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DYNAMIC WEB CACHING WITH SATELLITE CLUSTERING FOR High Availability - NCache

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Abstract: The Dynamic Distributed Web Caching System decline from scalability, Load Balancing and less robustness problem due to overloaded and more congested proxy servers. Server load-balancing solves the scaling problem by letting you deploy a single web application to more than one physical machine. These machines can then be used to share the web application traffic, reducing the total workload on a single machine and providing better performance from the perspective of the user. We'll discuss Resin's load-balancing capabilities in greater detail, but load-balancing is usually achieved by transparently redirecting network traffic across multiple machines at the systems level via a hardware or software load-balancer (both of which Resin supports). Load-balancing also increases the reliability/up- time of a system because even if one or more servers go down or are brought down for maintenance, otherservers can still continue to handle traffic. With a single server application, any down-time is directly visible to the user, drastically decreasing reliability. We are making clusters based on knowledge proxy serves having similar data are collectively make a cluster. Based on which hit ration will be high. It increases the scalability by maintaining metadata of neighbors collectively and balances load of proxy servers dynamically to other less congested proxy servers, so system doesn't get down unless all proxy servers are fully loaded so higher robustness of system is achieved.

Keywords: Distributed Web Caching; Satellite Clustering; Proxy Server; Latency; Hit Ratio; Robustness.

1. INTRODUCTION

A cache is a temporary storage location for copied information. There are over a billion pages (or objects) on the internet. Many users request the same popular objects. A Web cache is a dedicated computer system which will monitor the object requests and stores objects as it retrieves themfrom the server. The more people (or simply clients) request resources (in this case files) from web servers, the faster servers have to accept and process the requests. With these requirements Programmers as well as system administrators must take countermeasures to cope Requirements From the very beginning of the WWW the for servers have not only changed from the view of Traffic, but also from the type of content theydeliver to the client. This development takes the

main source of load away from the operating system responsible for reading the files from the hard disk or another type of memory and shifts it to the program that dynamically generates the page. Also computer hardware has evolved. This makes it possible to have web pages generated the way they are today. Generally speaking, servers are capable of serving most pages in quite a reasonable amount of time. This is true as long as only a small number of visitors request pages to be generated. The larger the numbers of clients, the more pages have to be generated simultaneously. Multi-tasking enables servers to do so, but CPU capacity is limited. If it was only for system administrators, they would add more hardware power (for instance clustering servers, load balancing).

Furthermore, the number of requests per second that a single server machine can handle is limited and cannot scale up with the demand. Two common approaches to implement a large scale cache cooperation scheme are hierarchical and distributed [1], [2] caching. The need to optimize the performance of Web services is producing a variety of novel architectures. Geographically distributed web servers

[2] and proxy server systems aim to decrease user latency time through network access redistribution and reduction of amount of data transferred, respectively. In this it consider different web systems, namely web clusters that use a tightly coupled distributed architecture. Cluster technology is a cost effective solution because it is cheaper than a single faster machine. From the user's point of view, any request to a Web cluster is presented to a logical server that acts as a representative for the Web site. This component called Web switch retains transparency of the parallel architecture for the user, guarantees backward compatibility with Internet protocols and standards, and distributes all client requests to the Web and back-end servers. A valuable recent survey is in [4].One of main operational aspects of any distributed system is the availability of a mechanism that shares the load over the server nodes. Numerous global scheduling algorithms were proposed for multi-node architectures executing parallel or distributed applications. Unlike traditional distributed systems, a Web cluster is subject to quite different workload. The hit rate of a Web cache can be increased significantly by sharing the interests of a larger community [5]; the more people are accessing the same cache, the higher the probability that a given document is present in the cache. To increase the effective client population using a cache, several caches can cooperate.

2. Problems in Distributed web caching [6]

Extra Overhead

Extra Overload increases when all the proxy servers keep the records of all the other proxy servers which results congestion on all proxy servers. They all have to keep check on the validity of their data which results in extra overhead on proxy servers.

