Literature Survey for Improved Content Delivery for Mobile Network

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Abstract—**In this mobile dominated age there has been observed a need to augment the existing content delivery systems for mobile users to achieve a level of sophistication consistent with the rising popularity of mobile usage. Given limited bandwidth and unreliable wireless channel, users perceive a delay in content delivery. To overcome these drawbacks various solutions have been proposed. In this paper a comprehensive study of recent activities in the field of mobile delivery network has been done, that highlights the various *Prefetching and Clustering Replication* algorithms that can enhance the existing content delivery network.**

Keywords—Mobile Content Delivery, Web Pre-fetching, Clustering Replication, Bandwidth consumption, Wireless Network.

I. INTRODUCTION

In the twenty-first century, mobile and the Internet has become an important part of everyone's life. End users are accustomed to a certain Quality of Experience (QoE) when it comes to Internet access and their expectations have been growing over the past few years. Over the years the mobile development has led to a major shift of Internet application access from macro to micro i.e. from desktop to mobile. Most of the network data traffic is generated by mobile web browsing and video applications. Mobile network uses low bandwidth but service delivery mainly depends on network latency. End users get impatient to wait while a video is buffering or when they are obliged to wait for a web page to load. Thus for a content provider one second delay in load page can make a huge difference, such as loss of few review pages, low customer satisfaction, lost conversations etc. Tablets, smart phones, and other hand-held devices are now able to support high bit rates for video loading. Thus, the bottleneck does not reside in the device capacity, but in the network's ability to deliver the content. Bandwidth of each video differs and depends on the quality of the video and also the size of the mobile. The bandwidth can be saved in the backbone network by deploying a standard content delivery network (CDN). The principle of a CDN relies on the distribution of caching servers in the network capable of serving popular content from a location closer to the end users. Integrating the CDN system with mobile networks will provide even greater Quality of Service than conventional system and by placing the required equipment closer to consumers. To understand the performance measurements of mobile networks, many measurement studies have been presented. These studies unveil the obstacles of content delivery for mobile network and shed light in research to improve the performance metrics of the system. Fig 1 shows the classification of Accelerating Content Delivery for Mobile, it is broadly divided into 3 main categories, i.e. Mobile System Evolution, Content and Network Optimization and Mobile Data Offloading.

This paper will mainly focus on reviewing in the category of Content and Network Optimization.

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II. TECHNIQUES

There are many types of solutions addressing mobile content delivery. All the current solutions reside outside of the mobile network or within the core network.
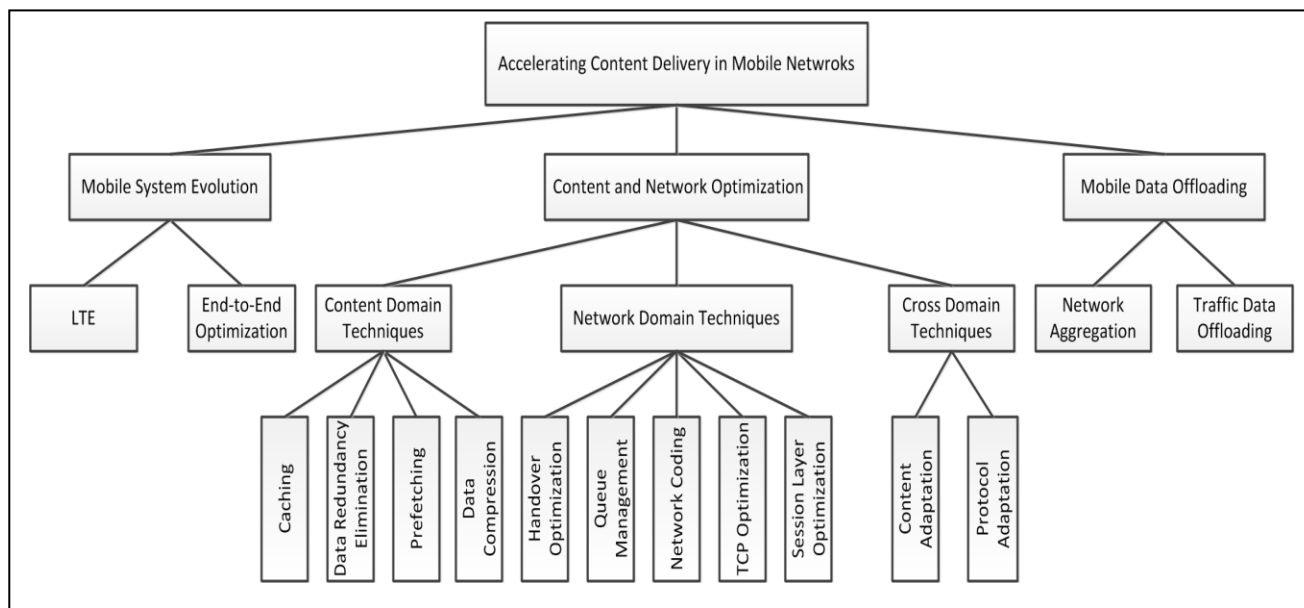
Fig.1. Classification hierarchy of content delivery acceleration solutions in mobile networks [4]

