ISSN 2229-5518

Fair Resource Allocation using Volume-based Strategy on University Networks

Juliana Ali[1], Abuagla Babiker[2], Salaheldin Edam[3]
[1, 2, 3] Sudan University of Science and Technology, College of Engineering, Electronics Engineering- Sudan – Khartoum.
Julianaali840@yahoo.com, Abuagla2002@gmail.com, Salah_edam@hotmail.com

Abstract— This paper investigates the problem of the abuse user level and network congestion on university networks that caused by the existing of the heavy users. These user's usage high bit rate applications like Peer-to-Peer (P2P), online internet gaming, Internet Protocol Television (IPTV). This paper presents a bandwidth control mechanism based on volume control to specify a restriction for the links' quotas for colleges, departments, labs, and users. To achieve fairness between user's max-min fairness algorithms was used to allocate the bandwidth to different mentioned levels, the algorithm was written using MATLAB. By using the max-min fairness algorithm, the result shows that the abnormal use of the network resource can be reduced. Therefore, the fair utilization of the link at the all levels of the University can be applied.

Index Terms— bandwidth, network congestion, heavy users, max-min fairness algorithm

---

1 Introduction

THE Serious growth of Cloud users makes the traffic of packets is augmented in the network which leads to performance deterioration of cloud services. This makes the data centers bandwidth suffers of the bottleneck [1]. Increasing of Internet services and growth of high bit rate applications makes the network providers suffer in allocating network resources due to the scars of the network resources[2]. Network resource allocation troubles are worried with the allocation of restricted resources between competing entities to esteem some fairness policy while looking for the general efficiency allocation. Max-min fairness or the lexicographic maxims in optimization are the most broadly known ideas of fair optimization[3]. Max-Min Fairness algorithm is a popular mechanism for resource allocation in the majority datacenter schedulers[4]. A significant aim of bandwidth share is to maximize the use of network resources while sharing the resources in a fair way between network flows[5]**.** With no a dedicated flow management method, diverse amounts of traffic flows are statically allocated to links without examined the recent link utilization. This, result in network congestion, and appear as latency via users[6].

A broad diversity of applications today is running on data centers, which cause the scarce in-network bandwidth of data centers and create a performance bottleneck. To assurance the network performance, an effective in-network bandwidth management can be leveraged, but small work has been complete so far. The core is that existing study principally depends on a static or dynamic bandwidth allocation strategy. This leads to ineffective methods to permit elastic and flexible utilize of the in-network bandwidth between diverse applications. The bandwidth in a data center is difficult to be managed with a huge number of diverse applications[7].

2 Related Work

The efficient bandwidth management in multi-service computer networks such as university networks has become very difficult in current years. The increase of Internet traffic and restriction of bandwidth resources convinces the information technology (IT) administrators to center of attention on efficient bandwidth allocation policies[8]. European Internet traffic was studied, and it found that the usage through the peak most dynamic 5% of subscribers represented about 56% of the overall bandwidth, as the top 20% of dynamic subscribers extra than 97% of overall bandwidth. The major use of bandwidth with 65.5% of traffic on the network is P2P applications[9]. In another study in diverse areas the P2P created on average between 49% and 83% of all Internet traffic[10]. Recently, it was found that P2P traffic occupied between 60–80 % of the total traffic volumes, which seriously consumes network bandwidth and can be a reason for network congestions[11]. To reduce the effect of P2P and other heavy applications the bandwidth must be allocated in an affair manner.

3 Methodology

The capacity of the Internet links on university networks are considered to accommodate a certain amount of traffic. The system is design with a target rate and has to ensure that the traffic generated by the university networks must not exceed the capacity of the link; to achieve this the system is divide to the four levels as shown in figure 1.

University level is responsible for the monitoring of the traffic generated by faculties, and each faculty has specific volume determined by the university during the capacity planning phase. If each faculty exceeds the volume, the university level controls that faculty. The traffic generated by all faculties must not exceed the link capacity of the campus network.

