Presenting an approach in order to predict routers traffic and amount of their alternation in Internet Data Centers (IDC)

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Summary
These days many of the data centers are looking for new ways in order to increase the amount of responding to requests and also offering effectual and optimal services. Hence, in many of the data centers procedures like cache management of physical resources same as routers, load balancing, controlling over load, QOS mechanisms are utilized. One of the reasons that decrease the effectiveness of a router after a period of time is the reduction of the buffer level and the elimination of the packets by the router. It makes many unanswered requests or at least prolonged answering time. This article tries to offer an approach in order to increase the amount of the routers to improve the efficiency of an Internet Data Center (IDC). The article has shown an appropriate correspondence between the results and the hypothesis.

Key words:
Internet Data Centers, Performance, Router, Router Pool Management.

1. Introduction

There are involved elements in a growth in the amount of users' requests. The first one is high costs of stable communication and the second is lack of appropriate support in terms of new compulsory progresses.
Immediate accessibility to IDC (Internet Data Centers) is achievable through two procedures: first, direct access of the customers to the nearest servers [1-6] second, shifting overcrowd links instead of near links [7, 8].
These two procedures will reduce the requesting time of the customers to the data, thus more requests will be responded.
In order to increase the efficiency of the data center hardware and software redundancy can be utilized; although it would make new costs. There are other procedures to increase the efficiency, such as alternation in terms of available protocol in away that TCP/IP packets store the maximum information that causes a reduction in the used bandwidth, reduction of packets in order to reduce overloads, a growth in bandwidth, overcrowd prevention.
Every router is able to respond to a number of packets in a time unit up to its structure, model and its company. And it uses memory, processor, and its buffer according to the amount of responses.
Figure 1 shows an effectiveness diagram of the router processor in the procedure of responding to users of a WebTV router. Many believe that when we talk about a processor or evaluation of router efficiency; an efficient router is one that is able to achieve 100% performance. Figure 1 Shows that the amount of a router performance in 300 seconds which is working 23.85% average. It is observed that the performance of the router is less than 30% and experimentally, it is believed that one should not allow the router performance make a rise above 40 or 45%. It will cause a decrease in buffer rate for the router. Consequently, the packets will be deleted because of buffer shortage.
If the performance of a router processor goes above 80%, it shows that the router is used as a Bottleneck. And it must look for sources of packet production on the net, which have caused an overcharge. Router designer companies such as Cisco offered some situation to resolve this problem such as interrupt and making new packets on the net. Many of the managers when this happen tries to change the procedures or upgrade the router or some will do an easier job, they buy routers with higher performances and use it on the net. There are three sources: 1. Width band which you can not send more than its capacity 2. Buffer zone, packet of the memory will be read, and then they will stay in the buffer. If the buffer is not enough, the information will be dropped. 3. Router process or cycles which are the most signification elements of growth in the performance on the net.
Figure 2 is load of a router in 300 seconds. In this figure the most incoming of packets in 63 %(6259.2kb.) And most outgoing of the packets is 5.5% (5488.7 kb/s). it shows a decrease of 0.8%, so packet deletion(dropping) happens.
According to fig.1 and fig.2 whenever workload goes up, the performance increases, too. And some of the packets will be deleted for some reasons. In the following parts: part 2 will talk about current architecture of Data Centers. Part 3 offers an algorithm of a proposed way on traffic forecast. Part 4 show a simulation and part 5 discusses the conclusion.