These techniques can be divided into 3 categories[3]:

A. Network Optimization techniques

Network optimization techniques such as network coding, the TCP optimization, etc., are introduced to enhance the robustness and effectiveness of data transmission over lossy wireless networks. TCP does not perform well in mobile networks because of unreliable wireless links. Therefore, enhancing TCP performance in mobile networks is crucial for accelerating mobile content delivery. Therefore, integrating network coding into TCP may enhance TCP performance in lossy networks.

B. Content Optimization techniques

The content delivery mainly focuses on solving problem of content availability and reducing latency. Content domain techniques aim to reduce the data volume over mobile networks. They include caching, data redundancy elimination, pre-fetching, etc. Caching stores copies of frequently requested content in user's local cache or in the cache proxy located at the network edge. And the requests are served by these intermediate servers instead of being responded by the original content server. The performance of the caching scheme is determined by the hit rate of the cache; the higher the hit rate, the better the performance. While, pre-fetching techniques hide network latency from the users by predicting the user's next requests and per-retrieving the corresponding content. Data compression techniques accelerate content delivery by reducing the data volume generated by applications. But, above mentioned techniques alone are not sufficient to observe significant improvement in content delivery.

C. Cross Domain techniques

Cross domain techniques optimize the interactions between applications/content and the underlying networks. These techniques can be classified into two categories: content adaptation techniques and protocol adaptation techniques. Implementation of these techniques requires knowledge of mobile devices along with the networking part.

III. LITERATURE REVIEW

A) *George Pallis and Athena Vakali (Insight and Perspectives for CONTENT DELIVERY NETWORKS(2006))* [1]:-

This paper surveys the CDN its needs and its importance for web and desktop application and how it can be expanded for mobile applications. Their main focus lies in customer satisfaction. Mention of CDN manager to fulfil each individual needs was a highlight of this paper, that makes it necessary to look into this drawback.

B) *Erik Nygren, Ramesh K. Sitaraman, Jennifer Sun(The Akamai Network: A Platform for High Performance Internet Applications (2010-11))* [2]:-

In this paper they have given a brief study of the overall Akamai Content Delivery system that provides Internet services to hundreds and billions of people, handling hundreds of interactions daily, helping enterprises and businesses to boost their services and reliability of services and Internet application. Overview of the various components, architecture, design principles and operations of the system is discussed. The mainly focus on the Internet Delivery challenges and try to overcome it by the proposed system. But the system architecture is for desktop services rather mobile applications and no mention of CDN for mobile networks has been done.

C) *Tao Han, Student Member, IEEE, Nirwan Ansari, Fellow, IEEE, Mingquan Wu, Member, IEEE, and Heather Yu, Member, IEEE (On Accelerating Content Delivery in Mobile Networks (2012))[3]*

In this survey paper overview of content delivery for wireless mobile network is mentioned. By studying live measurements, various performance measures have been noted and various solutions to overcome this obstacle have been mentioned. The adaptive control algorithm for UDP streaming is mentioned, but also have mentioned a comparative study of TCP congestion mechanism is also studied. Multimedia delivery consumes a lot of bandwidth and dynamic contents like high definition videos and 3D videos, users expect the quality as well as low latency, but providers prefer quality over latency, hence users get impatient. Overcoming these issues with the existing system is of utter importance. Steps to overcome these are mentioned, but implementation details are kept for further investigation [5].

