Poster: An Adaptive Content Sharing Protocol for P2P Mobile Social Networks

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***Abstract*: In Mobile Social Networks (MSN) users can participate in communication based on their mutual interests. Many solutions for Mobile Ad Hoc networks have been proposed however content based communication in partially or intermittently connected MANETs has been a recent research area. In this paper we present an adaptive protocol to facilitate implementation of a Mobile Social Network based on peer to peer content driven communication when end-to-end connectivity is not possible. The proposed protocol takes into account the information about user's interests, content based data storing and forwarding, and host mobility in a disconnected, delay tolerant MANET.**

Index Terms: Mobile Social Networks, disconnected MANET, P2P communication, simulation, content sharing.

I. INTRODUCTION

In this paper we address the issue of content based communication in mobile peer-to-peer (P2P) networks. We propose a protocol for adaptive peer-to-peer content sharing between users of a Mobile Social Network. As we assume that the MSN application is running on hosts (cellphones, PDAs etc) with stringent resource constraints such as limited battery life, processing power, limited connectivity and frequent network topology changes due to physical location change of users, seamless communication may not be always possible. We therefore find the underlying network topology to be similar to a delay tolerant disconnected Mobile Adhoc Network (MANET) [1]. In a delay tolerant disconnected MANET, the network can become disconnected when the mobile hosts that compose the network are very sparsely or irregularly distributed, therefore appearing as a collection of distant groups of hosts [2]. Communication with-in a group is possible but no communication is possible between hosts of distant disconnected groups. In such conditions communication between the groups can be achieved by storing the message temporarily on a host, in order to be forwarded by this host when circumstances permit [3]. Since hosts in an MSN are mobile, the mobility can be an advantage making it possible to propagate the message throughout the network serving mobile hosts as carriers.

The proposed protocol utilizes the notion of opportunistic networking in a delay tolerant environment where messages are stored, carried and propagated when deemed suitable. Each host maintains a list of interests containing the various interest topics that it is interested in. Hosts sharing similar interests share content that can be various documents, audio/video files etc. The shared content can be passed to other hosts in a different location provided that they have similar interests thus enabling store and forward properties of a delay tolerant network. We intend to utilize this property of delay tolerant networks to maximum extent for an implementation of a Mobile Social Network Environment. The rest of the paper is organized as follows. Section 2 presents the Protocol; section 3 shows the simulation environment and analysis of results followed by conclusions in section 4.

II. PROPOSED PROTOCOL

We define the proposed protocol as a three layer stack. The top layer supports the user interface and works as an application layer. The middle layer provides support for content driven data dissemination in the form of documents and messages. It manages sending and receiving messages to neighboring nodes in the network, inquiring about common interests and validating a node to be a friend. A friend node is usually a neighbor with at least one similar interest. A neighbor must be within the range of the node thus being a member of the same group of nodes. It is also responsible for sending, receiving and storing documents in the repository of the node. The third layer is the lowest layer responsible for data forwarding to distant nodes in a multihop manner.

A. Application layer (top layer)

In the application later we consider three factors to be essential to successful data sharing in a social network; Interest Profiles, Document Lists and Document Repository.

Interest Profiles: Each user maintains a list of keywords describing his interests. These keywords are used for searching and indexing purposes. An interest profile can be detailed and may even contain both text as well as graphics data and therefore it can take increasing amount of storage allocation. However for the proposed protocol we assume that an interest profile would be a collection of keywords only and therefore would take minimal amount of storage.

Document List: is a list of documents stored at a host. A document list consists of attributes of documents stored in the repository. These attributes include but are not limited to a Unique Identifier for the document, Document size, Document type, ownership and a Timestamp. Each document stored in the document repository has this information.

Document Repository: Each node maintains a document repository for documents to be shared. Since most mobile devices have limited memories for storing documents, we set limits to the size of each nodes document repository.

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B. Content Dissemination Layer (middle layer)

At this layer our protocol defines interaction between neighboring nodes. A neighboring node is within the range of the node interested in communication, thus being a member of the same group of nodes. To make our model simple we follow a three step process for all transmissions. These three transmissions are announcing and receiving Interest Profile, Inviting interested host and Requesting, Sending and Storing Documents.

C. Content Forwarding Layer (lowest layer)

This layer of the protocol is responsible for storing and forwarding documents from immediate neighbors to distant nodes using neighbors over a multihop connection.

