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Author(s)	Le, Nam Jr
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Japan Advanced Institute of Science and Technology

Collaborative Editing Application in Mobile Ad-hoc Networks

Le, Nam Nguyen Hoai (1010227)

School of Information Science,
Japan Advanced Institute of Science and Technology

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Keywords: Group editing, concurrency control, replicated objects, fault tolerance.

Collaborative editing is the study on how a group of people works together on a shared document. It plays an important role for Computer Supported Collaborative Work (CSCW). Furthermore, in recent years, with the advance of mobile technology, people use mobile devices as tools for collaborating and working anytime, anywhere. That allows developing applications that enable users, using their own mobile devices, to collaboratively edit the same document without the presence of a fixed network infrastructure. Therefore, collaborative editing application in mobile ad-hoc networks (MANETs) attracts a lot of interest.

In a centralized architecture, collaborative editing application consists of many users and a central server. Every update made by a user is sent to the central server, the role of which is to keep the shared document and manage all aspects of the collaboration. However, in the context of MANETs, the existence of a central server is not always guaranteed. Consequently, a decentralized architecture is more appropriate for collaborative editing application in MANETs. In a decentralized architecture, every user has to maintain a copy of the shared document because there is no dedicated server holding the shared document. A user can make any updates on his/her own local document anytime, anywhere and sends every update

to all other users. That promotes concurrency, independence and responsiveness in the collaboration. However, in MANETs, mobile device can move freely outside of the transmission range of other devices, while it has to receive and process correctly all updates from other devices especially concurrent updates, which causes many problems for a decentralized collaborative editing application in MANETs.

The major contribution of our work is the development of an Android-based application for decentralized collaborative editing. In our application, we focus on document consistency and fault tolerance.

About document consistency, in a decentralized collaborative editing application, it is difficult to keep all copies of the shared document in the collaboration to be consistent regardless of concurrent updates and arrival orders of those updates. Currently, most of collaborative editing applications are based on Operational Transformation approach to solve this problem. However, in MANETs, high latency causes a large number of concurrent operations while according to Operational Transformation approach, every remote operation must be transformed against all of its concurrent operations in the history to ensure document consistency. In our application, we reply on the concept of TreeDoc, a data structure that supports eventually consistent information. With TreeDoc, concurrent operations can commute with each other, so a large number of concurrent operations do not affect application performance. Beside the advantages, TreeDoc has the problem of overhead. Our application minimizes overhead of TreeDoc by developing rebalancing. We carry out the experiment on real environment with android mobile devices to compare the performance of TreeDoc with Operational Transformation and investigate the effect of rebalancing to the performance of TreeDoc in order to determine the most suitable value of rebalancing period for our experiments.

About fault tolerance, in MANETs, user frequently gets disconnected from other users. In the scope of our work, we concentrate on the disconnection in the case when a user goes too far outside of the transmission range of other users. When a user is disconnected, it misses messages consisting of joining messages, leaving messages, and document operation messages from/to the users that it is disconnected from. However, disconnected user is still able to work on local document. Consequently,

disconnection event may affect the process of joining, leaving and editing in the collaboration session. In our application, we provide a solution for tolerating disconnection event in order for disconnected user to be able to get the missing messages after it has reconnected.