Size of Cache

An intermediary system which will act as both a server and a client for the purpose of making requests, on behalf of other clients. If Cache Size is large then Meta data become unmanageable because in traditional architectures each proxy server keeps records for data of all other proxy servers. In this way if Cache size becomes large then maintenance of Meta data is a problem.

Cache Coherence Problem

When client send requests for data to proxy serverthat data should be up-to-date. This results into

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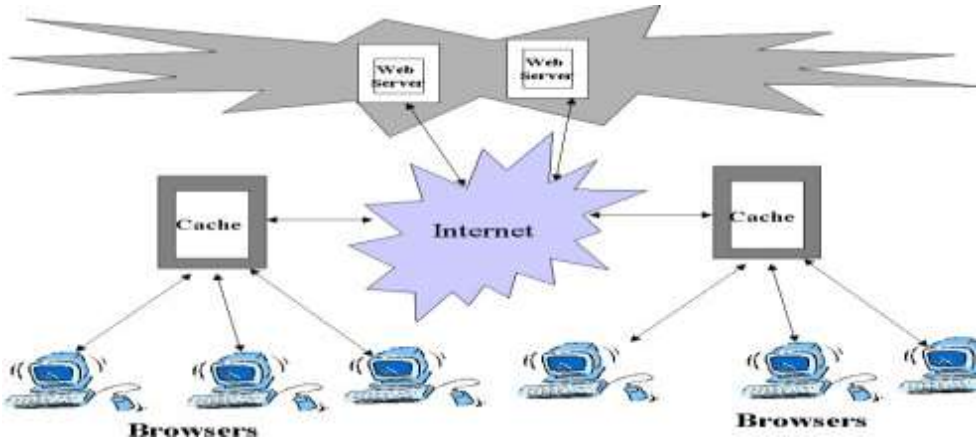
Cache Coherence problem.

Scalability



Finally, By Clustering we can also solve the problem of scalability, add more number of clients, and data of these clients will be managed on the basis of geographical region based Cluster. A particular cluster will only have to manage the id's and update the Meta data of all the proxy servers or of the neighbor clusters.

Robustness

In distributed web caching there is no any conceptof clustering so the mostly user is not satisfied because they request to same proxy server so the system is no more robust.

Hit Ratio

When the congestion will occur in the network then the hit ratio will be decreased because all the clients will wait for requested pages.

Load balancing

When one proxy server will busy and other proxyserver will free. It depend on several identities like Load balanceconnect timeout, Load balance idle time, Load balance recover time and Socket timeout.

3. Proposed Solution for Distributed WebCaching

Clustering reduces this extra overhead. By makingclusters on the basis of Geographical region we can solve this problem. From now one proxy will manage the Meta data regarding the proxy servers which fall under the same cluster region and its neighbour clusters. By using the concept of Knowledge based clustering more clients request will be satisfied then the system will be more robust. If Cache Size is large then Meta data become unmanageable because in traditional architectures each proxy server keeps records for data of all other proxy servers. In this way if Cache size becomes large then maintenance ofMeta data is a problem. When client send requests for data to proxy server that data should be up-to- date. This results into Cache Coherence problem. This can be solved by having a timer with origin server, after a particular time period if there is any

