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Efficient Content Sharing over Delay Tolerant Networks

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Abstract: Now days there are increasing demand for content sharing in wireless networks. Previous data delivery schemes are not efficient for content sharing because of the discontinuous connectivity between smartphones. To overcome this, store carry-forward protocol schemes are used. In these schemes a node stores a message and holds it for a certain interval until a communication opportunity occurs. In an ad hoc method of peer-to-peer content sharing, contents are unexpectedly discovered and shared. The proposed system triggers the query based on forwarding decisions. It finds whether two nodes would have a contact in the future considering the distance and time when the contact occurs. The utility function is used for efficient routing of contents.

Keywords: Wireless communication, Energy efficiency, Store and forward networks, location dependent and sensitive.

I. INTRODUCTION

In wireless networks the problem of content sharing remains troublesome. The numbers of smartphones are increasing now days. Ad hoc method of peer to peer content sharing is the way to reduce the burden of registration, uploading, and searching and downloading contents from users. This method spontaneously discovers and shares the contents. This approach will improve the efficiency as compared to existing methods. Ad hoc networks can easily be constructed with Smartphone are prepared with network interfaces like Bluetooth and Wi-Fi. The connectivity between smartphones is expected to be discontinuous due to the movement patterns of carriers. To overcome this problem, researchers have proposed a variety of store carry-forward routing methods. In Store-forward networks information is sent to an intermediate station where it is kept and sent at a later time to the final destination or to another intermediate station. This technique is commonly used in networks with intermittent connectivity mainly requires high mobility.

In the store-carry-forward routing schemes [2],[7],[8] a node stores a message and carries it for a certain period until a communication occurs. Utility functions are used for making local forwarding decisions. To increase the delivery possibility multiple copies of the same message are spread in parallel. Delay-Tolerant Network (DTN) routing protocols achieve better performance than traditional mobile ad hoc network (MANET) routing protocols [1]. The absence of the requirement of a central server is the advantage of both DTN and MANET routing protocols. Hence contents are distributed and stored directly on the smartphones.

In Delay Tolerant Networks communication is possible even if end-to-end connectivity is never achievable. Also DTN uses node's mobility. The node uses store-carry-forward mechanism. A basic DTN routing solution is Epidemic routing [2] which quickly distribute messages to hosts, within connected portions of ad hoc networks. At this point, the message spreads to an additional island of nodes. Through such transmission of data, messages have a high probability of eventually reaching their destination.

DTN routing protocols delivers a message to a given destination, whereas the content sharing method first discovers content before delivering it to the destination. Existing methods are based on traditional mobile ad hoc network routing protocols which delivers worst performance for content sharing. Some methods presented using the DTN, but deliver the less efficiency. The method introduced with more efficiency. In this paper we are introducing the energy aware method which can able to reduce the consumption of mobile energy. The system mainly focuses on query search-termination technique. The contents are shared using new utility function.

II. LITERATURE SURVEY

Epidemic Routing for Partially Connected Ad Hoc Networks [2]. Epidemic routing is a simple solution for DTNs .in which messages are delivered with high probability even when there is never a fully connected path. This routing accomplishes the highest possible delivery rate and lowest possible latency, but the disadvantage is it requires huge bandwidth and storage resources. In prediction-based schemes [7] utility functions are designed using the history of the mobility, the encounter times, and the encounter rates. Depending on the number of copies of a single message that may coexist in the network, define two categories of mobility-assisted routing schemes. In single-copy schemes, there's only one node in the network that carries a copy of the message at any given time. This node is considered as the custodian of the message. When the current custodian forwards the copy to an appropriate next hop, this becomes the message's new custodian, until it reaches its destination. The multiple-copy routing schemes [3] may generate multiple copies of the same message, which can be routed independently for increased robustness.

Searching for Content in Mobile DTN by M. Pitkanen[4], explores various methods to limit query spread. The key differences in content detect are that we use a multicopy query distribution scheme, and our detect scheme efficiently uses location information to prevent the unnecessary propagation of queries. In the store-carry-forward networking the nodes communicate using DTN bundle architecture [7]. All users are ready to cooperate and supply a limited amount of their resources, like bandwidth, storage, and processing power, to help others. This method allows users to issue queries for content stored on other smartphones anywhere in the network and to review the chances of obtaining the information needed.

EnLoc[6] uses GPS, GSM, and Wi-Fi system for energy-efficient localization. The system takes advantage of human mobility patterns to predict a location of user to minimize the sampling count. Mobility prediction has been widely studied in and out of the delay-tolerant networking community. Markov-based schemes formulate the problem as a Hidden Markov or semi-Markov model and predict human mobility. Previous work has studied the power of Bluetooth/Wi-Fi devices which either focus on only Bluetooth or ignore the duration of device discovery, but without which it is hard to evaluate the energy consumption of these devices. Entracked [5] is a location tracking system for GPS-enabled devices. The system is configurable to understand different tradeoffs between energy consumption and robustness.

III. IMPLEMENTATION DETAILS

A. Data flow Architecture

Data flow of proposed method is described by following steps:

Step 1: Input content request.

Step 2: Generate the query based on request if the contents are not found in local storage.

Step 3: Forward query in network based on distribution and termination technique.

Step 4: If content is found deliver it to query originator.

B. Content sharing algorithm

1) Input content request
2) Search in local storage.

