

# Implementation of Cooperative Caching in Social Wireless Networks

*S.L.Suganya<sup>1</sup> and Dr.R.Indra Gandhi<sup>2</sup>*

<sup>1</sup>Research Scholar, Dept of Computer Applications, GKM College of Engineering and Technology, Chennai-63

<sup>2</sup>Professor, Dept of Computer Applications, GKM College of Engineering and Technology, Chennai-63

## ABSTRACT

This paper introduced cooperative caching policies for minimizing the content provisioning cost in Social Wireless Networks(SWNET). SWNETs are formed by mobile devices, such as data enabled phones, electronic book readers etc., sharing common interest in electronic contents, and physically gathering together in public places. Electronic object caching in such SWNETs are shown to be able to reduce the content provisioning cost which depends heavily on the service and pricing dependences among various stakeholders including content providers (CP), network service providers, and End Consumers (ES). This Drawing motivation from Amazon's Kindle electronic book delivery business, this paper develops practical network, service, and pricing models which are then used for creating two objects caching strategies for minimizing content provisioning costs in networks with homogeneous and heterogeneous objects demands. This paper constructs analytical and simulation models for analyzing the proposed caching strategies in the presence of selfish users that deviate from network-wide cost-optimal policies. It also report results from an Android phone-based prototype SWNET, validating the presented analytical and simulation results.

**Keywords :** Wireless, Networks, Content Providers, Service Providers

## 1. INTRODUCTION

Wireless devices have scarcity of resources such as storage capacity and processing power. For WANETs, cooperative caching strategies are proposed in this paper to improve efficiency in information exchange in peer-to-peer fashion. The caching strategies such as small sized caches and large sized caches depend on the

estimation of density off information being flown in the network. In the former strategy content replacement takes place when new information is received while in the latter a decision is made as to whether the information is to be cached and for how long. In either case every node is capable of deciding as per the content in the caches of nearby nodes. This is to ensure that each node has

different content that is content diversity and share the content of other nodes thus managing memory efficiently. Rajkumar et al. expressed that features is the simulations made using NS2 show that our caching strategies are capable of making expected content diversity and improve of information sharing in wireless ad hoc network.

Guohong Cao says that cooperative caching, in which multiple nodes share and coordinates cached data, is widely used to improve web performance in wired networks. However, resources constraints and node mobility have limited the application of these techniques in ad hoc networks. We propose caching techniques that use the underlying routing protocols to overcome these constraints and further improve performance.

Saihan and Issarny [2] proposed a cooperative caching scheme to increase data accessibility by P2P communication among MHs, when they are out of bound of a fixed infrastructure. It is implemented on the top of Zone Routing Protocol (ZRP). The authors proposed a fixed broadcast range based on the underlying routing protocol. However, the mobile environment, so the fixed broadcast scheme is hard to adapt to real mobile applications.

## 2. NETWORK, SERVICE, AND PRICING MODEL

### 2.1 Network Model

Fig. 1 illustrates an example SWNET within a University campus. End Consumers carrying mobile devices from SWNET partitions, which can be either multi-hop (i.e., MANET) as shown for partitions 1,3, and 4, or single hop access point

based as shown for partition 2. A mobile device can download an object (i.e., content) from the CP's server using the CSP's cellular network, or from its local SWNET partition. In the rest of this paper, the terms object and content are used synonymously. We consider two types of SWNETs. The first one involves stationary [1] SWNET partitions. Meaning, a partition is formed, it is maintained for sufficiently long so that the cooperative object caches can be formed and reach steady states. We also investigate a second type to explore as to what happens when the stationary assumption is relaxed. To investigate this effect, caching is applied to SWNETs formed using human interaction traces obtained from a set of real SWNET nodes [4].

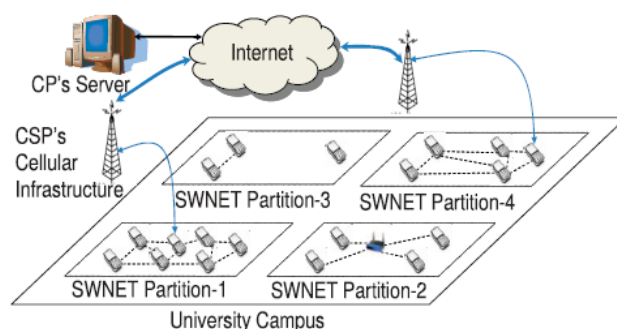


Fig.1 Content access from an SWNET in a University campus.