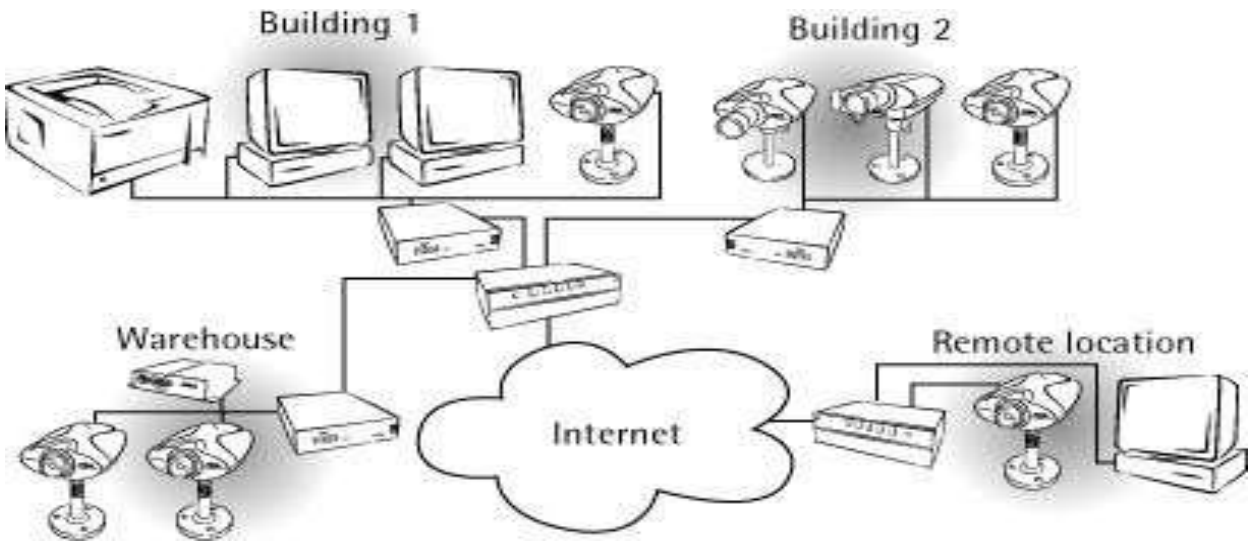
fresh page then origin server will check for it and send the fresh pages to any of proxy server which in turn forward this information to all other proxies and one cluster region have to maintain the now if there is any fresh page then originserver will check for it and send the fresh pages to any of proxy server which in turn forward this information to all other proxies and one cluster region have to maintain the record for cache updation for that cluster only. This gives proper updating of data and also less workload. Finally, By Clustering we can also solve the problem of scalability by this, add more number of clients, and data of these clients will be managed on the basis of geographical region Cluster.

4. The Proposed Caching System

In this section, we first define the structure for which our proposed caching model is intended. This is followed by a detailed description of the caching model. We then discuss some interesting properties of the proposed system.

Structure of Network

At the highest level origin server are scattered around the world. These origin servers are connected to proxy server via various form of communication medium. These proxy servers are in turn connected to client computer whose purpose are just to send the request and get response. Proxy servers are arranged at middlelevel which acts as both client and servers. For origin server they act as client and for client computers they act as servers. All the proxy servers are arranged in the geographical region based. After adding the concept of clusters now it is easy to maintain the data in the cache of proxy servers. To maintain the data consistency we associate a timer with the origin server so that if there is any fresh page then origin server keep check for that and forward fresh pages to the proxy servers on designated port which in turn forward data to other proxy servers to maintain metadata. Each Proxy server is having metadata in its cache which keeps the record about data in other proxy servers. Each proxy server in one cluster is having metadata about proxy servers which fall in corresponding cluster and proxy servers of neighbor clusters.



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Proposed Architecture According to the architecture described in [7]browsers are at the lower level, proxy servers atthe middle level and origin servers at the highestlevel.