D) *Arun Pasrija and Sikha Sharma (Review of Web Pre-Fetching and Caching Algorithms(2014))[4]*

In order to provide efficient web services web pre-fetching is done. Based on client history, the data that is likely to be pre-fetched is bought to the server closest to the client. Pre-fetching signifies finding the probable content or documents that can be requested before they are actually requested. It is complimentary to cache and can improve cache performance and reduce user perceived latency. Various techniques are mentioned which can be used according to system requirements. These techniques are applied to reduce network traffic, improve user satisfaction and efficiently improve data management.

IV. PROPOSED SYSTEM

After surveying some of the papers, a system was generated which was a mixture of all the proposed architectures to make a better one to obtain the two most important performance metrics:-
  1) Reduce bandwidth consumption
  2) Improve cache performance

The proposed system will consist of a Master-Slave architecture where they will be spread region wise to gain maximum output. A caching proxy will be present at the slave server to pre-fetch the content and the clustering of the similar data will be recorded to the master.

Pre-fetch algorithm will mainly focus on:-
  1) Popularity
  2) Bandwidth contribution

Clustering Replica algorithm will mainly focus on:-
  1) "What to Replicate"
  2) Placement of the replica content

So, these algorithms in the proposed methodology will improve the overall system performance.

V. WEB PREFETCHING TECHNIQUES

Among the many a few are being mentioned here[5]:
1) *Domain top approach*
   In this approach proxy is responsible for finding the most popular domains and most popular documents in those particular domains and making a ranking list according to the access of each document or domain. It is done for pre-fetching. It is done to improve the hit ratio and this puts a little burden on the proxy server. This approach can be done without changing the client or server.
2) *Top 10 Approach*
   In this approach proxy makes a list of frequency of access for predicting the web object on the sever side and not based on client characteristics on the web. This is done on the server side rather than on the client side. The server side is responsible of periodically making a list of most popular documents. This method combines server's active knowledge and client's list of web profilers.
3) *Model based Predictive Pre-Fetching*
   In this approach there is integration between the web cache and the web pre-fetching. This technique is time based and comparison between two web objects. It creates a correlation graph to show relation between web objects and pre-fetch objects and the currently requested web objects.
4) *H/B-greedy Pre-Fetching[6]*
   A pre-fetching algorithm chooses subset of web objects from the entire collection, in this algorithm a group of web objects are requested to achieve better hit ratio to bandwidth (H/B) metric better than the existing algorithms. Since object characteristics are known such as lifetime, frequency etc. the H/B ratio should be max to obtain accurate results.

VI. CLUSTERING TECHNIQUES FOR REPLICATION

Among the many techniques mentioned a few are mentioned here [7]:
A) *Squared Euclidean distance*
Euclidean distance is mostly used in clustering problems, including clustering text. It satisfies all the conditions necessary for a true metric. For the document to belong to the same cluster it should have minimum Euclidean distance. It measures the distance between two text documents to comprehend the similarities and to assign documents to a cluster.
B) *Cosine similarity*
It is one of the most popular similarity techniques used for information retrieval and clustering. It uses the concept of vectors, the correlation between two vectors gives the similarity between two documents. This is quantified as the angle between the two vectors hence the name *Cosine - similarity*. The important factor is the independence of document length.

VII. CONCLUSION

In this survey, we have presented an overview on improving content delivery for mobile networks. By studying the network obstacles various solutions have been presented that can improve delivery for wireless mobile networks. Comparative study of various web pre-fetching and clustering replica algorithms help to analyze which algorithm is best according to your system needs. Considering web service and video streaming as the two main services of mobile networks, an overview of various algorithms and a proposed system has been discussed. Hence this paper can be useful for further investigation for improving mobile delivery. With increasing demand of video streaming and high quality videos, the system should provide the service with low latency and without compromising on the quality of the video. To achieve this a great advancement in the existing system is going to be hour of need.

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