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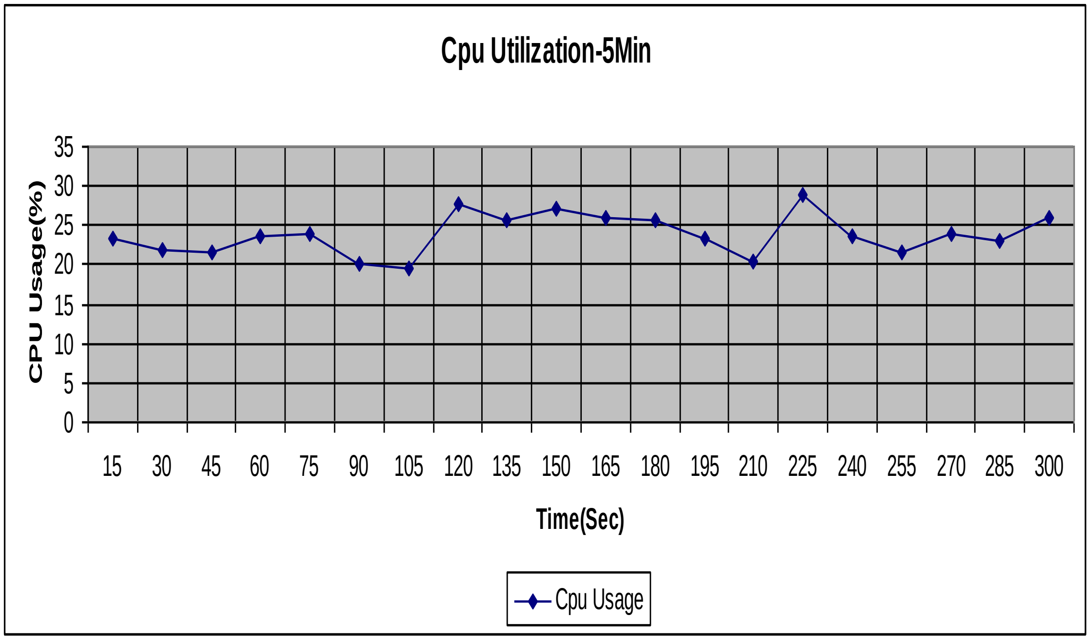
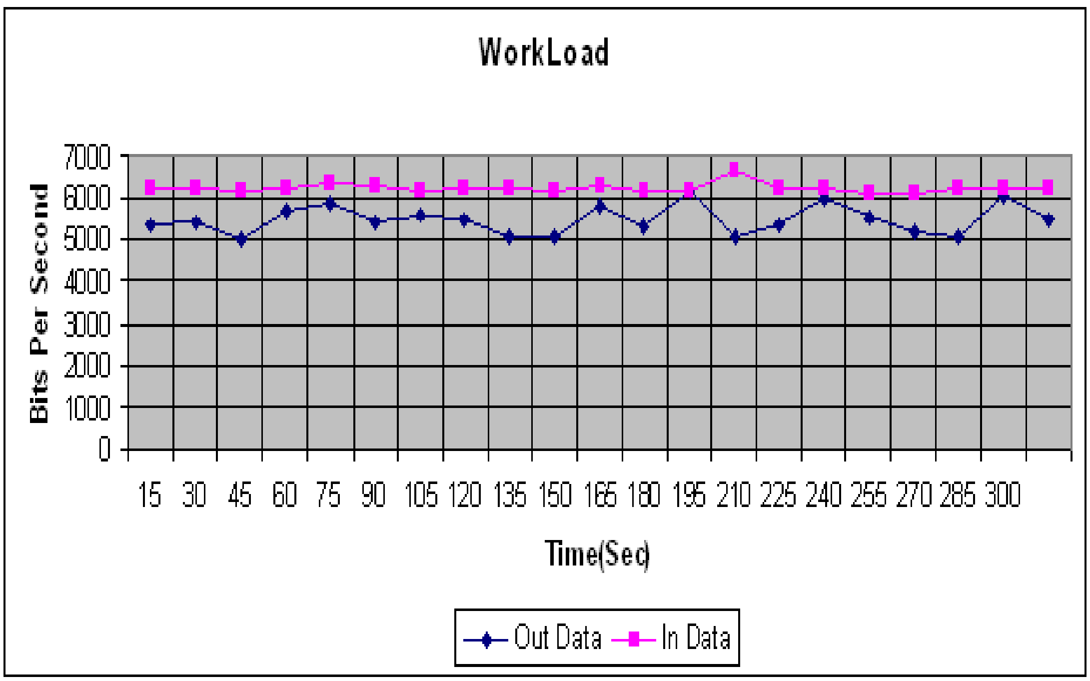


