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DPDRM: A Decentralized Post-Disaster Resource Management Scheme using Energy Efficient Smart Phone Based DTN

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Abstract

Large-scale natural disasters affect traditional communication infrastructure due to incidental destructions and damages. Delay-tolerant networks (DTN) proves to be a viable option for exchanging information during such scenarios. Different disaster management agencies setup camps and mobilize their resources and manpower in the affected areas after the disaster. Resource management is an integral part of post-disaster relief operation. Each camp manages its own resource inventory. Periodic sharing of resource inventories from different camps is essential for maintaining a near-accurate unified global inventory at each node that enables successful search and retrieval of resource requests (queries). But, due to the intermittent network connectivity, maintaining such a consistent resource inventory and successful search/retrieval of queries becomes challenging. We map this post-disaster resource management as a content sharing problem with strict time constraint and propose an automated, energy efficient and decentralized resource management scheme over DTN. The proposed scheme allows periodic group based sharing of resource inventories and supports search and retrieval of queries within a restricted time period. Here, resource inventories are shared among the group members by employing publish-subscribe mechanism. Moreover the queries are propagated to the group members based on the probability of encounters. This probabilistic propagation controls the unintended replication of query. Finally, the proposed scheme is evaluated through ONE simulator based on a realistic post-disaster scenario of the 2015 Nepal earthquake. The results reveal that our proposed scheme outperforms one of the state-of-the-art content sharing schemes, discover-predict-deliver in terms of response delivery, average energy consumption and average delivery latency.

Keywords: Post-Disaster Communication; Delay Tolerant Networks; Post-Disaster Resource Management; Content Sharing;

1. Introduction

The number of natural disasters has increased significantly in the past couple of decades. According to the World Disasters Report 2016 published by the International Federation of Red Cross and Red Crescent Societies (IFRC), during the decade 2006 to 2015, Asia region has witnessed around 40% of the total natural disasters. For example, in India as many as 200 million people are exposed to recurring floods every year [1]. Massive natural disasters cause heavy human casualty and enormous damage of property. Post-disaster relief operations are crucial to reduce unwanted human casualties and damage of property. Such operations are carried out by different response/relief groups. Based on their activities, the groups set up different types of camps. Each camp has a dedicated group of volunteers or relief workers who provide a specific type of service related to that camp. Every camp contains resources (medicines, food stuffs, cloths, other relief materials) necessary for providing aid to the victims. The resources are managed locally at camps. The resource inventories are time varying in nature, the relevance of any resource inventory is valid only for a certain period of time after which that information becomes stale. Majority of post-disaster relief activities in developing countries like India, suffer from disproportionate distribution of resources [2]. Hence, efficient resource management is crucial in post-disaster scenarios. Otherwise, the possibility of resource wastage or scarcity could not be ruled out. Our interaction with several renowned disaster-management NGOs of India like *Doctors For You*[1] (DFY) and *Society for Promotion*

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[1] Doctors For You (DFY) is a pan India humanitarian organization with international presence and is working in various disaster hit zones since last 9 years. Website: http://doctorsforyou.org/