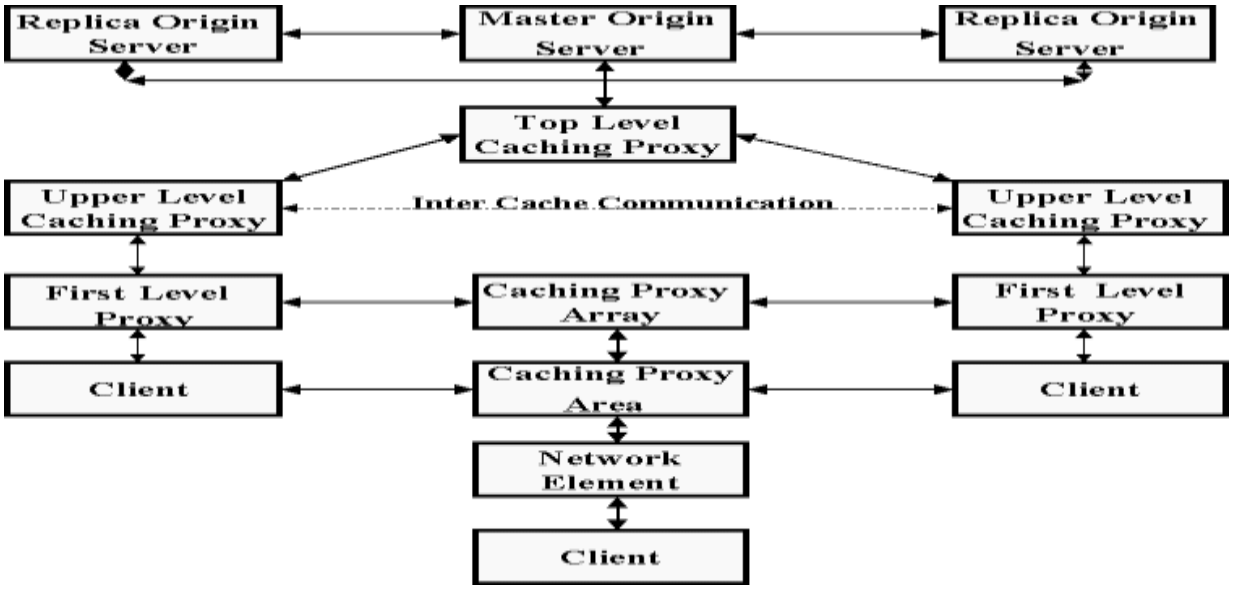

Fig.1 Proposed Architecture of Knowledge based clustering

Working

These problems like extra overhead problem of unmanageable data, cache coherence, less robustness and scalability are major problem for data retrieval from proxy servers. In some earlier paper solutions for these problems are given by making clusters on geographical region based. We get a high benefit by clustering but in the term of hit ration, if we want to increase hit ration we can add the concept of knowledge based clustering.

Whenever a query found from a client to proxy server for a particular data, firstly queuelength check as earlier defined in [3] after that pattern match in this proxy server if pattern match in then same knowledge based pattern cluster are picked and page is reached in that clusters metadata, if data found then ok otherwise data is requested to origin server.

Proposed Algorithms

We have given the Algorithm for Proxyservers.

Proxy Servers:

/* queue length: It is associated with every proxy server, which tells how many client's requests can be made to a proxy server.*/
PS: Proxy Servers. Noofservices: tells how many connections are active with proxyserver. CIP: Client's Internet Address. Reply: has either requested page or message "NO". Rpage: Requested page or file.
Ps_ip []: is a stack of Internet Addresses of allthe proxy servers in same Cluster. OS []: is a stack

of Internet Addresses of all the Origin Servers.
Cluster []: is a stack of Internet Addresses of all Clusters. MB: Match Bit
KBC: Match Bit for Knowledge based clustering
KBC[]: is a stack of Internet Addresses of all the proxy servers in same Knowledge based clustering KBC_CSE[]: is a array of computerscience Engineering
KBC_ECE[]: is a array of Electronic &communication Engineering KBC_ME[]: is aarray of Mechanical Engineering KBC_CVE[]: is a array of Civil Engineering

