



TOWARDS MAXIMIZING TIMELY DELIVERY OF CONTENT IN DTNs

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Abstract— Many applications, such as product promotion advertisement and traffic congestion notification, benefit from opportunistic content exchange in Delay Tolerant Networks (DTNs). An important requirement of such applications is timely delivery. However, the intermittent connectivity of DTNs may significantly delay content exchange, and cannot guarantee timely delivery. The state-of-the-arts capture mobility patterns or social properties of mobile devices[1]. Such solutions do not capture patterns of delivered content in order to optimize content delivery. Without such optimization, the content demanded by a large number of subscribers could follow the same forwarding path as the content by only one subscriber, leading to traffic congestion and packet drop. To address the challenge, in this paper, we develop a solution framework, namely Ameba, for timely delivery. In detail, we first leverage content properties to derive an optimal routing hop count of each content to maximize the number of needed nodes. Next, we develop node utilities to capture interests, capacity and locations of mobile devices. Finally, the distributed forwarding scheme leverages the optimal routing hop count and node utilities to deliver content towards the needed nodes in a timely manner. Illustrative results verify that Ameba achieves comparable delivery ratio as Epidemic but with much lower overhead.

Keywords— Information Dissemination, Delay Tolerant Networks, Opportunistic Communication.

I. Introduction

In Delay Tolerant Networks (DTNs), whenever mobile devices (PDAs, vehicles, mobile phones, etc.) encounter each other, they exchange content via short-range communications (e.g., Bluetooth or WiFi). Many applications and services, such as product promotion advertisement and traffic congestion notification, benefit from the opportunistic content exchange. It is useful in the areas where wireless networks do not cover, wireless access is blocked, or cellular networks are congested. Opportunistic communication thus helps to expand the network coverage, without building dedicated network infrastructures. An important requirement associated with exchanged content is freshness[1]. That is, besides successfully delivering the content to appropriate users, we further expect the content to be delivered in a timely fashion. For example, the timely delivery of certain product promotion advertisement is a critical requirement, e.g., at least before the end day of the product promotion period. Otherwise, outdated content, though delivered, is meaningless to users.

In this paper, we study the problem of maximizing the number of users who can receive content in a timely manner. In detail, we are inspired by the topic-based model to offer personalized content subscription. This model is widely used in many applications (e.g., RSS feeds, online games) to decouple content producers and consumers. The consumers, namely subscribers, declare their interests by specifying topics inside subscription conditions (called filters). An advertisement (which precisely means a content item in this paper) is associated with a topic[7]. An advertisement *matches* a filter (or a filter matches an advertisement), if and only if the advertisement and filter contain the same topic. The state-of-the-art systems leveraged mobility patterns or social properties of mobile devices to optimize content delivery. However, such works do not capture the patterns of delivered content for the content delivery. Without such optimization, the content demanded by a large number of subscribers could follow the same forwarding path as the case with only one subscriber. This obviously leads to traffic congestion and packet drop on the forwarding path. Moreover, many real applications show that the number of subscribers frequently exhibits the well-known Zipf distribution. This further aggravates the above-mentioned issue. To solve the above maximization problem, in this paper, we propose a solution framework, namely *Ameba*, by considering two subproblems and designing the associated techniques. First, *Ameba* considers a simple case by assuming that each node in a DTN has an equal probability to forward a given advertisement towards needed subscribers[6] (i.e., ignoring the constraint of mobility pattern and limited capacity). In this

way, *Ameba* develops a strategy to assign an optimal hop count for published content. To solve this subproblem, *Ameba* leverages the distribution of content and assigns a larger hop encounter for the highly popular content demanded by more subscribers. In this way, more nodes act as intermediate carriers of the popular content, and subscribers have more chance to receive the advertisement in a timely manner[12].

Next, *Ameba* solves the general maximization problem, where node capacity is heterogenous and mobility pattern is further considered. To this end, *Ameba* develops a metric, namely the forwarding utility, to identify (i) which nodes are interested in the advertisement and (ii) how fast the encountered node can forward the advertisement towards subscribers. Based on the developed utility, *Ameba* selects the best carriers to forward the advertisement, and adaptively creates the copies of an advertisement for timely delivery.

As a summary, we make the following contributions.

- We develop a forwarding strategy to design an optimal hop count for each content. The content with such a hop count is expected to reach the needed nodes.
- By the developed utilities to capture the interests, mobility patterns and resource capacity of mobile devices, we design an adaptive algorithm to select the best carriers for timely delivery.
- By analyzing the locations of mobile devices, we extend the utility function to optimize the selection of the best carrier, and further improve the forwarding algorithm.
- We extensively evaluate the efficiency of the *Ameba* over three realistic data sets and verify that *Ameba* is able to achieve a delivery ratio comparable with Epidemic but with much lower overhead.