Fig 1.CPU Utilization of Router



Max In:6259.2 kb/s (6.3%) Average In: 511.0 kb/s (0.5%) Current In: 796.1 kb/s (0.8%)
Max Out:5488.7 kb/s (5.5%) Average Out:2004.8 kb/s (2.0%) Current Out:2682.6 kb/s (2.7%)

Fig 2.WorkLoad

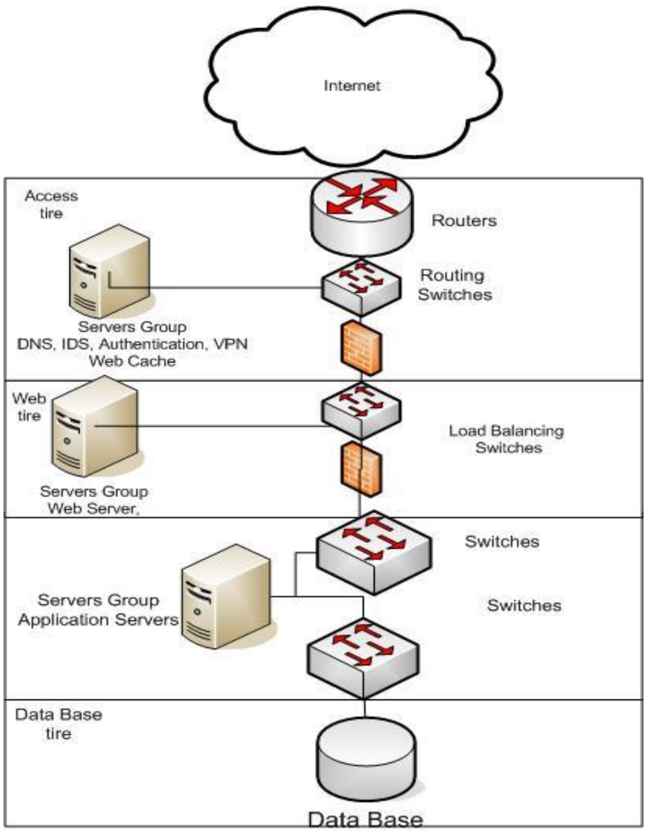


Fig 3. IDC Four Tier Architecture

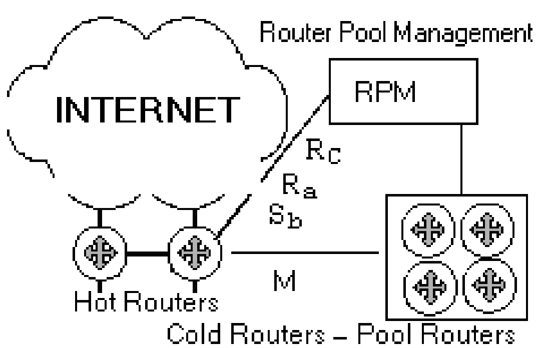


Fig. 4. System Model

2. Architecture of a Data Center

Figure 4 Shows four-tier architecture in accordance with current Internet Data Centers. Consider the necessities of an electronic trading session. First level of accessibility: here the requests will be checked then their rout will be distinguished. Then they will be sending to the server or the switcher based on the type of requests. At last, the information must pass the firewall to reach the next step.

In the next layer, load controllers will check the information. If they are requested information, they will be load-balanced and that layer will answer the user. Otherwise, information is send to the next layer. In the application layer, the applicable program extracts the information from Data Center layer and the extracted information will be displayed to the user.

Remember that in every session in Data Center that happens for a request, data Center will that information a unique sign. This will help information clusters not to interfere with each other.

2,1 A typical system in a simple way

In this section multilayer Internet Data Centers are considered crucial In order to talk about router management. As you can see in fig.4 the considered model is in access layer and available routers. In this way a router can be a transferable router (transfer is defined as a limited time from launching point of the router to the normal performance of it to get the information in order to response). That would be transferred to groups of answering routers based on the needs and rising of workload and after answering in consideration to the situation will be back on the last state.

3. Proposed algorithm

Proposed algorithm, which is called Router Pool Management (RPM), has two router groups. Routers that are answering to incoming requests are called hot routers or working routers. Routers that are in the router pool and time algorithm will decide their entrances are called cold or off routers.

