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Efficient Message Caching Scheme for MANET

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Abstract: Mobile adhoc networks are infrastructure less networks. MANET does not have any fixed topology. Base station, routers and switches are not used in MANET. Mobility is high in mobile adhoc networks. Cooperative caching algorithm is used to manage data transmission by overhearing data from intermediate nodes. Data request and data reply are overheard to optimize cache placement and cache discovery. Cache placement mechanism is used to assign data under cache nodes. Cache storages are provided in the overheard nodes. Cache discovery process is used to identify a requested data from the cached data collection. The overhearing aided cache management mechanism is designed to manage cache placement and cache discovery process. Cache placement algorithm is used to assign cache data values. Data access cost and transmission cost factors are used in the data request process. The Overhear aided cache management scheme is enhanced to handle cache updates with recent data values. Cache management mechanism is used to maintain the cache storage levels. Cache storages are maintained with node movement factors. Multiple cache copies are maintained with primary and secondary cache models. The system reduces the storage overhead and traffic flow.

I. INTRODUCTION

Recent explosive growth in computer and wireless communication technologies has led to an increasing interest in mobile ad hoc networks (MANET) which are constructed only from Mobile hosts (MH). In ad hoc networks, every MH plays the role of a router for communication with other MHs. Even if the source and destination MH are not in communication range of each other, data packets are forwarded to the destination mobile host by relaying transmission through other MH which exist between the two MH. They allow users to access the services offered by the fixed network through multi hop communications, without requiring infrastructure in the user proximity. However, in order to offer high quality and low cost services, several technical challenges still need to be addressed in ad hoc networks. Multi hop ad hoc network suffers from poor performance because the cost of wireless communication is very high.

Most of the previous researches ad hoc networks focus on the development of dynamic routing protocols that can improve the connectivity among MHs. Although routing is an important issue in ad hoc networks, other issues such as data access are also very important since the ultimate goal of using such networks is to provide information access to MH. Caching has been proved to be an important technique for improving the data retrieval performance in mobile environments. 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 may not be applicable to multi hop mobile environments since the data or request may need to go through multiple hops [11]. As mobile clients in ad hoc networks may have similar tasks and share common interest, cooperative caching, which allows the sharing and coordination of cached data among multiple clients, can be used to reduce the bandwidth and power consumption.

To date there are some works in literature on cooperative caching in ad hoc networks, such as consistency, placement, discovery and proxy caching. However, cache management exploiting clustering in ad hoc networks is not considered yet. We investigate the data retrieval challenge of mobile ad hoc networks and propose a novel scheme, called Cluster Cooperative (CC) for caching. The goal of CC is to reduce the cache discovery overhead and provide better cooperative caching performance. CC partitions the whole MANET into equal size clusters based on the geographical network proximity. To enhance the system performance, within a cluster, individual caches interact with each other such that combined result is a larger cumulative cache. In each cluster, CC dynamically chooses a "super" node as cache state node (CSN), to maintain the cluster cache state (CCS) information of different nodes within its cluster domain. The CCS for a client is the list of cached items along with their time-to-live (TTL) field.

To further improve the efficiency of CC caching, a cooperation management scheme including cache admission control, a replacement policy called *Least Utility Value with Migration (LUV-Mi)* and cache consistency has also been developed. Distinguished from existing replacement schemes, our LUV-Mi scheme determines cache replacement not only favorable to a client but also important to other clients within the cluster. We also perform analytical study for the CC caching system. Simulation experiments are performed to evaluate the proposed CC caching scheme and compare it with existing strategies in the ad hoc networks.

II. LITERATURE REVIEW

In popularity-based algorithm, placement decision is made based on how "popular" the data item is. Popularity can be represented by access frequency, time interval from last access, etc. These algorithms differ in whether and how the access of a neighbor host is considered. The work of Yin and Cao focuses on information cached at a node. Depending on the access frequency and cache space, a node may cache the data itself or the path to the nearest cache node. On the other hand, in a benefit-based algorithm [8], data items are selected according to how much "benefit," e.g., the reduction in message cost, query delay, energy consumption, etc., can be obtained by caching the data items. Compared with popularity-based approach, the benefit based one is more efficient, as shown in [8]. This is because "benefit" can directly and precisely reflect the objective of data caching, i.e., the reduction in data access cost. Therefore, we also adopt benefit-like metric in our design. Nuggehalli et al. formulated the cache placement problem with a single data item as a special case of the connected facility location problem. They considered the tradeoff between the query delay and overall energy consumption. For cache placement of multiple data items, Baev and Rajaraman and Tang et al. [8] designed approximation algorithms for general ad hoc networks. Both the algorithms are centralized. These algorithms mainly differ in how the benefit is defined and calculated.

