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Propagate Cooperative Caching on MANETS

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Abstract: - Mobile Adhoc networks (MANET) are formed by mobile devices, such as data enabled phones, electronic book readers. Generally users can share common interests in electronic interests in electronic content. As MANET become more and more crucial to everyday functioning of the people. This paper discusses cooperative caching technique for minimizing price in MANET. Caching frequently accessed data items on the client side is an effective technique for improving performance in a mobile environment. The effectiveness of the caching depends on the replacement strategy the relative value of different objects. Such type of strategy is to predict next request time. This caching strategy utilizing statistics on resource inter request times. Such statistics can be collected either locally (i.e., content providers) or at server (i.e., communication service providers). This paper shows that the caching techniques in the presence of selfish users that deviate from network wide cost optimal policies. Major works in this paper caching technique focused primarily on reduce latency by avoiding slow links between client and CSP.

Keywords: - ad hoc networks, caching, content providing, wireless networks, MANET

1. INTRODUCTION

Basically, mobile Adhoc networks (MANET) are imposed vital burden to the communication service providers (CSP), leading to noticeable increases in the end user latency. Recently, cooperative caching in MANETs has been played a vital role in rebate. Several cooperative caching schemes were proposed during the preceding years. These MANET's are become more and more crucial to everyday functioning of people. Now a day's data enabled mobile devices and wireless enabled data applications have stimulate new content based models in today's mobile ecosystem. Such devices include Google's Android, electronic book readers, apple's iphone, ipads, and Amazon's kindle. These data enabled applications include electronic book and magazine readers and mobile phone apps. With the standard download modes, a user can download contents directly from a content providers (CP) server over a communication service providers (CSP) network. The level of proliferation of mobile applications is shown by the example fact that as of May 2013, Apple's app store over 850,000 claimed.

Users can carry their mobile devices physically gather in public places such as University campus, work place, shopping complexes and airports etc. in this places MANETs can be formed using Adhoc wireless connections between the devices. In which individual devices can communicate each other. The deployment of wireless nodes where there is no infrastructure or the local infrastructure is not reliable can be difficult. With the existence of such networks an alternative approach to content retrieve by a device would be to first search local MANET for the requested content before downloading it from the CP's server. The retrieved object provisioning cost of such a proposal can be significantly lower since the download cast to the CSP. It can be avoided when the content is found within the local MANET. This strategy is named as cooperative caching [1].

A common strategy is used to improve the performance of data access is caching. Cooperative caching, which allows the sharing and coordination of cached data among multiple devices, can further explore the potential of the caching techniques. Due to mobility and resource constraints of MANETs, cooperative caching techniques designed for wired networks may not be applicable to MANETs. However, in an MANET, the network topology changes frequently. Also, mobile devices have resource (battery, CPU, and wireless channel) constraints and cannot afford high computation or communication overhead. Therefore, existing techniques designed for wired networks may not be applied directly to Adhoc networks.

In order to encourage the end user to cache previously downloaded content and share it with the other users, a p2p marketing mechanism. This mechanism can serve as an incentive so that the end users are enticed to participate in cooperative content caching in spite of the storage and energy costs. In order for cooperative caching to provide cost benefits, this p2p marketing must be dimensioned to the smaller than the content download cost paid to the CSP. This marketing mechanism should be factored in the content provider's overall cost. Manets are having the limited storage, so these devices are not expected to store all downloaded content for long. That means after successfully downloaded the content; device may remove it from the storage. The basic contribution of this paper includes first, Manet's service, search and price models, Second, content request and cooperative caching in MANETs.

2. BACKGROUND

2.1. Manet's service

Users can carry mobile devices from one place to another place. In Adhoc networks, since mobile devices move freely, disconnections occur frequently, and this causes frequent network division. The data accessibility in MANETs is lower than that in the conventional fixed networks. It is very important issue to prevent deterioration of data accessibility at the point of network division in Adhoc networks. A possible solution is by relay data items at mobile hosts which are not the owners of the original data.

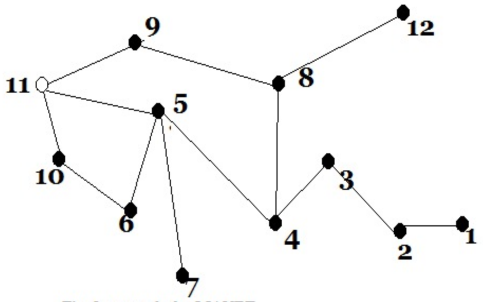

Fig. 1. example for MANET

Fig. 1 shows example network architecture for MANETs. Some nodes in the MANET may have wireless interfaces to connect to the wireless infrastructure such as wireless LAN or cellular networks. Suppose node N_{11} is a data source, which contains a database of n items. In the MANET, a data request is forwarded hop-by-hop until it reaches the data center and then the data center sends the requested data back.