II. PROBLEM DESCRIPTION

DTNs is an complementary network communication technologies. They help content providers deliver the content to needed nodes and explore more potential customers[2]. Suppose that N opportunistically encountered devices are connected as a DTN. The roles of mobile devices can be publishers (source), subscribers (destinations) or intermediate carriers. Publishers publish advertisements of specific topics. Subscribers register subscription filters to receive the needed advertisements.

A. DATA SETS

The proposed *Ameba* essentially is a hybrid of multicast and unicast, and it highlight its basic idea as follows. After an advertisement is published by its publisher, the advertisement is forwarded from the publisher to needed subscribers[5]. When a current carrier node of the advertisement encounters another node, *Ameba* adaptively decides to (i) relay the advertisement from the current node to the encountered node, or (ii) keep the advertisement still on the current node without any movement, or (iii) create a copy of the advertisement onto the encountered node, and the current and encountered nodes both act as the carriers.

B. ADVERTISEMENT RELAY STRATEGY

Consider a simple case by assuming that each node in a DTN has an equal capacity to forward a given advertisement towards needed subscribers[10]. Based on this assumption, they are interested in the optimal hop count to forward advertisements towards needed subscription. It will design a solution for a general case that the nodes are associated with heterogeneous capacities.

III. PROPOSED SYSTEM

Many applications, such as product promotion advertisement and traffic congestion notification, benefit from opportunistic content exchange in Delay Tolerant Networks (DTNs). An important requirement of such applications is timely delivery. It is useful in the areas where wireless networks do not cover, wireless access is blocked[9], or cellular networks are congested. Opportunistic communication thus helps to expand the network coverage, without building dedicated network infrastructures.

However, the intermittent connectivity of DTNs may significantly delay content exchange, and cannot guarantee timely delivery. To overcome the unavailable access of advertisement in a particular time, a solution framework, namely *Ameba*, for timely delivery. In detail, first leverage content properties to derive an optimal routing hop count of each content to maximize the number of needed nodes. Next, to develop node utilities to capture interests, capacity and locations of mobile devices. Finally, the distributed forwarding scheme leverages the optimal routing hop count and node utilities to deliver content towards the needed

nodes in a timely manner. Illustrative results verify that Ameba achieves comparable delivery ratio as Epidemic but with much lower overhead.

Ameba will generate the copies based on the requirement of the request from the subscriber. It will find the appropriate shortest path to send the advertisement in a timely manner. The state-of-the-art systems leveraged mobility patterns or social properties of mobile devices to optimize content delivery[13]. However, such works do not capture the patterns of delivered content for the content delivery. Without such optimization, the content demanded by a large number of subscribers could follow the same forwarding path as the case with only one subscriber. Provide multi copy to parallel accessing node same file has been duplicated for parallel downloading by multiple node concurrently. Message transferred to a DTN node classified as *persistent*, which has large amounts of non-volatile storage. It can hold the message until the next communication opportunity.

B. Architectural Diagram

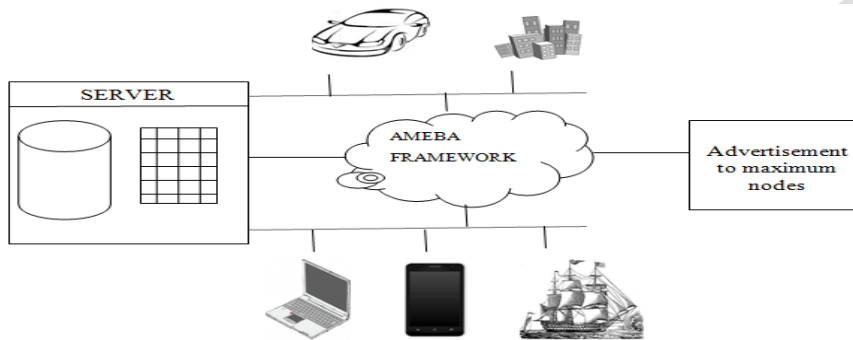


Figure 3.1. Architecture Diagram

Many applications, such as product promotion advertisement and traffic congestion notification, benefit from opportunistic content exchange in Delay Tolerant Networks (DTNs)[8]. The important requirement of such applications is timely delivery. However, the intermittent connectivity of DTNs may significantly delay content exchange, and cannot guarantee timely delivery. To address the challenge, it shows a solution framework, namely Ameba, for timely delivery. An important requirement associated with exchanged content is freshness. That is, besides successfully delivering the content to appropriate users, for further expect the content to be delivered in a timely fashion.