   If not found then

   - Find the location of node for time instances..
   - Generate the query with query information
3) Apply distribution and termination technique.
4) Find utility Ui(d)value of each node

   If content found at node then

   - If $(U_j(d) > U_i(d))$ then

     Deliver content to destination

Generate Query

In the proposed method, contents are locally indexed and easily identified. We assume there are no limitations on content size, the contents are not fragmented, and they are not coupled to locations. Localization devices should be equipped in Smartphone e.g. GPS and inertial movement units, as well as various networking interfaces like GSM/CDMA, Wi-Fi, and Bluetooth. Contents are shared using the mobility information of individuals.

When any user needs some content, it generates the query. The query has query information QI.

QI contains: node identifier ID e.g., IMEI number, the creation time of the query t_{qc}, the query time T, the replication size, and the q node's mobility information:

$$\mathrm{IM}_{q} = \{l_{q,t_{qc}}, l_{q,t_{qc}+\delta}, \ldots\ldots\ldots\ l_{q,t_{qc}+k\delta} \mid k = [T/\delta]\}$$

Distribution and termination technique

The query is triggered in the network based on a particular forwarding decision and search-termination technique. Each node can make independent forwarding decisions. To limit the query triggering: a split query time limit and a query distance limit. We use a controlled replication-based [8] routing scheme because this scheme performs better than single-copy scheme. Our work splits the query lifetime for discovering and delivering contents.

When a query-carrying node encounters another node, the carrying node executes the following forwarding decision to spread the query:

$$\begin{array}{l} \textit{if}\ \ (t - t_{qc} < (1-\alpha).T)\ \ \text{then} \\ \quad \text{forward(QI)}, \\ \quad \text{if}\ (|l_{f,t} - l_{q,t}| < H)\ \ \text{then} \\ \quad\quad \text{forward(QI)} \end{array}$$

Where, α Є [0, 1] is the ratio of percentage of the query time used for detection and percentage used for delivery.

$l_{f,t}$ is the location of the forwarding node f at time t,

$l_{q,t}$ is the location of the query originator node q at time t

H is the threshold distance for query triggering It is set by the user.

This decision function is for limiting the query trigger in unnecessary area. A node may carry a query traveling long distance even the content can be found in the node's residing area. The content delivery cost will be very high, or the content may not be delivered due to the query time expiration. Hence limiting the query trigger to a certain region is reasonable.

If node finds that the query time will get finished while forwarding the query then the node terminates distributing the query.

Content delivery

Let the maximum distance to exchange messages between two nodes be R. The distance between smartphones i and j at time t is denoted as $D_{ij,t} = D_{ji,t}$. Thus, nodes i and j can exchange messages if and only if $D_{ij,t} < R$.

The content is routed toward the query originator using utility function. Each node maintains the utility value for other nodes. The contents are delivered to the node with higher utility.

$$U_i(d) = \sum_{m=t}^{t+k\delta} U_m,$$

$$\text{if } (\left|l_{i,m} - l_{d,m}\right| < R) \text{ then}$$

$$U_m = \frac{t}{m} \times \left(1 - \frac{\left|l_{i,m} - l_{d,m}\right|}{R}\right)$$

$$\text{else}$$

$$U_m = 0$$

Where, R is the communication range

$k = [T/\delta]$

C. Mathematical Model

1) Mobility Information:

$MI_i = \{l_{i,t}, l_{i,t+\delta}, \ldots\ldots. l_{it+k\delta}\}$

$L = \{l_1, l_2, \ldots l_m\}, \quad m \geq 1$

$k = [M/\delta]$

2) Query time:

$t_i = \{t_0, t_1\}$

3) Definations

1. Query time: The time difference between query release time t_0 and content usage time t_1, $T = t_1 - t_0$.

Hence after the query lifetime, both query and content are no longer useful.

2. Mobility information: A set of locations and paths between these locations. The mobility information of node i from time t for the interval of M is:

$$MI_i = \{l_{i,t}, l_{i,t+\delta} \ldots\ldots. l_{i,t+k\delta}\}$$

3. Utility function: The utility function $U_i(d)$ is for the effectiveness of node i in delivering a message to destination d. In utility-based routing, node i forwards a message with destination d to node j, if

$$U_j(d) > U_i(d) \text{ and } \forall_m : U_d(d) \geq U_m(d)$$

IV. Results

The implementation on the android platform with time instance δ=10 minutes, 5 nodes generates query every 30 minutes. Figure 1 summarizes the sharing efficiency of proposed system in delivering the contents for generated queries.

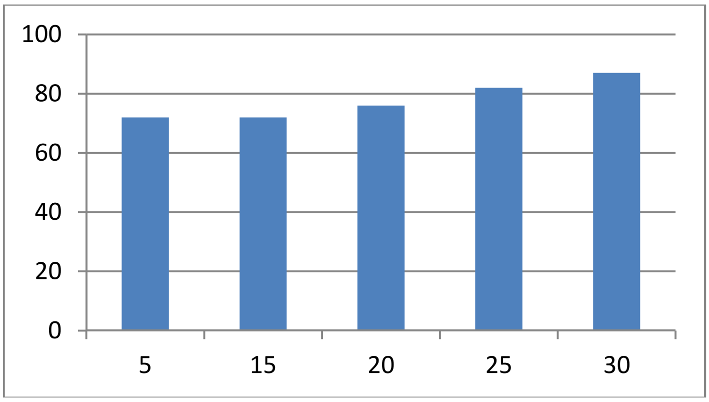

Figure 1. Resultant graph showing percentage of sharing efficiency with time

V. Conclusion

The proposed method tries to share contents efficiently over the DTN. By utilizing the Smartphone technologies the method shares the contents. By limiting the query distribution, the transmission rate is reduced. The utilization function uses the distance and time of nodes. This shows the effectiveness in delivering contents to the destination. Evaluation confirms the effectiveness of the proposed method.

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