

A DIFFERENTIATED SERVICE BASED CONTENT DISTRIBUTION METHOD IN CDN

Binjie Zhu, Ke Xu and Renjie Pi

Beijing University of Posts and Telecommunications, Beijing, China

Keywords: Content delivery, Overlay network, Differentiated service.

Abstract: With the development of Internet applications, there are more and more problems about delay in the Internet. Content distribution network is an overlay network to distributing the content to the edge of Internet to reducing the user perceived delay. This paper focuses on the content distribution problem in the content delivery network. A differentiated service based content distribution algorithm was designed in this paper. Clustering algorithm was used to get pedigree chart of the edge server, and then ant algorithm was used to search for the optimal edge server based on the pedigree chart. The analysis shows that this algorithm combines the clustering method and ant colony algorithm, and it has a good distribution of results.

1 INTRODUCTION

CDN (Content Delivery Network) use distributed caching and the load balancing techniques on the Internet to build a distributed overlay network. This overlay network pushing the content from the source to the network edge equipment. On one hand, it allows the user to access to near location server with the desired content, reducing the end to end delay, improved customer service quality; On the other hand, the central server bottleneck was broken, and reducing the backbone network traffic. It effectively alleviating the throughput of backbone network, and increasing of system capacity.

There are three layers in the CDN overlay network. The first layers is source server where the source content object come from. The second layer is the copies server layer. This layer is used to storage the copy of the content for distribution. The third layer is the user layer, obtains the content from the copy servers. The copy server is put in the edge of internet, so the network traffics are pushed to the edge of the Internet (George Palls, 2006). It is the basic idea of content delivery network (CDN).

We designed a P2P-CDN with two layers, shown as figure 1. The edge server in the CDN is divided into two layers: the wide-area and the local level. Wide-area node was distribution in different locations, for the purpose of pushing the content into

the edge of Internet. Local level nodes were in the same location, and the function is to increasing load capacity.

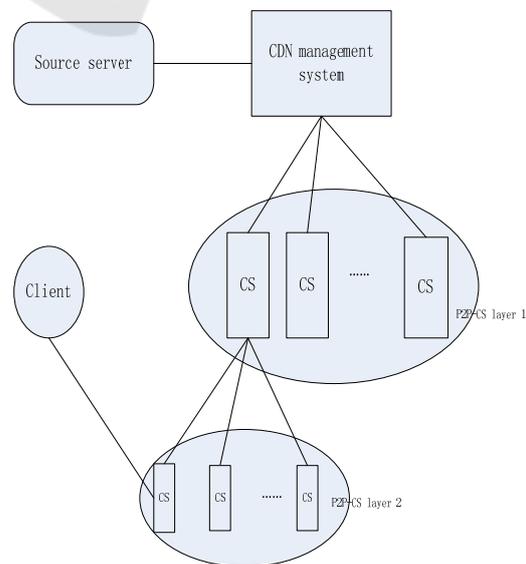


Figure 1: P2P-CDN with two layers.

2 BACKGROUND AND PREVIOUS WORK

After a contract was signed between the CDN pro-

vider and the CDN user, the contents were delivery to a CDN provider. All the content files were copied in the source server by the CDN providers. CDN content were transmission to the edge cache server by distribution module of CDN according to a certain distribution means, shown as figure 2.

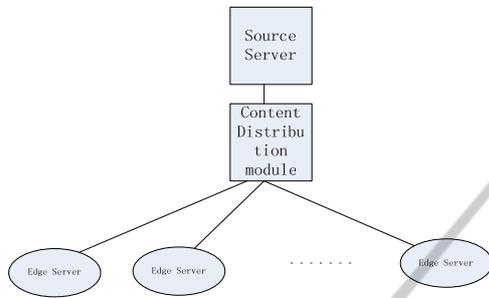


Figure 2: Content distribution.