### 2.2 Search Model

After an object request is originated by a mobile device, it first searches its local cache. If the local search fails, it searches the object within its SWNET 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 3G/4G cellular network. In this paper, We have modeled objects such as electronic books, music, etc., which are time non varying, and therefore cache consistency is not a critical

issue. We also assume that all objects are popularity-tagged by the CP's server [3].

### 2.3 Pricing Model

Fig. 2 illustrates an example of a pricing model similar to the Amazon Kindle business model in which the CP (e.g., Amazon) pays a download cost  $C_d$  to the CSP when an End-Consumer downloads an object from the CP's server through the CSP's cellular network. Also, whenever an EC provides a locally cached object to another EC within its local SWNET partition, the provider EC is paid a rebate  $C_r$  by the CP. Note that these cost items, namely,  $C_d$  and  $C_r$ , do not represent the selling price of an object (e.g., e-book). The selling price is directly paid to the CP (e.g., Amazon) by an EC (e.g., a Kindle user) through an out-of-band secure payment system. A digitally signed rebate framework needs to be supported, so that the rebate recipients EC's can electronically validate and redeem the rebate with the CP.

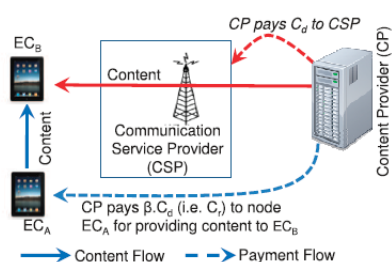


Fig.2 Content and cost flow model..

### Related Work

Caching is an important technique to enhance the performance of the both wired and wireless network. A number of studies have

conducted to improve the caching performance in wireless mobile environment [9-12]. Cooperative caching has been studied in the web environment, but little work has been done to efficiently manage the cache in ad hoc networks. Due to mobility and constrained resources (i.e., bandwidth, battery power and computational capacity) in wireless networks, cooperative cache management techniques designed for wired networks may not be applicable to ad hoc networks. In the context of the ad hoc networks, it is beneficial to cache frequently accessed data not only to reduce the average query latency but also to save wireless bandwidth. Hara [5] proposed several replica allocation methods to increase data accessibility and tolerate network partitions in MANETs.

## 3.METHODOLOGY

### 3.1 Split Cache Replacement

To realize the optimal object placement under homogeneous object request model we propose the following Split Cache policy in which the available cache space in each device is divided into a duplicate segment ( $\alpha$  fraction) and a unique segment. 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  $\alpha$  in  $(0 \leq \alpha \leq 1)$  indicates the fraction of cache that is used for storing duplicated objects. With the split cache replacement policy, soon 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 in the network. Also, when a node downloads an object from another SWNET

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 object in the whole cache is selected as a candidate and it is replaced with the new object if it is less popular than the new incoming object. For a duplicated object, however, the evictee candidate is selected only from the first duplicate segment of the cache. In other words, a unique object is never evicted in order to accommodate a duplicated object. The Split Cache object replacement mechanism realizes the optimal strategy established in section 4. With this mechanism, at steady state all devices caches maintain the same object set in their duplicate areas, but distinct objects in their unique areas. The pseudo code of the Split cache replacement policy is shown in Algorithm 1.

```

INPUT: Object  $O_{new}$ 
IF ( $O_{new}$  is downloaded from another node)
     $O_{min}$  = the least popular obj in the duplicate area
ELSE
     $O_{min}$  = The least popular obj in the entire cache
END
IF ( $O_{new}$ .popularity >  $O_{min}$ .popularity)
    replace  $O_{min}$  with  $O_{new}$ 
Algorithm 1: Split Cache object replacement policy
    
```

### 3.2 Object Provisioning Cost with Split Cache

To compute the provisioning cost for Split Cache we need to compute PL and PV used in (4). We first define function  $f(k)$  to be the probability of finding an arbitrary object within a device cache that is filled with the  $K$  most popular objects. This function can be expressed as  $\sum_{i=1}^k p_i$ . Substituting  $p_i$  for the Zipf distribution (see Section 2), we can write

$$f(k) = \sum_{i=1}^k p_i \approx \int_1^k \Omega/i^\alpha \, di = \Omega \frac{k^{1-\alpha} - 1}{1-\alpha}$$

Similarly,  $\Omega = 1 / \sum_{i=1}^N p_i \approx 1 / \int_1^N \frac{\Omega}{i^\alpha} \, di = \frac{1-\alpha}{N^{1-\alpha}}$ . Therefore,