Tang et al. [8] also proposed a distributed cache placement algorithm. To our knowledge, this is the only benefit-based distributed algorithm for general cooperative caching scenario, i.e., an ad hoc network with multiple data items and general network topology, which is more practical than scenarios with single data item and/or tree network topology. Since we consider the same caching scenario, we use the distributed algorithm in [8] as a comparison point of our work. In [8], the placement metric is defined as the reduction of data access cost by caching a data item. Each node calculates the data access frequency individually by observing the data request messages passing-by. Then, when a new data copy arrives, a node needs to decide whether or not this data should be cached. Based on the historic data access frequency of different data items and the distance to the nearest cache copy, the node can calculate the overall cost of access all the data items needed with or without the new data cache copy, respectively. If caching the data copy can reduce overall data access cost, the data copy is added to the cache space. Of course, replacement is also considered in the access cost calculation if there is not enough free space.

Fan et al. [5] proposed the only caching algorithm that has considered the openness feature of wireless links. However, their work focuses on the contention status of a link in cache node selection. More precisely, the delay of the links is evaluated with respect to contention caused by concurrent requests and heuristics to achieve short access delay is designed. For the cache discovery problem in ad hoc networks, there have been few efforts made. Existing cache discovery approaches can be categorized into two classes: passive discovery and active discovery. In passive discovery systems the cache copy at one node is unknown to other nodes. The data requests are always destined to the data source. When the request encounters a cache copy at some intermediate node in the path, this node stops forwarding the request and sends the cached data back to the requestor. In active cache discovery, a cache node proactively disseminate the cache information to other nodes so that each node can maintain a nearest cache table. Then, a data request is destined to the nearest cache node

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rather than the source node. Obviously, there is a tradeoff between cache information dissemination cost and the query dissemination cost. Active discovery can save query cost while passive discovery does not need to disseminate cache copy information. If the data request preference of network nodes is localized and stable, active discovery is better than passive one; otherwise, passive discovery is better.

Hybrid approaches can be found in [8], [9]. The solution in [8] imposes a cluster-based hierarchy on a flat ad hoc network. It focuses on how to construct the hierarchy and how to discover the nearest cache node, inside and outside of the clusters. In [9], a node tries to find a cache by flooding within a predefined zone before sending the request to remote nodes. Dimokas et al. studied the selection of the sensor nodes which will take special roles in running the caching and request forwarding decisions. The works in [6] target at wireless mesh networks, a special type of ad hoc network. Since the network itself is hierarchical by nature, those works focus on how to make use of mesh routers in cache placement and discovery as cluster heads.

As discussed above, there have been quite a number of algorithms and solutions for cooperative caching in ad hoc networks, and they consider both communication cost and time cost of data access. Different from existing works, our research focuses on making use of overhearing, which has never been considered in cooperative caching. With overhearing, a requesting node can obtain data copies from an intermediate node in the path toward the cache node so as to reduce data access cost. Also, overhearing helps collect more data access information and data copies, so as to improve the efficiency of cache placement. To obtain such advantages, we design the overhearing-aided cooperative caching algorithm. We design benefit-like placement metric and adopt active cache discovery approach due to their advantage against popularity and passive discovery as shown in [8]. However, our design focuses on how to utilize overhearing on calculating data access cost and disseminating cache request/reply.