The existing distribution method (Adrian J. 2006) (S. S. H., 2003) does not support service differentiation. All content objects as a whole, does not distinguish the different server quality requirements between different content. The proposed method in this paper supports differentiated Service and supports optimization for each content object. A contract was signed between the CDN provider and the CDN user in which contain the service level requirements of each content object. Different levels of service corresponding to different number of copies. Every content objects has the attributes of service level requirements. How to distribute the contents of an object with differentiated Service effectively is the aim of this paper.

3 DIFFSERV-BASED CONTENT DISTRIBUTION METHOD

CDN systems included source server, edge servers, and the CDN management system. CDN management system including the content distribution related modules: service differentiation module, content distribution control module, ant search module, the delay measurement module, shown as figure3. Content distribution module's function is to distribute the content object to the edge server node.

Delay measurement module is to measure the network delay between the edge servers. If there are N edge servers, n ($0 < n \leq N$) points selected from

the edge servers randomly. The delay data were statistics to get the delay date of other points to the n points. The hierarchical diagram was obtained through clustering these data. The pedigree chart was transformed into a standard pedigree tree for a heuristic algorithm of content distribution.

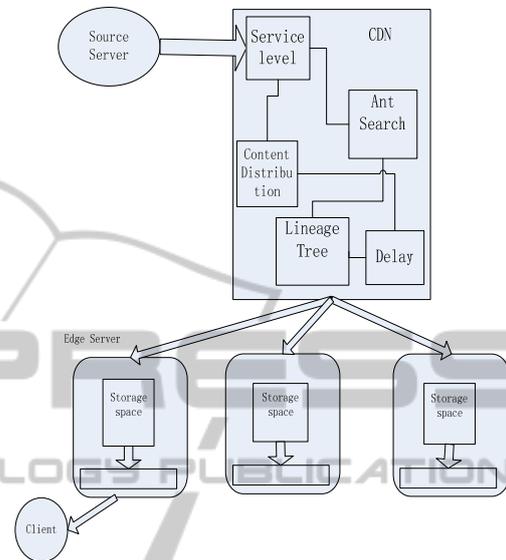


Figure 3: CDN system modules.

If there are n copies for one content, then n ants climb out in ant colony search modules. For a set of content objects, there may be a crowding phenomenon, in which a lot of content was assigned to one location, causing unbalance distribution. However, this distribution unbalanced is necessary from the view of all the point of positions. The purpose content distribution network is to reducing the delay, the best performance in a position to do distribution copy is necessary. However, it is necessary to balance distribution in the peer position with the same effect. In another word, the balance is necessary form the view of local area or the nearby position. According to this principle, ants were crawling, and sprinkle pheromone. Distribution balance guided by the pheromone information.

The service level argument was obtained from the service distinction module. The service level information contains the number of copies for a content object. The service level as an argument was transmitted to ant search module. The ant searching module run heuristic search in the space of edge server based on the pedigree tree. Contents were distribution to the optimal position based on the ant search result. It is shown as figure 4.

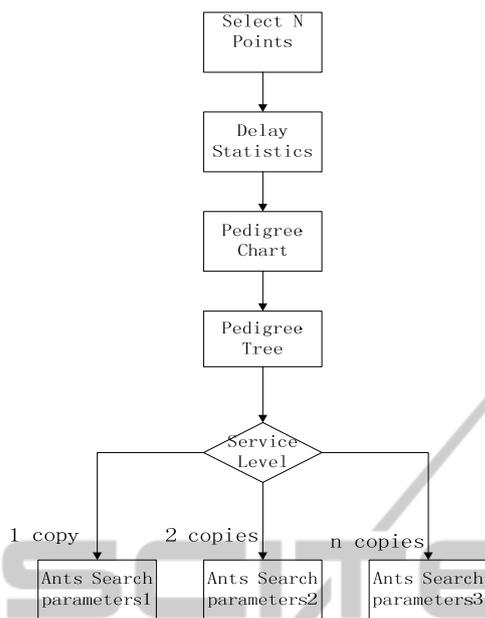


Figure 4: Distribution Flow.

