

A Literature Survey on Caching and Prefetching Techniques in MANET

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Abstract

Mobile Ad-hoc Networks (MANET) is an emerging area of research over the past decades. Most current work is centered with different enhancements. This paper discusses to enhance the access of image data in MANETs. Mobile adhoc network consists of mobile nodes that can move freely in an open environment. Communicating nodes in a Mobile Adhoc Network usually interact with other intermediate nodes to establish communication channels. A number of challenges like caching, adopting prefetching technique, open peer-to-peer network architecture, stringent resource constraints, shared wireless medium, dynamic network topology etc are to be addressed in MANET. As MANET is quickly spreading for the property of its capability in forming temporary network without the aid of any established infrastructure or centralized administration, Access rate of image data or Query latency has become a primary concern in MANETs. In this paper focus is on data caching and adopting efficient prefetching techniques to improve or enhance the access rate of data there by reducing the query latency.

Keywords: MANETs; Caching; Latency; Mobile; Server; Network; Prefetching; Communication

Introduction

In 1970 Mobile ad hoc network are called as Packet Radio Network (PRNET) [1]. A mobile network consists of a fixed network of clients and servers, mobile clients move throughout the geographic area of the network. Within the mobile network, servers communicate with mobile hosts over a wireless connection and have unlimited power. Mobile clients may only interact among themselves through a server. Among the concerns in this type of network are access rate of data through caching and prefetching, connectivity of the network, and reachability of mobile clients from a server. In contrast, a MANET is a collection of mobile servers and clients. All nodes are wireless, mobile and battery powered [2]. The topology can change frequently. The nodes organize themselves automatically, and can be a standalone network or attached to a larger network, including the Internet [3]. All nodes can freely interact with every other node. In addition to the concerns associated with a mobile network, the cache management and prefetching approach to enhance the access rate of data must also be considered as a primary concern in MANET. MANET is originally called Mobile Packet Radio, Mobile Ad-hoc Network (MANET) technology has been an important communication research area [4]. This technology has practical use whenever a temporary network with no fixed infrastructure is needed. Other uses include rescue operations and sensor networks [5]. The support of communication in all fields often requires a database to store and transmit critical information data such as inventories, Images and tactical information. There is one other crucial characteristic of a MANET. Traditional mobile networks involve the server in all data communication. MANET includes the database capabilities of data push and data pull, but it also allows the clients to communicate directly with each other without the involvement of the server, unless necessary for routing [5]. Due to open medium, dynamically changing network topology, cooperative algorithms, lack of centralized monitoring and lack of cooperative caching and prefetching there is a need to improve the access rate of data in MANETs. So, in order to reduce the query latency in MANETs, study of cooperative caching and prefetching technique approach are to be considered. So caching and prefetching in MANETs will remain a potential research area in near future. Illustration of a typical mobile ad hoc network is shown Figure 1.

MANET have given rise to many applications like Tactical networks, Wireless Sensor Network, Data Networks, Device Networks, etc. With many applications there are still some design issues and challenges to overcome.

The rest of the paper is organized as follows. Section 2 discusses some of the related works, section 3 describes about the overview of caching and prefetching technique, section 4 discusses on caching and prefetching problems in MANETs, section 5 shows the analysis, section 6 provides conclusion and future scope of research and section 7 lists the references.

Related work

Bhat [6] have proposed An Efficient Cache Management using Adaptive Buffer Mechanism in MANET. In a mobile environment, as a mobile node moves from one point of attachment to another during an ongoing application it is subjected to packet loss due to network and storage capacity [7]. For future work, there is a need to Investigate more sophisticated TTL algorithms for life time of the data and selection of Query directories are dynamic so that requesting node gets the data without delay.

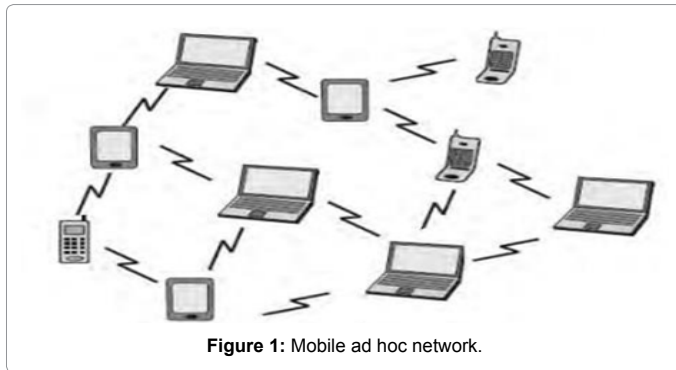
Nayyar [8] have proposed a Cross-Layer System for Cluster Based Data Access in MANET'S. In this paper A cross-layer design approach is utilized to improve the performance of combined cooperative caching and prefetching schemes [9-12]. For future research there is a need to find out an efficient prefetching technique which further improves the data accessibility and reduce query delay to compliment the cooperative caching scheme [7]. Waleed et al., [13] have proposed A Survey of Web Caching and Prefetching. Web caching and prefetching are the most popular techniques that play a key role in improving the Web performance by keeping web objects that are likely to be visited in the near future closer to the client. Web caching can work independently or integrated with the web prefetching [12,14]. In the future research, concentrate on constructing an intelligent web proxy caching and prefetching approach based on support vector machine and artificial immune system.