III. DATA SHARING IN MANET

Wireless ad hoc network, as a promising technology for pervasive Internet access, has received a lot of attention from both academia and industry communities. In a wireless ad hoc network, there is no support of any fixed infrastructure (e.g., the base stations in 3G networks or access points in wireless LANs), and network nodes communicates with each other through multihop paths. A network node can be any computing device, ranging from a mobile computer, e.g., smartphone, laptop, to a backbone network device, e.g., mesh routers, or even an embedded small sensor node. Due to the advantages in flexible deployment, low cost and easy maintenance, wireless ad hoc networks are especially suitable for the scenarios where the deployment of network infrastructure is too costly or even impossible, e.g., outdoor assemblies, disaster recovery and battlefield. On the other hand, wireless ad hoc networks are resource constrained in terms of bandwidth, power, etc., so data access cost is a major concern. Data caching has been widely used to reduce data access cost in traditional computer networks [1], [2]. It is much more desirable and effective in wireless ad hoc networks. When data are delivered through multihop paths, caching the data at intermediate nodes can significantly reduce the message cost and consequently save various resources, from network bandwidth to battery power. Accessing data at cache node can also help reduce data access delay (AD).

Quite a lot of work has been conducted for data caching in wireless ad hoc networks, including cache placement, cache discovery [8] and cache consistency [7], [3]. Cache placement refers to determining where and what to cache; cache discovery refers to the mechanism to find and obtain a cached data item; and cache consistency means to ensure that the data value in cache copies is consistent with the source copy at the data server. The first two problems are so closely related that they are usually studied together. The cache placement problem in ad hoc networks has been proved to be NP-hard, even if only one data item is considered. Existing works on cache placement mainly focus on how to make use of the data access frequency information and network topology information in selecting cache nodes [10]. For cache discovery, recent research has been focused on combining passive and active query approaches.

Although there have been quite a number of algorithms for ad hoc networks, the openness of wireless link has not been considered in designing cooperative caching system. Due to the openness of wireless links, a network node transmits

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data in a broadcast way by nature, so a packet can be received by any node within the transmission range even if the node is not the intended target of this transmission. In this case, we say that the node "overhears" the packet. Correspondingly, we say that the intended target node "hears" the packet. Here, the target node means the node specified as the receiver of the packet in MAC address. It can be an intermediate node in the routing path or the destination node of the massage. In this paper, we propose a novel cooperative caching algorithm for wireless ad hoc networks by taking overhearing into consideration. Our algorithm makes use of the overhearing property to significantly improve the performance of data caching in several aspects. First, by overhearing, a requesting node can obtain data copies from an intermediate node forwarding the data copy so as to reduce data access cost. Second, overhearing helps collect more data access information, e.g., access frequency, which is necessary to make decision on cache placement.

However, making use of overhearing in data caching is not a trivial task. Several issues need to be addressed in order to make use of overhearing. First of all, what requests can be met by overhearing is a key issue. The cache discovery mechanism must be delicately designed so as to capture as many overhearing data copies as possible. Second, how to define and evaluate the access cost should be considered carefully for cache placement. In existing work, the access cost is defined by the distance between a requesting node and the nearest cache node. With overhearing, however, this definition is not applicable any longer because a request may be replied by an intermediate node that overhears the data from passing by replies for other requests. Although overhearing has been studied and used in cooperative communication achieve transmit diversity in signal propagation level, and routing protocols help construct route more efficiently, our work makes use of the application level information via overhearing and the focus is how to help the overhearing node rather than the destination node.

Based on the above observations and considerations, we have designed an overhearing-aided data caching algorithm that jointly considers the cache placement and cache discovery issues. To evaluate data access cost with overhearing, we define function to calculate the access cost with the distance between the requestor and the replier rather the cache node. To capture data copies through overhearing, we find out the sufficient condition for predictable data reply overhearing. In our design, mobility is not the primary concern, so we basically assume a static ad hoc network, i.e., the nodes do not move. However, we still propose enhancing mechanisms to handle node mobility to make our algorithm applicable to various environments. To our knowledge, this is the first overhearing-aided data caching algorithm. To evaluate the performance of our proposed algorithm, we have conducted extensive simulations. We consider various scenarios with different parameter settings and compare our algorithm with the one proposed in [8], which is the best one among existing distributed caching algorithms for ad hoc networks. To show the advantage of our placement metric, we also simulate a naive overhearing algorithm as the baseline of overhearing caching. The simulation results show that our proposed algorithm performs much better than the other two algorithms in terms of both message cost and data access delay.