4 EXAMPLE

For a detailed description of the algorithm process, there will be an example. Assuming the six edge points in the content distribution system, $N = \{A, B, C, D, E, F\}$, every point is one edge server, shown as the figure 5. Because there are fewer number of point, so all the six points were selected for the delay monitoring points. All the edge server point has a distance to this 6 monitoring points, and it is forms a matrix.

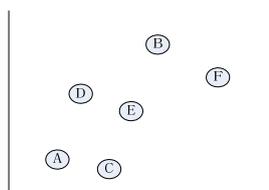


Figure 5: The edge servers.

Pedigree chart was obtained through the hierarchical clustering of these points base on the matrix. As shown in figure 6.

The chart was transformed into a pedigree tree, as shown in Figure 7. Suppose there is a content object, the content object needs to have three copies. Because there are n copies of the content to be distributed, so there are three ants crawling in the

pedigree tree. After the ants search in pedigree tree, three positions got for the three copies.

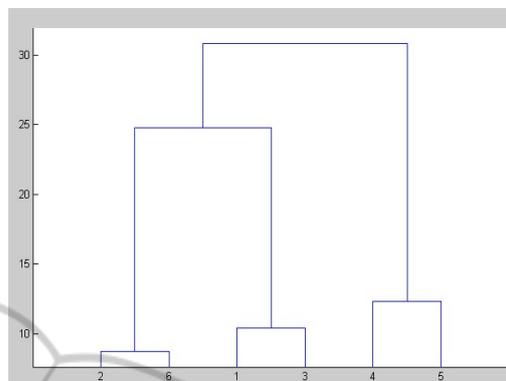


Figure 6: Pedigree chart.

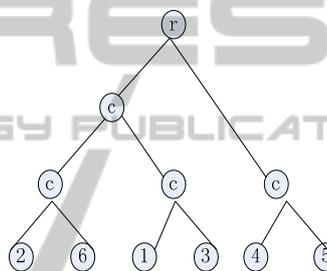


Figure 7: Standard pedigree tree.

Ants crawl in the pedigree tree with 3 deep. As ants climb with a depth of 3, each ant is faced with two choices. For example, there was an ant facing the choice of points 2 and 6. According to the crawl rules in front, it can randomly select the point, but the pheromone was sprinkled in the choice path, in order to facilitate the next ants to choose a different path for load balancing purposes. Finally, the three servers choose are shown in Table 1.

Table 1: The result of distribution.

Copies	C1	C2	C3
Edge servers	2	1	4

5 CONCLUSIONS AND FUTURE WORK

This paper studies the content delivery network content distribution problem. Different quality of service has a different number of copies, are distributed with service differentiation. The contents

with high QoS level were distributed to the optimal position to achieve utility maximization. This paper presents a hierarchical clustering based heuristic method and ant colony algorithm to solve this problem. Future work is to further optimize this method.

ACKNOWLEDGEMENTS

This work is supported by the National Key project of Scientific and Technical Supporting Programs of China (Grant Nos. 2008BAH24B04, 2008BAH21B03, 2009BAH39B03); the National Natural Science Foundation of China (Grant No. 61072060); the Program for New Century Excellent Talents in University (No. NECET-08-0738); Engineering Research Center of Information Networks. Ministry of Education.

REFERENCES

- Adrian J. Cahill, Cormac J. Sreenan, 2006, An efficient resource management system for a streaming media distribution network, *Intreactive Technology and Smart Education*, Vo. 3, No. 1
- George Palls, Athena, Vakali, 2006, Insight and Perspectives for content delivery networks, *Communications of the ACM*, January, Vol. 49, No. 1
- S. S. H. Tse, 2003, Approximate Algorithms for Document Placement in Distributed Web Servers, *IEEE Transactions on Parallel and Distributed Systems*, Vol. 16, No. 6, pp. 489-496