Step 1: queuelegnth(ql)=0;
Step 2: If Request from OS [] for connection then
Establish connection with the origin server.
Connection Established.
(1) A new thread is established.
(2) Receive data from origin server.
(3) Update its metadata and broadcast informationto all clusters.
Step 3: Proxy Server will wait for connection with clients or from other proxy servers. Step 4:
If request is to update data by any other proxy server then update metadata. Step5: if (q11+q12+q13)
<=240
Step6: if (q1<80)
Step7: A Connection is established by creating a new thread to deal with it & client's locative address in CIP. Step8: Get client's locative on in IP address in CIP.
Step9: if Incoming request from Client CIP
/*request is from client*/

a. If Pattern match is on same KBC []
/*KBC_CSE[], KBC_ECE[], KBC_ME[],KBC_CVE[] */
wait();
ql=ql+1;
Signal();
Search metadata();
If matchfound then

1) If matchfound is on current cluster
   1. If (same proxy server)
      i. wait();
      ii. ql=ql+1;
      iii. signal();
      iv. Search for Rpage incache.
      v. Return Rpage to CIP.
      vi. ql=ql-1;
   2. else/*else of 1.*/
      i. Send request to another proxy server.
      ii. looking for reply.
      iii. Return Rpage to CIP.

else /*else of (1) */
(1) if(MB==1)/* Data on Neighbour cluster*/
1.wait();

2.ql=ql+1;3.signal();
4. Return Rpage to CIP.5.ql=ql-1;

(2)else If (MB==0)/*else of (1) */ /*Incrementcluster to search*/

1. (Owncluster+2)% n
2. If (r page=NO)
   No Such page Exist in ThisCluster & Goto step A
3. else /* Else of (2).2*/
   i. Wait();
   ii. Ql=ql+1;
   iii. Signal();
   iv. Return Rpage to CIP.
   v. Ql=ql-1;else /*else of (a) */

(1) if(KBC==1)/* Data on Neighborknowledge based cluster*/

i. wait();
ii. ql=ql+1;
iii. signal();
iv. Repeat step 9
v. Return Rpage to CIP.
vi. ql=ql-1;

(2) else If (KBC==0)/*else of (1) */
/*Increment knowledge based cluster tosearch*/

I. (Ownknowledgecluster+2)%n
II. If (r page=NO)
No Such page Exist in ThisCluster & Goto step A
III. else /* Else of (2).2*/
i. Wait();
ii. Ql=ql+1;
iii. Signal();
iv. Repeat step 9
v. Return Rpage to CIP
vi. Ql=ql-1;

Step 10: Else/*else of step 9*/

If(request is from proxyserver)&&(MB==1)&&(SameCluster)

(1) Accept Connection();
(2) wait();
(3) ql=ql+1;
(4) signal();
(5) Return Rpage to Proxy Server.

ql=ql-1;

If(request is fromproxyserver)&&(MB==1)&&(Differ ent Cluster)/*else of 10.1*/

(1) Accept Connection();
(2) wait();
(3) ql=ql+1;
(4) signal ();
(5) Return rpage to proxy server.
(6) ql=ql-1;
Else if (request from proxy server)&& (MB==0)/* Else of 10.2*/
(1) Accept Connection ();

(2) wait (); (3) q1=q1+1;
(4) signal();
(5) Search Metadata();

(6) If(Datafound)
(7) Go to step 9.5

10.4 Else/*else of 10.3.(6)*/
(1) Send Request to Origin server.
(2) Accept Connection from origin server.
(3) If datafound
Send Rpage to proxy server.
(4) Else /* Else of 10.4.(3)*/
B. No page existStep 11 if (Request
is fromorigin server)

11.1.AcceptConnection();

1.2. Update metadata & cache; Step 12 Else If(ps2.ql<80)/*Else ofstep 6*/

12.1. Forward request of client to ps2. Step 13. Else Forward request of client to ps3. /*Else of step 12*/

Step 14. Else Send Request of client to any othercluster.