Cooperative caching algorithm is used to manage data transmission by overhearing data from intermediate nodes. Data request and data reply are overheard to optimize cache placement and cache discovery. Cache placement mechanism is used to assign data under cache nodes. Cache storages are provided in the overheard nodes. Cache discovery process is used to identify a requested data from the cached data collection. The overhearing aided cache management mechanism is designed to manage cache placement and cache discovery process. Cache placement algorithm is used to assign cache data values. Data access cost and transmission cost factors are used in the data request process. The following drawbacks are identified in the existing system.

- Node mobility is not handled
- Cache consistency is not maintained under overhear environments
- Cache storage is not managed
- Cache duplication process is not controlled

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IV. MESSAGE CACHING SCHEME FOR MANET

The Overhear aided cache management scheme is enhanced to handle cache updates with recent data values. Cache management mechanism is used to maintain the cache storage levels. Cache storages are maintained with node movement factors. Multiple cache copies are maintained with primary and secondary cache models. The MANET cache management system is designed to manage cache storage and consistency levels. Cache request frequency is used for the cache storage space management process. Node mobility is managed with cache storage consideration. The system is divided into five major modules. They are MANET data provider, request reply process, cache update process, consistency management and cache storage management.

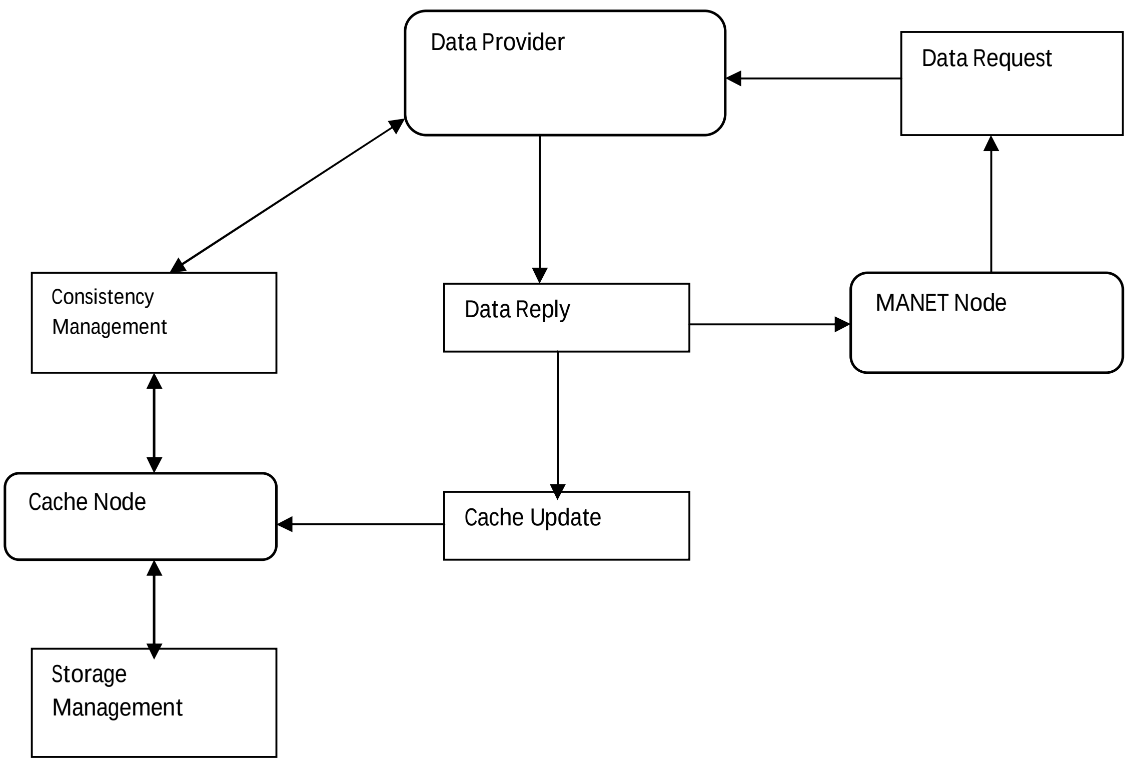

Fig. No: 4.1. Message Caching Scheme for MANET

The data provider module is designed to manage the shared data values. Request reply module is designed to handle the data access operations. Cache update process module is designed to store cached data in overheard nodes. Cache storage and their current level are maintained under the consistency management module. Cache storage spaces are maintained under the cache storage management module. Data provider shares the data files to the mobile ad hoc network nodes. Data files are transferred with reference to the requests. The users can collect the shared data file list from the providers. Response values are transferred through the intermediate nodes. Data request is submitted by the nodes. Request values are redirected to the provider through the intermediate nodes. Data request and reply information are updated in the overheard nodes. Data reply is prepared by the data provider nodes.