We consider two types of MANETS. The first one involves stationary [2] MANET partitions. Meaning, after a partition is formed, it is maintained for sufficiently long so that the cooperative object caches can be formed and reach steady states. Second one is to explore as to what happens when the stationary assumption is relaxed. To investigate this effect, caching is applied to mobile devices formed using human interaction traces obtained from a set of real MANET devices [3].

2.2. Searching for content

End user wants to download any content from server, first user can do object request is originated by a mobile device; it gives first preference to searches its local cache. If the local search fails, it searches the object within its MANET partition using limited broadcast message. If the search in partition also fails, the object is downloaded from the CP's server using the CSP's data network. In the searching process all the objects are popularity-tag by the CP's server [4]. The popularity tag of an object indicates its global popularity; it also indicates the probability that an arbitrary request in the network is generated for this specific object.

2.3. Price content model

In the level of proliferation of mobile applications pays a download cost C_d to the CSP when an end-user downloads an object from the CP's server through the CSP's data network. Also, whenever user provides a locally cached object to another user within the MANET partition, the provider user is paid a rebate C_r by the CP. Optionally, this rebate can also be distributed among the provider user and the users of all the intermediate mobile devices that take part in content forwarding. Note that these cost items, namely C_d and C_r do not represent the selling price of an object. The selling price is directly paid to the CP by a user through an out- of-band secure payment system.

A digitally signed rebate mechanism needs to be supported so that the rebate receipt to user can electronically validate and rebate with the CP. Also, a digital usage right mechanism [5] is needed so that a user which is caching an object should not necessarily be able to use it unless it has explicitly bought two mechanisms on which the proposed caching mechanism is built.

Operationally, the parameters C_d and C_r are set by a CP and CSP based on their operating cost and revenue models. The user does not have any control on those parameters.

3. CONTENT REQUEST GENERATION MODEL

There are two request generation modes, those are

- Homogenous request generation model
- Heterogeneous request generation model

In the homogenous case, all mobile devices maintain the same content request rate and pattern which follow Zipf distribution. Zipf distribution is widely used in the literature for modeling popularity based online object request distributions [6]. According to Zipf law, the popularity of the *ith* popular object out of N different objects can be expressed as

$$P_i = \frac{\Omega}{i^{\alpha}},\ \Omega = \frac{1}{\sum_{i=1}^{N}\frac{1}{1^{\alpha}}}\ (0 \le \alpha \le 1) \text{ ---------- } (1).$$

Where α is a Zipf parameter that determines the skewness in a request pattern. P_i indicates the probability that an arbitrary request is for the *ith* popular object.

In the heterogeneous request model, each mobile device follows an individual Zipf distribution. This means popularity-tag of object j is not necessarily the same from two different nodes standpoints. This is distinct to the homogenous model in which the popularity of object j is same from the perspective of all network nodes. Also, the object request rate from different nodes is not necessarily the same in the heterogeneous model.

3.1. Rebate under homogeneous request model

To calculate the average content provisioning cost under a homogenous request model. Let P_L be the probability of finding a requested object in the local cache, P_V be the probability that a requested object can be found in the local MANET partition after its local search fails, and P_M be the probability that a requested object is not found in the local cache and in the remote cache. We can write P_M in terms of P_V AND P_L as

$\mathbf{P_M = 1 - P_L - P_V}$**. -------- (2).**

If the object is found in local cache then the object cost is zero, C_r when it is found in the MANET, and C_d when it is downloaded from the CP's server through the CSP's network then the average content provisioning cost is

$\mathbf{Cost = P_V C_r + P_M C_d}$ **-------- (3).**

4. MOBILE COOPERATIVE CACHING

Mobile cooperative caching is basically follows-

Cooperative data dissemination the work of cooperative data dissemination mainly focused on the designing protocols for the Adhoc networks to search their desired data items and forward the data items from source to the mobile devices in the mobile environment. The work pertaining to cooperative cache management focuses on designing protocols and algorithms to the Adhoc networks to manage their cache space not only with respect to themselves, but also with respect to peers. It supports continuous media access in MANETs. Two data location schemes, namely cache-state and reactive are proposed for the networks to determine the nearest data source that can be either the cache of their nodes or the original servers to retrieve their media objects. Cache-state is a proactive scheme, whereas reactive is an on-demand scheme. The performance evaluation result shows that the reactive scheme outperforms the cache-state one in terms of network traffic, quality of service (QoS) and access latency.

5. CACHING FOR OPTIMAL OBJECT PLACEMENT

Split cache replacement

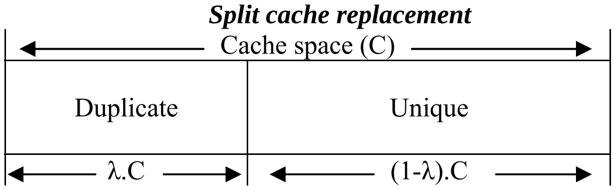

Fig: 2. Split cache mechanism

In the optimal object placement under homogeneous content request model is using the split cache mechanism in which the available cache space in each device is divided into duplicate segment (λ) and a unique segment is shown in below fig. in the first segment, nodes can store the most popular objects without worrying about the object duplication and in the second segment only unique objects are allowed to be stored the parameter λ ($0 \leq \lambda \leq 1$) indicates the fraction of cache that is used for storing duplicated objects.