4.3.2 Explanation

In this Algorithm , Firstly request goes to Proxy server from Client then proxy server will check queue length of cluster in which that proxy server lies , if it is less than 240(we have fixed the queuelength of proxy server say 80 ,and consider three proxy server in a cluster) then check the queue length of proxy server if it is less than 80 then check that the request is from client or from other proxy server if request is from client then hold the wait signal for lock and increase its queue length by 1 if requested page is found in its current knowledge based cluster and on current cluster on same proxy server then return Rpage toclient otherwise check its metadata it has all information of its own proxy servers and allinformation of its neighbor clusters. If it is foundin neighbor cluster then there is an match bit(MB) it is equal to one it means that proxy serverknow the requested page in that proxy serverbecause it has all information of its neighborproxy server send request to that match proxyserver otherwise send request to its neighborcluster and match bit is equal to zero if it hasrequested page then send reply back to that proxyserver otherwise it can be on different cluster. If it is found in neighbor knowledge based cluster then there is an Match Bit for Knowledge basedclustering (KBC) it is equal to one it means thatproxy server know the requested page in thatproxy server because it has all information of itsneighbor proxy server send request to that matchproxy server otherwise Repeat the previousprocessing otherwise send request to its neighbor cluster and Match Bit for Knowledge based clustering is equal to zero if it has requested page then send reply back to that proxy server otherwise it can be on different knowledge based cluster. If request is from proxy server of its same cluster and MB is equal to one then return Rpageto that proxy server if request is from different cluster and MB equal to one then check in its metadata and return page to the proxy server elsethere is an third case request is from proxy serverand MB is equal to zero it means that requestingproxy server don't have the information of thatproxy server. If the requested page is not found inall the proxy servers then send the request to the origin server and make connection with origin server and receive the requested page. There isanother case the request can from origin server toupdate the information in metadata than proxyserver will receive the updated copy from originserver and will update it.When the client willrequest to the proxy server there may be possibility that the

proxy server have no morespace means it is equal to its defined queue lengthThen send request to other proxy server in samecluster if no space then send other proxy server otherwise send the request to the other cluster. Working of Client is just to send request for Rpage to the Proxy server and wait for result ifresult comes under the time limit then process theresponse otherwise send request again.Working of Origin Server is to send the updated data after a particular time interval say after 3sec., and sendthe requested pages to proxy servers wheneverrequest comes.

5. Results and Discussion

Based on this algorithm we got the better results than previous algorithms in terms of hit ratio, delay, scalability and robustness.

In this table there is comparison between three architectures. In distributed web caching the hit ratio was Average and delay was Above Average and scalability, robustness was low, unmanageable data was high. In second Architecture the result was better than previous in case of hit ratio, Delay, scalability and robustness. And in third Architecture the results are better than previous architectures in case of hit ratio, scalability and robustness.

Table-1 Comparison between Different Architectures

Network	Hit Ratio	Delay	Scalability	Robustness	Unmanageable MetaData
Distributed web Caching	**Average**	**Above Average**	**Low**	**Low**	**High**
Distributed web caching with clustering	**Above Average**	**Low**	**Average**	**Average**	**Low**
Knowledge based clustering distributed web caching	**High**	**Low**	**High**	**High**	**Low**

6.Conclusions

Scattered Web service becomes more popular, users are suffering network congestion and server overloading. Great efforts have been made to improve Web performance. We develop a model that allows us to predict and compare the performance of traditional and service differentiated caching schemes, using traditional hit rate and object lifetime. Web caching is recognized effective techniques to alleviate server bottleneck and reduce network traffic, thereby minimize the user access latency. In this work, I give an algorithm to reduce the Extra Overhead, solves the problem of Cache Coherence (Get if Modified), problem of Scalability along with solving all these problems it also improves the Hit Ratio and the Latency Time .By surveying previous works on Web caching, we notice that there are still some open problems in Web caching such as proxy placement, cache routing, dynamic data caching, fault tolerance, security, etc. There we can improve performance by adding pagereplacement algorithm and by making it activeDynamic.

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