This article tries to offer an algorithm according to hardware redundancy which is called RPM (router pool management) to transfer the routers in a Data Center actively and automatically. The aim of the algorithm is to increase the number of answering when the incoming requests raise in Data Center. In order to get all the intended aims, algorithm must compute system behavior in all situations.

As a result, to study the situations of fig.4 a periodical manner of all working loads that go on the router (a periodical computing with a distinct T in a minute) is required. Furthermore, in the proposed algorithm of a router in transferring it from a hot group to a cold group, there is a delayed time which is called transferring time. Transferring time depends on some parameters in relation to its boot moment up to its accomplished moment. For example, transferring time can be of booting of a system and its working situation. Transferring time for routers can be a number between 1 to 10 minutes. Experimentally, transferring time is supposed to be 3 to 5 minutes. Besides, if a router is free, it must answer all the requests to be able

to leave the router groups. The assumed time for a router to leave would be between 1 to 15 minutes.
Therefore in every τ some parameters would be evaluated for routers:
N_{Ro}: initial routers in the first layer

N_{rn}: needed routers at the end of every time period…

D: average of the accomplished requests.

S_B: used buffer by all the routers in every phase.

R_C: accomplished requests in the previous period.

R_a: received requests in the last period.

N: number of periods.

μ: fixed factors.

S_{bi}: average of the used buffer in every period.

S_b: average of the used buffer which is computed from the last formula.

$$Sb=(Sb1+ Sb2+ Sb3+ …+ Sbn)/N \quad (1)$$

Which is computed by used buffer in every period. Now to compute the amount of Nrn the proceeding step should be followed:

$$D=Sb/Rc \quad)(2$$

2. Shows an average of the accomplished requests.

$$SB=Max[Ra,Rc]D \quad (3)$$

3. Shows the used buffer based on the multiple of the maximum of the received requests or accomplished ones in formula 1.

$$N_{rn} = \lceil N_{Ro}.S_B / \mu \rceil \quad (4)$$

At last formula 4 computes the number of the routers, which must be in the line for the next period.
In formula 2, D is obtained from mean of the used buffer and the number of accomplished requests (Rc,Sb).
$S_b = R_c.D$ mean of the used buffer by routers is computed by formula 1.

In formula 3 the amount of the used buffer is computed based on the available routers and the number of received requests in the period. When a system is under a high workload the incoming requests maybe more than the answers prepared by the routers. Thus, N_{rn} is computed in the next period to answer more requests and algorithm will be allowed to compute the number of the routers in the period in high workload by using S_b, which is obtained in formula 1 that makes D. Moreover, in high workload high amount of R_c , R_a is used to prevent leaving of the routers. It is tried not to let the routers leave the system quickly after a response and stay for some more responses.

Table 1 :FRM(Fixed Router Management)

Latency(ms) Avg	Drop(P) AVG	Cpu Utilization Avg	Packet Drop	Answer(Packet)	Number of Router
10	35	23.1	1400000	2600000	2
11	33	23	1650000	3350000	2
9	37	23.4	1480000	2520000	2
10.5	34	24	2040000	3960000	2
11	34	23	1700000	3300000	2
9.5	33	23.5	2640000	5360000	2
			10910000	**21090000**	

Table 2: RPM (Router Pool Management)

Drop(P) AVG	Cpu Utilization Avg	Drop(Packet)	Answer(Packet)	Number of Router
8	23.4	320000	3680000	2
4	24	200000	4800000	4
5	25.1	200000	3800000	5
4	27.3	240000	5760000	4
5	26.3	250000	4750000	6
4	27.2	320000	7680000	5
		1530000	**30470000**	

As a consequence, the multiple of the used buffer mean obtain from formula 1 in the maximum amount of received requests or accomplished responses is Sb (sum of used buffer in every period)

In formula 4 Number of the routers for the next period is computed by using a fixed factor. Algorithm RPM is studying the number of routers when Nro ≠ Nrn which is the result of the computing. Here, redundancy, which is the result of the router transferred, may be able to change the number of the routers. Therefore, there are some to reduce the effect of the workload redundancy. First, increasing the time period of computing T. second, considering the fact that if the number of the routers is more than enough (Nrn> NRo) and there are routers from last period and in a LIFO are leaving the group, let them come back again in the group to answer. Or if (Nrn< NRo) the number of routers is less than enough do not let the last router to come in and connect the chain of the routers. Finally, computing the number of the routers in order to transfer from/to the group reduces redundancy effect.