C. Data Flow Diagram

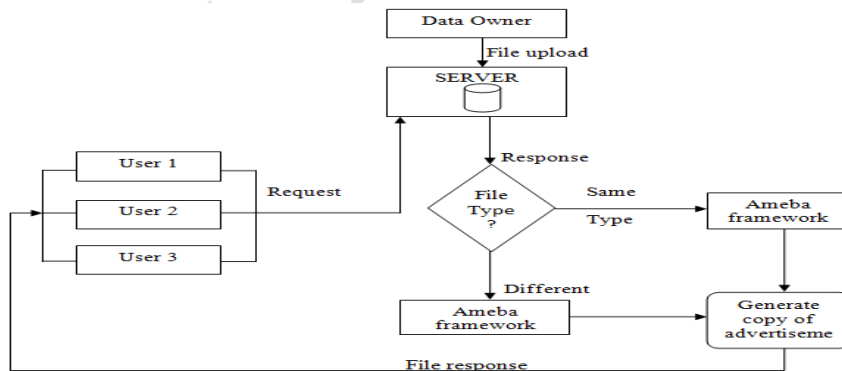


Figure 3.2. Data Flow Diagram

Ameba will generate the copies based on the requirement of the request from the subscriber. It will find the appropriate shortest path to send the advertisement in a timely manner. The state-of-the-art systems leveraged mobility patterns or social properties of mobile devices to optimize content delivery[3]. However, such works do not capture the patterns of delivered content for the content delivery. Without such optimization, the content demanded by a large number of subscribers could follow the same forwarding path as the case with only one subscriber.



IV. MODULES

A. Server Configuring

In Delay Tolerant Networks (DTNs), whenever mobile devices (PDAs, vehicles, mobile phones, etc.) encounter each other, they exchange content via short-range communications (e.g., Bluetooth or WiFi). Many applications and services, such as product promotion advertisement and traffic congestion notification, benefit from the opportunistic content exchange. It is useful in the areas where wireless networks do not cover, wireless access is blocked[1], or cellular networks are congested. Opportunistic communication thus helps to expand the network coverage, without building dedicated network infrastructures. Server can store all the required information whatever the owner can upload data in it, and it will deliver the data based on the user access.

B. File Uploading Process

An important requirement of such applications is timely delivery. However, the intermittent connectivity of DTNs may significantly delay content exchange and cannot guarantee timely delivery[11]. The state-of-the-arts capture the mobility patterns or social properties of mobile devices. However, there is little optimization in terms of the delivered content. Without such optimization, the content demanded by a large number of subscribers could follow the same forwarding path as the content by only one subscribe. Server can use the database to store the information about the owner those can upload the information and the time also.

C. Timely Content Access

Applications must be careful not to accept timely responses. In fact, the request/response time may often exceed the longevity of the server and client processes[4].

ALGORITHM 1: RELAY SELECTION

input : Node n_j , carrying d_i , is opportunistically encountering node n_k
1 n_j (resp. n_k) updates U_j (resp. U_k) by exchanging utilities with n_k (resp. n_j);
2 if n_k is interested in d_i then d_i is forwarded to n_k ;
3 if the element utility u^k_i is larger than the element utility u^j_i then
4 n_k keeps a copy of d_i ;
5 if $u^k_i > u^j_i$
6 then n_j removes d_i ;
7 else n_k does not keep a copy of d_i ;

The state-of-the-art systems leveraged mobility patterns or social properties of mobile devices to optimize content delivery. However, such works do not capture the patterns of delivered content for the content delivery.

D. Multi Node Access File Downloading

While the user can access some data at the time of downloading another user can access the same data means, that intermediate node can analyze that request[14], if the data that is downloading and the request data is same. It will send the copy of content to the requested another user.

ALGORITHM 2: Enhanced Ameba

input : Node n_j , carrying d_i , is opportunistically encountering node n_k
1 n_j (resp. n_k) updates U_j (resp. U_k) by exchanging utilities with n_k (resp. n_j);
2 if n_k is interested in d_i , or $V_k >$ during peak time then
3 d_i is forwarded to n_k ;
4 if the element utility u^k_i is larger than the element utility u^j_i then
5 n_k keeps a copy of d_i ;
6 if $u^k_i > u^j_i$
7 then n_j removes d_i ;
8 else n_k does not keep a copy of d_i ;



Provide multi copy to parallel accessing node .same file has been duplicated for parallel downloading by multiple node concurrently. Message transferred to a DTN node classified as *persistent*, which has large amounts of non-volatile storage. Can hold the message until the next communication opportunity.

V.CONCLUSION & FUTURE WORK

To advertisement content towards needed nodes over a DTN in a timely manner, ameba carefully adjusts the number of encounters and the number of content copies for advertised content, develop forwarding utilities capture interests, mobility patterns, capacity constraint and visit locations of mobile devices with low maintenance cost , and design distributed relay algorithms to select the best nodes as the carriers.via extensive experiments ,our evaluation demonstrates that the proposed ameba scheme is able to achieve high delivery ratio and significantly low overhead[15].

Future Enhancement of our maximizing timely content delivery using DTNs, with the help of ameba framework. While downloading the advertisement there may be a possible in occurrence of node failure, path problem or subscriber does not able to access the advertisement at the timely manner, at that time ameba framework will find the path and it will dynamically allocate the another shortest path to send the advertisement for that subscriber.

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