$f(k)$  can be simplified as

$$f(k) = \frac{k^{1-\alpha} - 1}{N^{1-\alpha} - 1} \quad (8)$$

Caching has been proved to be an important technique for improving the data retrieval performance in mobile environments [9-12]. With caching, the data access delay is reduced since requests can be served from the local cache, thereby obviating the need for data transmission over the scarce wireless links. However, caching techniques used in one hop mobile environment (i.e., cellular networks) may not be applicable to multi hop mobile environments, since the data or request may need to go through multiple hops. As mobile clients in ad hoc networks may have similar tasks and share common interest, cooperative caching, which allows the sharing and coordinate of cached data among multiple clients, can be used to reduce the bandwidth and power consumption.

### 4. CONCLUSION

The objective of this paper was to develop a cooperative object caching Strategy for provisioning cost minimization in social wireless networks. The key contribution was to demonstrate that the best cooperative caching for provisioning cost reduction requires an optimal split between object duplication and uniqueness. The paper analytically develops this optimal split point and subsequently develops the caching performance using a practical network, service and cost formulation that is motivated by Amazon's Kindle electronic book delivery model. It constructs

analytical and simulation models for analyzing the proposed caching strategies in the presence of selfish users that deviate from network-wide cost optimal policies. Based on a practical service and pricing case, a defined model for the content provider's cost computation is developed. A cooperative caching strategy, split cache, is proposed numerically analyzed, and theoretically proven to provide optimal object placement for networks with homogeneous content demands. It also report results from an Android phone based prototype SWNET, validating the presented analytical and simulation results. Cooperative caching in mobile environments and propose a cooperative caching scheme for mobile systems. It extends beyond these populations to distributed cooperative caching behavior in regions with millions of clients. Overall, system demonstrates that cooperative caching has performance benefits only within limited population bounds.

## REFERENCES

1. Mahmoud Taghizadeh, "Distributed Cooperative Caching in Social Wireless Networks", *IEEE Transactions on Mobile computing*, VOL. 12, NO. 6, JUNE 2013
2. F. Sailhan and V. Issarny, "Cooperative Caching in Ad Hoc Networks", *International Conference on MobileData Management (MDM)*, pp. 13–28, 2003.
3. E. Cohen, B. Krishnamurthy, and J. Rexford, "Evaluating Server-Assisted Cache Replacement in the Web," *Proc. Sixth Ann. European Symp. Algorithms*, pp. 307-319, 1998.
4. "Cambridge Trace File, Human Interaction Study," <http://www.crowdad.org/download/cambridge/hagle/Exp6.tar.gz>, 2012
5. T. Hara, "Replica Allocation Methods in Ad Hoc Networks with Data Update", *Kluwer Journal of Mobile Networks and Applications*, Vol. 8, No. 4, pp. 343–354, 2003.
6. M. Taghizadeh, A. Plummer, A. Agel, and S. Biswas, "Optimal Cooperative Caching in Social Wireless Networks," *Proc. IEEE Global Telecomm. Conf. (GlobeCom)*, 2010.
7. Ryan Farmer, "A Brief Guide to Android Security"
8. A. Chaintreau, P. Hui, J. Crowcroft, C. Diot, R. Gass, and J. Scott, "Impact of Human Mobility on Opportunistic Forwarding Algorithms," *IEEE Trans. Mobile Computing*, vol. 6, no. 6, pp. 606–620, June 2007.
9. N. Chand, R.C. Joshi, and M. Misra, "Broadcast Based Cache Invalidation and Prefetching in Mobile Environment", *International Conference on High Performance Computing (HiPC)*, Springer-Verlag LNCS 3296, pp. 410–419, 2004.
10. N. Chand, R.C. Joshi, and Manoj Misra, "Energy Efficient Cache Invalidation in a Disconnected Wireless Mobile Environment", *International Journal of Ad Hoc and Ubiquitous Computing (IJAHUC)*, Vol. 1, No. 3, pp. 184–192, 2005.
11. G. Cao, "On Improving the Performance of Cache Invalidation in Mobile Environments", *ACM/Kluwer Mobile Networks and Applications*, Vol. 7, No. 4, pp. 291–303, 2002.

12. G. Cao, "A Scalable Low-Latency Cache Invalidation Strategy for Mobile Environments", *IEEE Transactions on Knowledge and Data Engineering*, Vol. 15, No. 5, pp. 1251–1265, 2003.