RPM uses μ as a controlling parameter in order to control QOS. First, it is supposed the routers have many requests. Then, the requests are going to be answered as FIFO. In fig.4 in which group routers are available, response time can be computed in high traffic, approximately, by this formula [9]:

$$R=Sb/Rc \tag{5}$$

At last look at this example: μ: 0.3 and Nrc: 2 and take Rc: 300 (answered requests, Ra: 400 number of incoming requests and used buffer Sb: 0.6. As a result D=0.6/300=0.002 and finally needed routers is obtained by Nr: [2(0.8)/0.5]. In this way when (Nrn>NRo) number of routers will be obtained to join Nrn-NRo=2 group.

3,1 Computing control time and transfer time

In the proposed algorithm time period of τ and transfer time of M must be defined. In this way if τ of the algorithm is very small, the algorithm do not have the proper time to do the operation. And if T is very big, the algorithm can not consider load fluctuation considerately and therefore it would be inefficient.

Considering the facts that this number must coordinate with the transfer time and it must not be more or less. One can apply two ways to compute the time period. First, time period will be defined based on the needs. Second, time period will be obtained by formula 6

$$\tau=P.M \tag{6}$$

P is desired number and to have an efficient algorithm P>=10. The amount of P must be bigger than 10 not to let the algorithm spend the whole time for router transferring and computing and answers all the requests. Also, as it is mentioned before, M. is the transferring time.

4. Simulation

Figure 4 is designed and utilized by YACSIM [10]. Table 10 shows all the information related to access layer for two routers in 300 seconds in different time period in FRM (fixed router management).

For example in T4 time period, there are 6000000 requests. 66% of all these requests are answered and 34% are deleted, because of reasons like: buffer space. Also there is 10 Ms. delayed time in responding. Workload average of the processor at the same time is 24%. 2040000 of requests are deleted and 360000 o the packets are requested. In addition, all these numbers are an average of two routers in the first layer.

Here, proposed RPM algorithm or a model of system in figure 4 with various routers is simulated and the results in table 4 obtained. Remember that all the data in table 2 are obtained by a normal approach in 300 seconds in six time periods. As an example T4 tome period and FRM (fixed router management) are studied here and the differences are displayed. There are 6000000 requests in this period in which 96 %(5760000) are responded and 4% (240000) are deleted. Also there is a 10ms-delay time. Processor's performance is 27.3. All these statistics are four routers. Now, all the columns in table 1 and 2 are compared and algorithm performances to increase number of responses, is distinguished.

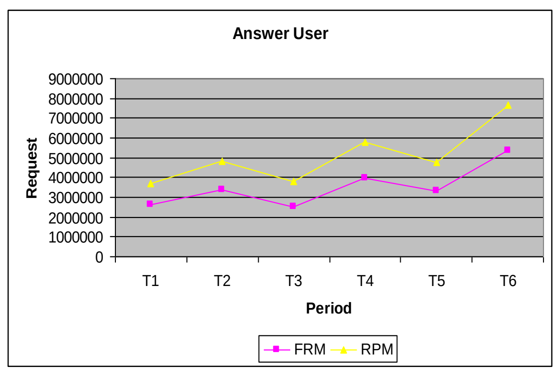


Fig.5. Average percent of the responses for two ways [%]

Figure 5 shows the average percent of the responses for two ways. Number of responses these two ways. Number of responses in these two algorithms is equal (320000000) which are received in six time period in both. In table 1 1000000 of them are responded while in table two 30470000 are answered. Comparing the parameters, it's clear that in PRM 95.2% of the responses are answered while in FRM 65.9% of the requests are responded.

Figure 6 shows the average of packet dropping In both performances. There are different numbers of request deletion. In table 1 10910000 requests are deleted but in table 2 1530000 requests are deleted.