With the split cache policy replacement, after an object is downloaded from the CP's server, it is categorized as a unique object as there is only one copy of this object from another MANET node, that object is categorized as a duplicated object as there are now at least two copies of that object in the network. For storing a new unique object, the least popular-tag object in the whole cache is selected as a user and it is replaced with the new object if it is less popular than the new selected object. For a duplicated object, however, deleted user is selected only from the first duplicate segment of the cache. In other words, a unique object is never deleted in order to accommodate a duplicated object. The split cache object replacement mechanism realizes the optimal strategy. With this mechanism, at steady state all devices caches and maintain the same object set in their duplicate areas, but distinct objects in their unique areas.

6. CACHE UNDER HETEROGENEOUS REQUESTS

The split cache policy may not minimize the cost for non homogenous object requests where nodes have different request rates and request patterns. So we are using the benefit based heuristics approach to minimize the object cost in the network with non homogenous request model.

Objects with different size

In the mobile devices may not have the same size of the objects in CP's server? The minimum cost object replacement mechanism is extended for the scenarios in which objects can have different sizes. In such situations, in order to insert a new downloaded object "*i*" from the CP's server, instead of finding the least popular object, a node needs to identify a set of objects μ in the cache. The set should be identified such that the quantity is minimized while the quantity x_i shows the size of object "*i*". This is a traditional knapsack problem for homogenous request model.

When there is not enough space in the cache for accommodating a new object, the existing object with the minimum popularity-tag is identified and replaced with the new object only if the new object shows more total benefit. The benefit of a newly downloaded object can be computed based on its source. When the object is downloaded from another device in the MANET partition the copy is labeled as secondary if one more copy of object is already exists in the partition. The new object is cached if its benefit is higher than that of any existing cached object.

Impacts on user selfishness

In the cooperative MANET cost and marketing an object with the homogeneous requests where all nodes run the split replacement policy with optimal λ. There is no collusion among nodes that behave in a selfish manner. A node is identified to be selfish when it deviates from optimal caching in order to earn more marketing. A rational selfish node stores an object only if that object increases the amount of its own potential marketing. The set of objects in such a node is expected to be different from that of a nonselfish node.

A selfish node will not store a duplicated object "*i*" before storing objects with higher popularity-tag. In other words a selfish node follows the popularity–tag storage constraint. If there are more no of selfish users, less number of objects is stored in the network, which in turn reduces the chance of finding a requested object in remote caches

7. RELATED WORK

In the existing systems [7],[8] on several methods of cooperative caching including object replacements, reducing cooperation overhead [9], the performance in traditional wired networks. In this paper MANETS which are often formed using mobile Adhoc network protocols, are different in the caching due to their additional constraints such as topological changes simultaneously and limited resources. As a result, most of the available caching solutions are not directly applicable for the MANETs.

Three caching schemes for MANETs have been presented in [10]. In the first scheme Cache Data, a forwarding node checks the passing by objects and caches. A problem with this approach is that storing large number of popular objects in large number of intermediate nodes does not scale well. In the second scheme Cache Path, is different in that the intermediate nodes do not save the objects instead they only record paths to the closest node where the objects can be found. The last approach is the

Hybrid Cache in which either Cache Data or Cache Path is used based on the properties of the passing by objects through the intermediate nodes. Using a limited broadcast cache resolution can significantly improve the overall hit rate and the effective capacity overhead of cooperative caching.

According to the protocols [11] the mobile hosts share their cache contents in order to reduce both the number of server requests and the number of access misses. The concept is extended in [12] for tightly coupled groups with the similar mobility and data access patterns. A notable limitation of this approach is that it relies on a centralized mobile support center to discover nodes with the common mobility pattern and similar data access patterns. Several routing protocols for MANETs have been designed, each with its own set of strengths and weakness. Srihari [13] has written an overview of a number of these and classified them into groups.

8. CONCLUSION

Cooperative caching in MANETS is naval hybrid communication architecture. It is one of the most promising techniques to improve system performance in mobile environments. The future mobile cooperative caching scheme will focus on investigating security and privacy issues. In our paper service provider can successfully exploit the network to obtain an optimal allocation of its aggregate object cache. We see several other applications that could be explored with existing model. For instance, content updates may actually be generated by the users, as opposed to being cache by a service provider. In our paper, method for computing average providing cost implies that devising a pricing scheme for such a system may be possible. This is because it essentially outlines how to compute a user's sensitivity to the popularity-tag based of other users.

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