Store and Forward: In the middle layer of the proposed protocol, we defined send and receive procedures for messages between neighboring nodes. As soon as the invitation is accepted by a node, a list of document types with similar interests is compiled and sent to the invited node. A copy of requested document is sent to the interested user and therefore stored in the repository. This document can be forwarded when an opportunity arises.

Multicasting messages: It is possible that many adjacent nodes would request the same document from a host. In this case a unicast message needs to be sent to all requesting nodes. This however would greatly decrease the performance due to overhead of repeatedly sending the same message. As a solution to this problem we use the n-list; list of adjacent neighboring nodes, as described in the middle layer. If a simple majority of hosts request the same document, we send a broadcast message to all immediate neighbors (ϕ = 1), instead of individual unicast messages.

III. SIMULATION AND EVALUATION

The proposed protocol in section 2 has been implemented in Java and interfaced with MADHOC [4] simulation tool. We run a number of 15,000 iteration / seconds, simulations to study the various conditions of the protocol based on many parameters. In MSNs, movement is driven by social relationships, the simulation area is divided into a grid of 5 x 5 in our experiment. Each group of nodes with similar interests is then placed in one of these squares. Each host moves within a square using a random waypoint model [5].

Simulation Parameters: We assume that each user is equipped with a laptop device or a Wi-Fi enabled PDA device. Each device has a Omni directional transmission range of 100m. There are 100 users in a 1000m x 1000m environment. The node speed is generated using a uniform distribution with values ranging [1, 5] m/s. The speed of the traveler node is set to 10 m/s. User may pause for up to 2 minutes to look for a destination. In our experiments we define 32 different interest profiles. Each host broadcasts an announce message every 15 seconds, we assume this delay because at pedestrian speeds 15 seconds is generally considered as an adequate time for MANETs.

Adaptive document broadcasts: In the description of the protocol we defined broadcast messages sent to neighbors requesting the same document. This is done in-order to reduce the overall uni-cast traffic destined to a majority of neighboring nodes. Here we study the impact of sending a single broadcast message containing the document to all neighboring nodes instead of sending only to the requesting nodes. We simply count the number of neighbors σ using the n-list. If the total number of requests made for a document

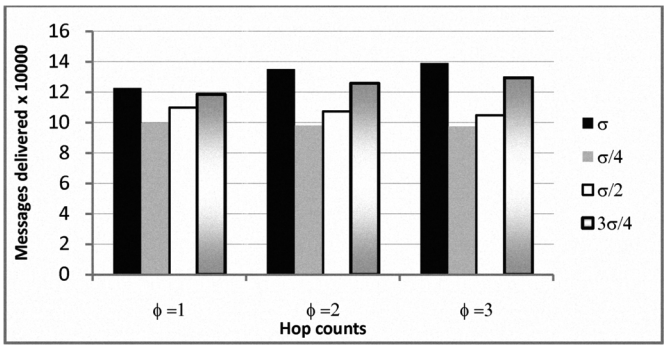

Figure 1: Messages delivered with various σ values for ϕ with 256KB document payload

from different hosts is σ/2 (50%) then we send a broadcast message instead of σ/2 unicast messages. Similarly we compute the threshold for σ, σ/4 and 3σ/4. Figure 1 shows the relationship between the broadcast threshold and total number of messages delivered. It can be seen that when the number of nodes requesting is σ/4, i.e. send a broadcast message when 25% of total nodes in the n-list are requesting the same document, relatively, the number of messages sent is minimal. Interestingly, for σ=0, when no broadcast messages are sent, the number of messages sent when σ/4 is almost 30% less. This shows that our approach for selective broadcasting improves the performance by reducing the number of messages sent.

IV. CONCLUSIONS AND FUTURE WORK

This paper presents a novel approach for content sharing in Mobile Social Network using content based routing in MANETS. It is based on an opportunistic routing mechanism for content sharing between users with similar interest profiles. Our results show that peer to peer data transfer over multiple hops in the network present faster data dissemination in the network. An adaptive approach to message broadcasting instead of uni-casting to specific nodes shows improved performance in message dissemination. In the future we intend to improve our protocol by incorporating context awareness into the routing mechanism. Also we plan to formulate methods for user privacy and content security.

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