

Title	インターネット環境に適した構造化P2Pネットワークソフトウェアの設計と実装
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Practical Design and Implementation of Structured P2P Network Software for the Internet Environment

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Abstract

P2P network, whose nodes communicate autonomously with each other and share their resources to serve several services, is a distributed service model. It is classified into two types. One is structured P2P networks, whose nodes are addressed by numerical values, and the second is unstructured P2P networks, whose nodes have no address. Retrievals on structured P2P networks are more efficient than unstructured P2P networks because of the address structure. Several algorithms of structured P2P networks are proposed, but Kademlia, which is a pretty simple structured P2P network algorithm, is chosen in this thesis to tackle problems of retrieval on routing table, NAT problems and problems on large-scale churned network.

The Kademlia's routing table is originally designed by a tree structure. In this thesis a array structure for the routing table is proposed to improve efficiency of the retrieval and compared to the tree and array. As a result of evaluations, when the network size is 100,000, the total cost of the tree is more than 30 times expensive than the array where the cost of the tree is the number of branches to follow and the array is the number of entries to look up.

Structured P2P networks are designed under a assumption that any nodes could communicate with each other without any restrictions. However, some nodes couldn't actually communicate with each other because there are NATs on the Internet. Thus, in this thesis, distributed NAT traversal mechanism named DTUN is proposed to solve problems caused by NATs. DTUN is more suitable for P2P networks than any other server based NAT traversal mechanisms because of distributed architecture.

It is required that the design of P2P networks is resilient to churn, and DTUN also needs resiliency against churn. In this study, the churn resiliency on large scale network is evaluated by using *libcage*, which is a structured P2P network library developed to demonstrate DTUN. As a result of evaluations, when the network size is 10,000, DTUN works very well even if there are NATs and the network is being churned.

The nodes, in other words users, of P2P networks share their resources each other, and they could determine their lifetime by themselves. P2P networks could hence build sustainable, scalable and available services. Although P2P networks potentially have such advantages, P2P networks couldn't demonstrate its abilities well because of the restrictions of the Internet, churn problems and so on. Therefore, in this thesis, several methods, approaches and systems are proposed to realize that P2P networks can fully demonstrate its potential. If the proposals of this thesis are applied, the potentials of P2P networks would be fully demonstrated.

Key Words: structured P2P network, NAT traversal, distributed hash table, churn