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A Replication Scheme Based on Clustering and Time Indexing for Ensuring Consistent Data Availability in Mobile Adhoc Networks

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The mobile ad-hoc networks (MANETs) are decentralized network with resource constrained and mobile nodes. This characteristics of MANETS has a direct impact on the data availability. Replication has been used as one technique to improve the data availability both in MANETs and fixed networks [1][2]. Data replication has an impact on the network resource utilization. In this paper, we propose a replica allocation scheme to reduce the communication cost while maintaining high consistent data availability. The proposed scheme builds group of 1-hop cluster of nodes in the network. One node in each cluster plays a role of a replica allocator for replica allocation based on the data access frequencies that are computed periodically. The provision of recent data on demand basis is based on Time indexing approach. We evaluate the proposed scheme by simulations using the network simulator NS-2. The results of simulations showed significance reduction in the communication cost in comparison with the existing replica allocation scheme (SAF and DCG) and the method exhibited improvement in the data availability with the increase in the number of users in the network in par with DCG.

1. INTRODUCTION

A popular acronym for Mobile Ad hoc NETwork is MANET. It is a Wireless Ad-Hoc Network technology. The nodes in the network are mobile and act as both client and server [1]. MANETs do not have any central authority or fixed infrastructure, unlike the traditional network . The major challenges in the mobile adhoc environment are limitations of the Wireless Network, limitations imposed by Mobility, and limitations of the Mobile node. Adding on stability to the dynamic nature of the network plays a key role in MANET.

There have been proposed several methods that replicate data to some new nodes based on particular strategies such as knowledge of the network, network partitioning, network density, or clients request rate [2] to improve data availability. In this paper, we propose a scalable replica allocation scheme based on clustering to resolve the communication cost problem especially when the number of nodes in the network increases. The clustering is used to reduce the communication cost and to achieve high data accessibility as well. For replica allocation, the cluster head in each cluster plays a role of the replica allocator who distributes replicas to the group nodes based on the estimated access frequencies that are computed by the allocator at the replica relocation time. Clustering with mobility and utilizing the data access rate information improves the stability of the topology of each cluster as well as the data availability. The technical contributions of this paper can be summarized as follows:

- Clustering method: The whole network is logically grouped into a set of clusters of 1-hop radius. These groups are done with the communication among one-hop

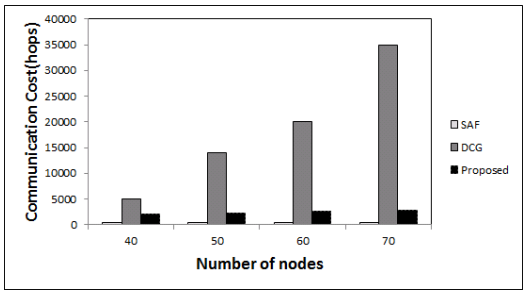

Figure 4. Communication Cost Vs. Network Size.

Table 6
Comparison of Proposed Technique and SAF, DCG Techniques

characteristics	Proposed technique	SAF	DCG
ClusterbasedArchitecture	*YES*	*NO*	*NO*
CentralizedArchitecture	*NO*	*NO*	*NO*
ConsistencyMechanism	*YES*	*NO*	*NO*
Loadbalancing	*YES*	*NO*	*NO*
Scalable	*YES*	*NO*	*NO*

6. CONCLUSIONS

The proposed cluster-based replica allocation scheme is based on mobility-based grouping and data item access estimated frequencies. The simulation results and analytical evaluations show that the proposed scheme is effective in achieving high data availability. Moreover, our proposed scheme is scalable because our scheme maintains similar performances as the number of nodes increases in terms of the communication cost. In this work, care is taken to maintain data consistency. Since time or occurrence is taken into consideration, if the replicated data is not recent and is an out-dated one, then an automatic replacement mechanism is encountered to prevent unnecessary space utilisation. All these, enhance the performance of the MANET environment, where node mobility and limited resources are the key issues, by providing for enhanced data availability features even with constrained resources.

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