모바일 데이터 오프로딩을 위한 콘텐츠 기반 Pocket 교환 네트워크 라우팅 기법

A Content-based Pocket Switched Networks Routing Scheme for Mobile Data Offloading

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요약

Continuous improvements of network infrastructures and mobile data offloading strategies are among the solutions of cellular providers to cope with the increase in mobile data demand. These options requires a lot of cost and time to implement. Few researches have been conducted to assess the applicability of Pocket Switched Network (PSN) to support mobile data offloading. In this paper, we present a PSN mobile data-offloading scheme that utilizes mobile users with available connectivity to deliver content-aware data to other mobile users. This paper also aims to evaluate the applicability and feasibility of PSN routing schemes to improve the current strategies in mobile data offloading. The simulation results show admirable results in terms of message delivery and latency.

1. Introduction

In recent years, cellular networks have begun to experience drastic problems in terms of keeping pace with mobile data traffic demand. The ever-increasing number of mobile users and the eagerness of every user to be connected to the Internet are among the reasons of mobile data traffic explosion [1]. Huge portion of the mobile data traffic delivered by service providers do not have real time constraints. Thus, the delay tolerant nature of DTN promises great feasibility to support mobile data offloading [2].

This paper introduces a content-based mobile data offloading scheme using Pocket Switched Networks (PSN). The concept of social similarity interest of mobile users in the community and its temporal and spatial correlation has been integrated in the message transmission scheme. The remainder of the paper is organized as follows; section 2 discusses the proposed scheme while section 3 depicts the simulation settings and results. Lastly, section 4 concludes this paper.

2. Proposed Scheme

The proposed scheme takes advantage of the social interest similarities [3] (same profession, hobbies, etc.) of mobile users in a community to offload data. It aims to be an alternative support for other mobile data offloading strategies and reduce data traffic of often-subscribed mobile services (e.g. news, weather, entertainment updates and classified ads). Figure 1 illustrates the offloading strategy of the proposed scheme. First, the proposed scheme looks into the interest of every subscriber node in contact with a publisher node. A user (or a node) that has no interest with a particular content does not necessarily mean that it will not be better message forwarder. Therefore, when a subscriber node is not interested with the content currently in the publisher's buffer, the scheme identifies how strong is the relationship of the subscriber node to other nodes to decide if it receives the particular message.

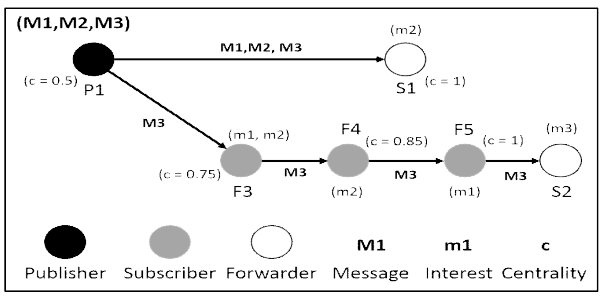

Figure 1. Mobile offloading decision rule using interest and centrality value

To assess the capability of the node to be a forwarder, the Freeman's degree centrality [4] shown in Equation 1 is used. This formula calculates for the relationship of every node to other nodes in the

network, where N is the number of nodes, D is maximum degree and m is the number of edges.

$$Ci = (N*D - m) / ((N-1)(N-2)) \quad (1)$$

3. Simulation Results

The simulation was performed using the ONE (Opportunistic Network Environment) simulator. Different content-types were labeled as M1-M4. One (1) publisher node and three (3) subscriber node groups have been simulated in the network emulating mobile users with walking speed and all equipped with Wi-Fi and Bluetooth interfaces. The 3 node groups have different number of interests such that 1 group has only 2 interest while the others has 3 and 4. The simulation time is set to 1 day where nodes move in the Helsinki map area using shortest path map based movement model. The following figures shows the result of the simulation.

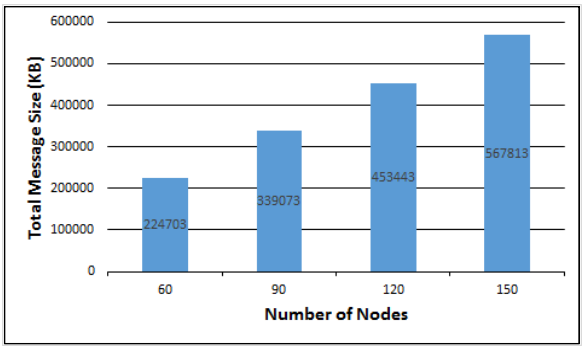

Figure 2. Total offloaded data size of the proposed scheme

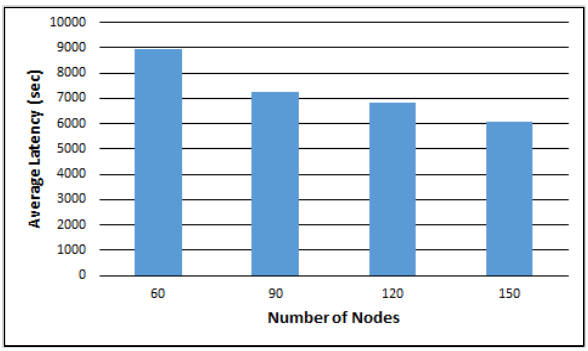

Figure 3. Average message latency of the proposed scheme

Figures 2 shows the total message size increases as the number of nodes in the network is also increased. This data shows that the denser the network, more messages will be offloaded even with only one publisher node given to the network. The result also shows a 500MB total data size is offloaded with 150 users for 1 day. This means that with more various data content more data can be offloaded to users. Even if the proposed scheme focuses on offloading non-time sensitive data, message latency is an important factor to consider in data offloading. Latency suggests the time difference between the content is created and it was delivered. A data transferred on the latter time even with interest will not be valuable enough for the user. Figures 3 depicts the average latency of messages. As node is increasing, the average latency decreases. A less than 3-hour delay of delivery can be seen in all the scenarios and at most 1 hour is achieved for 150 node simulation.

4. Conclusion

Cellular providers has put significant effort in finding better solutions to cope with mobile data demand in the recent years. The continuous research progress in Delay Tolerant Networks has brought about the new consideration of utilizing it for mobile data offloading. In this paper, we presented mobile offloading scheme that utilize Pocket Switched Networks formed by mobile users. The proposed scheme utilized social interest similarity among mobile users and implements a decision rule to identify better data forwarders. The simulation performed verifies the effectiveness of this scheme to deliver a valuable amount of traffic load among mobile subscribers. In the future, we seek to perform intensive simulation and comparison with other schemes for mobile data offloading. Furthermore, the components will be reviewed and improved to further enhance the performance of the routing scheme.

5. Acknowledgement

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