6

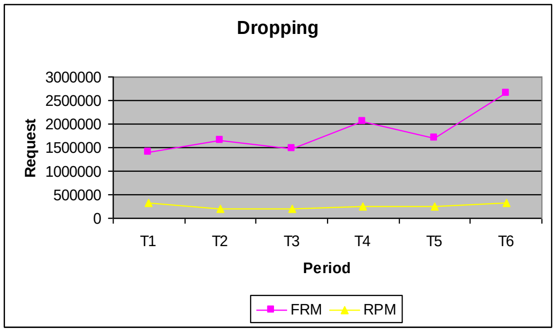


Fig.6. shows the average of packet dropping for two ways

Remember that high rate of responding is due to RPM operation which will cause redundancy costs.

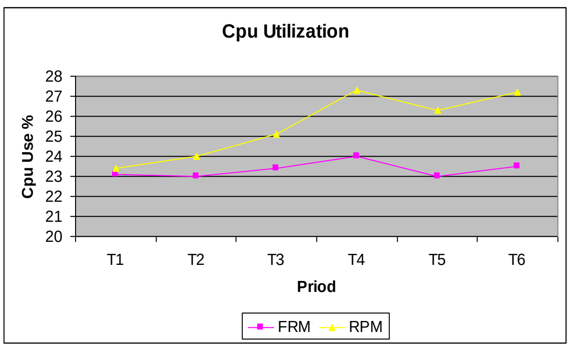


Fig.7. CPU Utilization

In figure 7 processor operation rate is shown for both procedures. It shows that RPM is more efficient that FRM. And this will show that average working of the processor is high. Consequently, when there is a rise in responding there is a rise in the function of the processor that makes new costs.

5. Conclusion

In this article, it is tried to offer a way in order to increase the efficiency rate of the access layer. Comparing the current procedures (FRM) and the proposed procedure (PRM). It is obvious that PRM is more effective in a way that in number of responses and time period of responding it is more successful that FRM. PRM makes the responding level a rise up to 19.3% and the performance of the router processor increases. These costs are in accordance with high responses and low request deletion.

References

[1] J. Guyton and M. Schwartz, "Locating nearby copies of replicated internet servers," in *Proceedings of ACM SIGCOMM'95*, Cambridge,MA, Aug. 1995.

[2] A. Shaikh, R. Tewari, and M. Agrawal, "On the effectiveness of dns-based server selection," in *Proceedings of IEEE INFOCOM'01*, Anchorage, AK, Apr. 2001.

[3] Z. Fei, S. Bhattacharjee, E. Zegura, and M. Ammar, "A novel server selection technique for improving the response time of a replicated service," in *Proceedings of IEEE INFOCOM'98*, San Francisco, CA, Mar. 1998.

[4] D. Karger, E. Lehman, T. Leighton, M. Levine, D. Lewin, and R. Panigrahy, "Consistent hashing and random trees: Distributed caching protocols for relieving hot spots on the world wide web," in *ACM Symposium on Theory of Computing*, May 1997, pp. 654–663.

[5] L. Wang, V. Pai, and L. Peterson, "The effectiveness of request redirection on CDN robustness," in *Proceedings of OSDI'02*, Boston,MA, Dec. 2002.

[6] M. Karlsson and M. Mahalingam, "Do we need replica placement algorithms in content delivery networks," in *Proceedings of the 7th International Workshop on Web Content Caching and Distribution (WCW'02)*, Boulder, CO, Aug. 2002.

[7] Y. Chen, R. Katz, and J. Kubiatowicz, "Dynamic replica placement for scalable content delivery," in *Proceedings of IPTPS'02*, Cambridge, MA, Mar. 2002.

[8] L. Qiu, V. Padmanabhan, and G. Voelker, "On the placement of web server replicas," in *Proceedings of IEEE INFOCOM'01*, Anchorage, AK, Apr. 2001.

[9] L. Kleinrock. *"Queueing Systems, Volume II: Computer Applications"*. Wiley, 1976.

[10] R. Jump. Yacsim reference manual version 2.1. ECE epartment, Rice University.

[11] http://www.cisco.com.Troubleshooting High CPU Utilization on Cisco Routers

[12] Computer Networks (FOURTH EDITION), Tanenbaum, Andrews.