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Network-Aware P2P File Sharing over the Wireless Mobile Networks

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With the advance in the wireless mobile communication technology, characteristics of the wireless mobile environment, such as variable bandwidth connectivity, location dependency, and energy sensitivity, bring new challenges for research of P2P computing over the wireless mobile networking environment. Although wireless mobile data communication is widely used in cellular systems and in wireless LANs, Internet-based data communication crossing different wireless networks is still a problem. The problem occurs when a device roams away from its home network and is no longer reachable using the normal IP routing. A wireless mobile host will lose connection, which makes active sessions of the host being terminated, when it moves across different IP subnets. The routing path's change may affect the quality of data transmission, e.g., the download performance of a file may become worse. Thus, how to improve the resource discovery and retrieval for P2P file sharing applications in wireless mobile networks becomes a critical issue for having P2P computing over the wireless mobile networks.

Traditional P2P file sharing applications do not support mobility, which makes it difficult for mobile users to retrieve files in wireless mobile networks. Two concerns that affect resource discovery and retrieval for P2P file sharing applications in wireless mobile networks are (i) peers' movements in wireless mobile networks and (ii) peers' join and leave in a P2P file sharing network. In a traditional P2P file sharing network, peers form a virtual overlay topology regardless peers' physical locations. However, such assumptions are not suitable for peers to retrieve files in wireless mobile networks, in which a user often needs to roam from a network to the other network. In a P2P file sharing network, peers can join and leave the P2P file sharing network freely. When peers join a P2P file sharing network, they can share new files and give chances for other peers to find desired files. Obtaining fresh status of participant peers in a P2P file sharing network can give chances for hosts to find desired files and can help hosts to resume data transmission from the other resource providing peer immediately.

The main objective of our work is to enable continuous resource discovery and file retrieval for mobile users in wireless mobile networks. In order to achieve the resource discovery and file retrieval in wireless mobile networks, we proposed a network-aware P2P file sharing architecture. In order to have a more efficient file sharing over wireless mobile networks, we propose a new peer-to-peer (P2P) file sharing architecture that can support mobility of peers when they roam from one network to other networks. The proposed architecture divides a P2P file sharing network into multiple network-aware clusters. Peers are assigned to a network-aware cluster using a network prefix division. All files within the same cluster are searched first, which can speedup the resource discovery in the wireless mobile network environment. Participants in the proposed architecture are divided into two types: peers and super-peers.

A peer is an ordinary host that can join and leave a P2P file sharing network freely at any time. The peer can search, publish, and retrieve files in the mobile P2P file sharing network. A super-peer is a selected node that provides functions for peers to locate a specific file. File lookup requests are forwarded to other super-

peers when a peer can't locate a file within its network-aware cluster. Figure 1 illustrates the proposed network-aware P2P file sharing architecture.The network-aware P2P file sharing architecture enables the files to be searched first with nearby peers. Peers with IP addresses that have the same longest prefix belong to the same network-aware cluster. Each network-aware cluster has a super-peer. A new super-peer is created when the first peer joins in a network-aware cluster. The super-peer maintains an index of the shared files and an index of peers' location information in its network-aware cluster. When a requesting mobile peer sends a lookup request to its own network-cluster super-peer, the super-peer checks whether the desired files exist or not. If the super-peer finds desired files, it sends a response message to the requesting mobile peer. If no such files can be found in the network-aware cluster, the super-peer forwards the lookup request to its nearby network-aware clusters for finding the desired files.

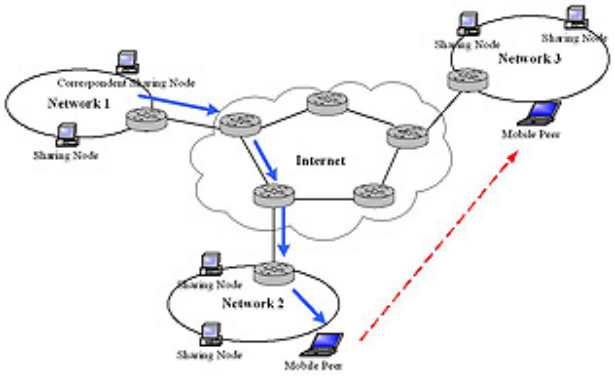

Figure1. Network-aware P2P file sharing clusters.

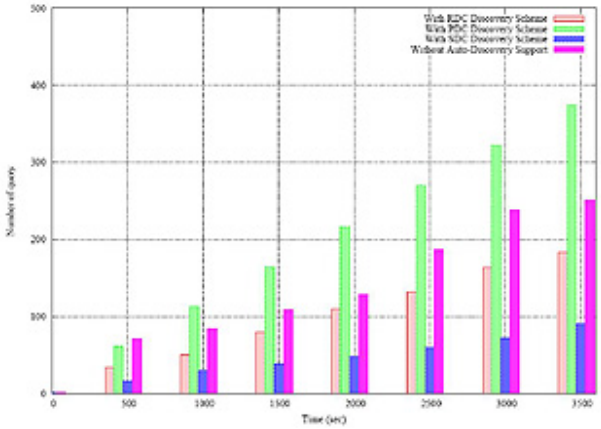

Figure 2. The accumulated number of discovery messages of different discovery schemes.

Sending discovery messages periodically is a way to obtain fresh status of peers that share files. In a wireless mobile network, a mobile peer that requests files can send messages periodically to discover peers and select a new and better one for file retrieval. However, it may waste network bandwidth if each requesting mobile peer sends a lot of messages periodically to discover peers that share files. To solve the problem, we propose two novel file discovery control schemes: receiver-driven discovery control (RDC) and subscribe-driven discovery control (SDC). Figure 2 shows that the accumulated number of discovery messages of different discovery schemes. The action of resource discovery consumes computing power and network bandwidth. It's the tradeoff between the file retrieval throughput and the number of discovery messages. In Figure 2, the total number of discovery messages of the RDC and SDC method is less than that of the other methods during long period time. This means that the proposed RDC and SDC discovery schemes can reduce the bandwidth requirement for resource discovery, which can avoid traffic jam in wireless channels. On the contrast, the traditional discovery schemes need to send lots of discovery messages. The proposed schemes can find new resource providing peers quickly when a new coming file is shared and reduce the number of messages that are used to discover new resource providing peers in the wireless mobile networks environment.

Retrieving a file from a fixed resource providing peer is not always a good choice in a wireless mobile network due to the movements of mobile nodes. Therefore, peers need a way to discover peers that have better connection quality for file retrieval. The network-aware P2P file sharing system architecture enables continuous resource discovery and file retrieval for mobile users in wireless mobile networks. The main contribution of this research is twofold: (1) The performance of file retrieval for mobile peers can be improved in wireless mobile networks and (2) a mobile peer can capture fresh status of peers for fault recovery quickly. The potential applications include network-aware services and multimedia file sharing for mobile users.