boot node. Finally, the node2 send join message to boot node. After that, boot node send node2 information to node1. So, all nodes are updated next and previous information of nodes.

3) Expire

If node2 is expired in the ring, boot node recognize that, and others nodes are received expire message from boot node. After that, each node is updated the information.

4) Maintenance

It must maintain node status for check of broken links on the ring. So each node are sending status message to neighbor nodes. If it can't find neighbor nodes, will be executed expire process

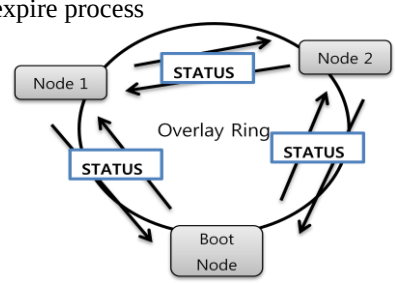


Fig. 11. The Process of Maintenance

C. Contents searching and receiving

Fig. 12. Request Protocol for Contents Search

If the user wants searching contents by typing keyword and click search button, it make request packet as Figure 12. After that, header(0x50) will be added in front of it. Next, this packet sends to super peer of mobile node and others super peers. The super peers that received contents searching request is send this packet to child nodes. The node sends a result to source node through source IP address in packet if the keyword is included in this node.

V. IMPLEMENTATION

We implement mobile IPTV system based on super peer P2P overlay network as Figure 13. There are three super peer server and eight nodes and IPTV contents are included as Table II. First, we initiated three super peers in each server and send a search request in mobile device.

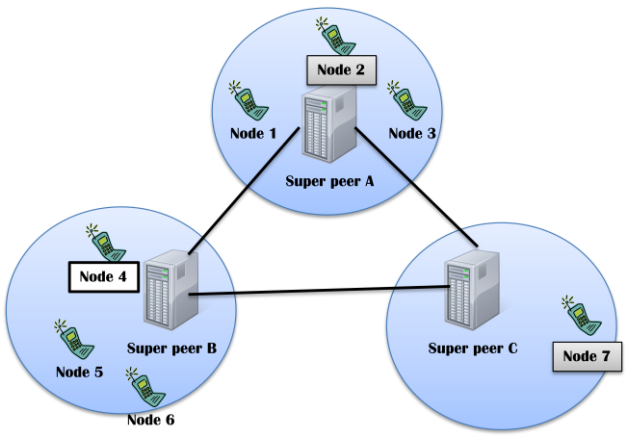


Fig. 13. Test-bed Environment

TABLE II
INCLUDING CONTENTS IN THE NODE

Node	Contents (keyword)	Super peer
1	Korea Broadcasting(KBS)	A
2	Girls generation M/V(music video) Sports TV(sports) KUT Music(music video)	A
3	Game Channel(game)	A
4	Toy story Movie(movie)	B
5	Comedy TV(comedy)	B
6	N/A	B
7	M-NET IPTV(music video)	C

A. Server application(super peer)

1) Boot peer node(super peer A)

The first super peer is called boot peer node. So super peer A is initiated boot node. And previous and next node information is null because there is one node only in network.

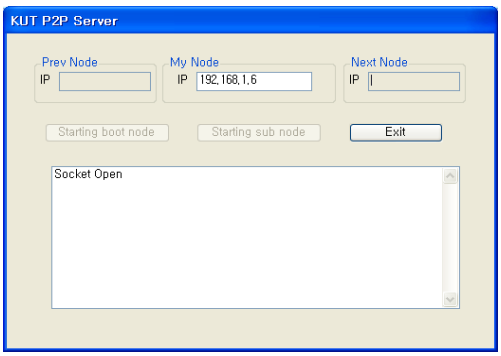


Fig. 14. Initiate the boot node on Super peer A

2) Sub peer node 1(super peer B)

After initiate the first node, the sub node was initiated. So, super peer B set previous and next information with super peer A IP address.

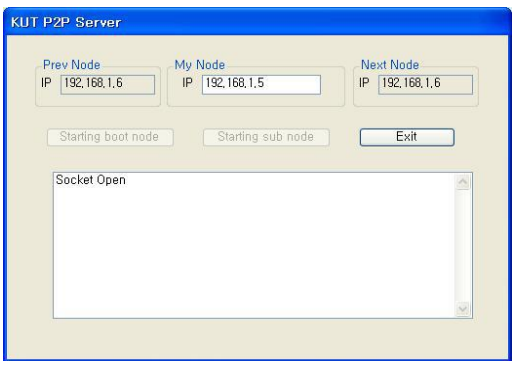


Fig. 15. Initiate sub node on Super peer B

3) Sub peer node 2(super peer C)

Super peer C set a previous and next information with super peer A and B information. Through that, three super peers are organized once network.

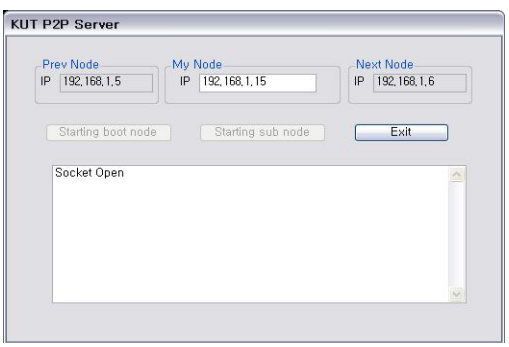


Fig. 16. Initiate sub node on Super peer C

B. Client application(mobile node)

We made client application using iPhone SDK. The iPhone is a smart phone which is widely used in the world. It provides contents searching by keyword and playing the IPTV contents using super peer P2P structure. Figure 17 shows testing results about search music video keyword. First, mobile node 4 is sending a search request to super peer B because it is managing server of mobile node 4. Next, super peer B is searching a keyword in node 5 and 6. And then broadcast search request to super peer A and C. After that, super peer A and C is searching a keyword in child nodes. The mobile node sends a reply to source node if there are contents that include this keyword. In this result, we can show contents list in Node 2 and Node 7 because this contents exist in these.

Fig. 17. Client Application in Node 4

VI. CONCLUSION

In this paper, we proposed mobile IPTV system and protocol based on super peer P2P and Overlay network. Current network services are trending toward open platform service. Therefore P2P network is very efficiency. Then, we will research P2P network for enhancement of performance. So proposed network structure is helpful to this research. And we implement mobile IPTV system by super peer structure. Through this system, IPTV contents provider will be decrease cost for managing server than previous server/client model. In the future work we will research efficient super peer network and implement mobile IPTV system for supporting various devices that has different screen size such as smart phone, tablet, TV, etc.

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