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Chungsoo [15] have proposed Exploiting Producer Patterns and L2 Cache for Timely Dependence-Based Prefetching. This paper proposes an architecture that efficiently prefetches for loads whose effective addresses are directly dependent on previously-loaded values [16]. As future research, more complex producer-consumer relations will be studied to cover more consumer load instructions. Another future direction will be considering control path information to increase prefetch accuracy.

Pallis [17] have proposed a clustering-based prefetching scheme on a Web cache environment. Web prefetching is an attractive solution to reduce network resources consumed by Web services as well as access latencies perceived by Web users [18]. Future research, is to compare the proposed prefetching scheme with other clustering algorithms.

Overview of Caching and Prefetching Technique

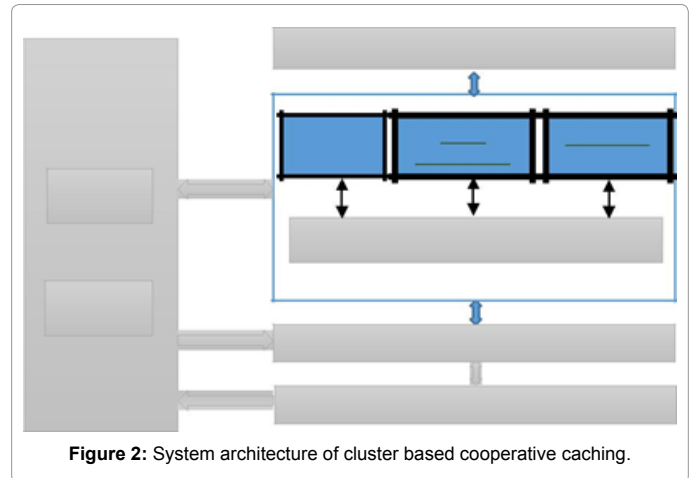
Cluster-based cooperative caching

Cluster-based cooperative caching (COCA) is a cluster-based middleware in the protocol stack. The architecture of COCA is illustrated in Figure 2. COCA provides a caching service for upper user applications and consists of five basic modules: clustering, stack profile, information searching, cache management, and prefetching. The clustering module is responsible for the formation and maintenance of clusters. The stack profile module provides cross-layer information. Using the stack profile, information is shared between the middleware, the network layer and the data link layer. The information searching module deals with locating the data item requested by the client. The data returned can either be the original data from the data source or the cached copy in a mobile node. Usually, a node searches for the requested items within the neighborhood before sending a request to the data source to eventually reduce query delay. The cache management module consists of three sub-modules: cache admission control, which determines whether a data item that was received should be cached; cache replacement, which determines which cached item in the cache space should be removed when the cache is full and a new data item has to be cached and cache consistency, which maintains synchronization of the cached data items with the original data items in data source.

Prefetching

The prefetching module determines which Image data item should be prefetched from the data source for future use. Every mobile Host has a certain amount of cache space for caching data items from the Data Centre or other Mobile Hosts, and the instances of COCA operate in every Mobile Host.

Prefetching is fetching the data in advance by the proxy server/client before a request is sent by a client/proxy server. Prefetching is suitable for traffic shaping and idle time processing [12]. The major



advantage of using prefetching is to reduce the query latency. When a client makes a request for data rather than sending request to the server, it may be fetched from a pre-fetch area. The main factor for selecting a data prefetching algorithm is that its ability to predict the data to be perfected in order to reduce the query latency. Data prefetching exploits the spatial locality of data, i.e. data is that are linked with current data will be accessed with higher productivity than other data.

Caching and Prefetching Problems in Manets

Performance degradation of data access or query latency is due to the following reasons with respect to caching and prefetching problems:

1. Cache Overflow: The contents not stored in the cache memory due to cache memory limit.
2. Cache Access: Slowdown in accessing the cache memory due to network congestion.
3. Cache Data Recovery: Data loss from the cache due to vulnerable attacks to be recovered.
4. Data consistency in cache and prefetch memory: Due to huge data traffic data consistency to be maintained between the cache and the prefetch memory
5. Data overflow in prefetch memory: Data overflow from prefetch memory due to prefetch memory limit.
6. Data time stamp record: In prefetch memory data will be discarded if the data is not utilized for certain period of time.
7. Memory constraint to store data: Memory is fixed, memory to be utilized efficiently to manage the data communication

Analysis

Based on the literature survey and the problems encountered in caching and prefetching in MANETs an efficient caching and prefetching techniques have to be proposed to improve or enhance the data accessibility and to reduce the query latency/delay. There is a need to focus on different approaches related to caching and prefetching, the approaches are intelligent web proxy caching and prefetching, cooperative caching and prefetching, data acknowledgment in prefetching approach, data sharing by neighboring nodes approach, data accessing from the central data repository approach, cooperative caching and data prediction in prefetching approach.

Conclusion and Future Scope of Research

The following conclusion is made based on the study of data communication, data access, cache management and prefetching approach in MANET's. There is a great development work carried out in the field of Mobile ad hoc network (infrastructure less network) in caching and prefetching. An efficient caching and prefetching technique is required to enhance the access rate of image data from source to destination there by reducing the query latency. Query latency is the main area which evaluates the performance of the data communication between the source and destination nodes. In this paper, the survey has been carried out on caching and prefetching approaches, benefits and limitations. Based on the outcomes of survey analysis and due to the mobility and open media nature of MANETs in future there is a need to develop an efficient caching and prefetching technique approaches to improve the access rate of image data and thereby reducing the query latency.

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