The overheard node collect data request and reply in the same coverage. Request and reply values are maintained with the cached data files. Data requests are verified with request history values. Cache data update is initiated for the new

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data request only. Cached data values are periodically verified with the data providers. Overheard node verifies the content level with actual data values. Data update time and cache verified time are checked in intervals. Counter values are used for the data consistency verification process. Cache storage values are maintained with redundant data copies. Initial copy of the data is maintained under the primary data storage environment. Duplicate data values are maintained under the secondary data environment. Request frequency levels are considered in the cache delete process.

V. CONCLUSION

Wireless ad-hoc networks are used to share Internet under wireless nodes. Cache storages are used to improve the data delivery process. Overhear aided cache placement algorithm is used to maintain cache storages. Cache consistency and storage management features are integrated with the system. The system reduces the message cost in the data sharing environment. Access delay is minimized by the overhearing aided catch management mechanism. Traffic overhead is controlled by the mobile ad hoc catch model. The system reduces the energy consumption in a considerable manner.

REFERENCES

[1] T. Hara, K. Maeda, Y. Ishi, W. Uchida, and S. Nishioz "Cooperative Caching by Clients Constructing a Peer-to-Peer Network for Push-Based Broadcast," Data & Knowledge Eng., vol. 69, no. 2, pp. 229-247, Feb. 2010.
[2] M. Hefeeda and B. Noorizadeh, "On the Benefits of Cooperative Proxy Caching for Peer-to-Peer Traffic," IEEE Trans. Parallel Distributed Systems vol. 21, no. 7, pp. 998-1010, July 2010.
[3] Y. Huang, J. Cao, Z. Wang, B. Jin, and Y. Feng, "Achieving Flexible Cache Consistency for Pervasive Internet Access," IEEE Trans. Parallel and Distributed Systems, vol. 21, no. 8, pp. 1150-1161, 2010.
[4] T.K.R. Nkwe and M.K. Denko, "Self-Optimizing Cooperative Caching in Autonomic Wireless Mesh Networks," Proc. IEEE Symp. Computers and Comm. (ISCC), 2009.
[5] X. Fan, J. Cao, and W. Wu, "Contention-Aware Data Caching in Wireless Multi-Hop Ad Hoc Networks," J. Parallel and Distributed Computing, vol. 71, no. 4, pp. 603-614, Apr. 2011.
[6] W. Wu and Y. Huang, "Hierarchical Cooperative Data Caching for Wireless Mesh Networks," Proc. IEEE/IFIP Int'l Conf. Embedded and Ubiquitous Computing (EUC), Dec. 2010.
[7] R. Gunasekaran, V.P. Divya, and V. Rhymend Uthariaraj, "Mitigating Channel Usage in Cooperative Caching for Mobile Ad Hoc Networks," Int'l J. Ad Hoc and Ubiquitous Computing, vol. 7, no. 2, pp. 87-99, 2011.
[8] N. Chauhan, L.K. Awasthi, N. Chand, R.C. Joshi, and M. Mishra, "A Cooperative Caching Strategy in Mobile Ad Hoc Networks Based on Clusters," Proc. Int'l Conf. Comm., Comp. and Security, Feb. 2011.
[9] G. Chiu and C. Young, "Exploiting In-Zone Broadcasts for Cache Sharing in Mobile Ad Hoc Networks," IEEE Trans. Mobile Computing, vol. 8, no. 3, pp. 384-396, Mar. 2009.
[10] B. Tang, H. Gupta, and S. Das, "Benefit-Based Data Caching in Ad Hoc Networks," IEEE Trans. Mobile Computing, vol. 7, no. 3, pp. 289-304, Mar. 2008.
[11] N. Chauhan, L.K. Awasthi, N. Chand, R.C. Joshi, and M. Mishra, "A Cooperative Caching Strategy in Mobile Ad Hoc Networks Based on Clusters," Proc. Int'l Conf. Comm., Comp. and Security, Feb. 2011.