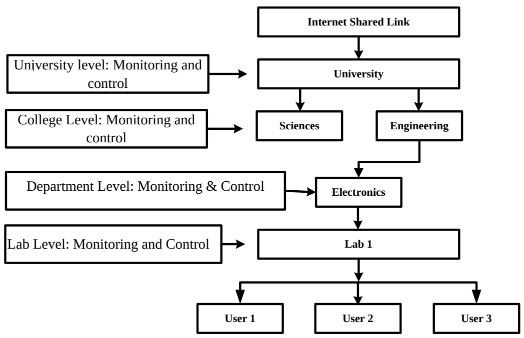

Fig. 1. volume based control

Faculty level is responsible for the monitoring the traffic generated by departments, and each department have specific volume. If each department exceeds this volume, the faculty level does control.
Department level is responsible for the monitoring the traffic generated by labs. And each lab has specific volume, if each lab exceeds this volume, the department level does control.
Lab level is responsible for the monitoring the traffic generated by users, and each user have specific volume. The traffic generated by each user must not exceed the volume dedicated to it, if exceed the lab level control the user.
When the traffic generated by the university become more than capacity grantee to the link, the university-level attempts to adjust the faculty that generated traffic more than the volume dedicated to it. In addition to that the faculty level attempts to adjust the department which generated traffic more than the volume dedicated to it. Moreover, the lab level attempt to adjust the user who exceeds the volume dedicated to it. The steps for solving the problem of heavy users is explained in figure 2.

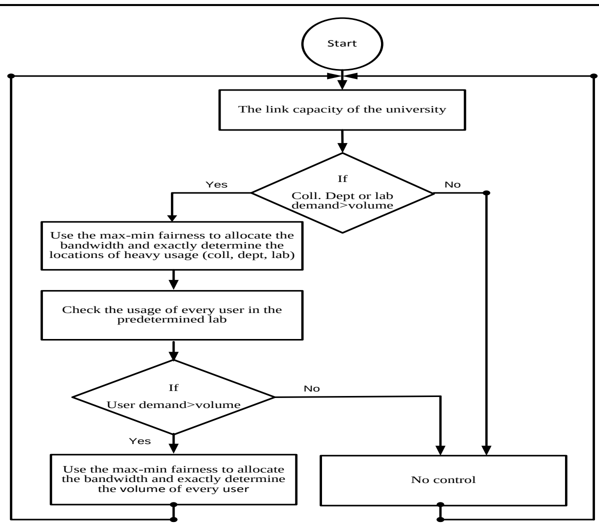

Fig. 2: Flow chart of the proposed Internet traffic

The previous flow chart demonstrates steps for determining the location of the heavy usage and controls it. In another case when some users generate traffic more than specific volume dedicated to them, and the link capacity is still under utilization nothing. The flow chart of max-min fairness is shown in figure 3.

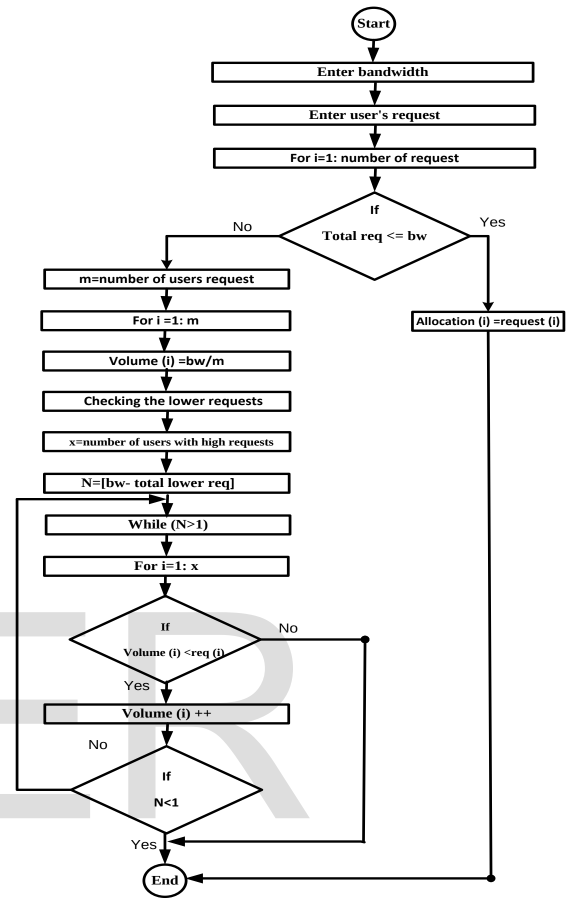

Fig. 3. Flow chart of the max-min fairness

4 Results and Discussion

The system was designed with target rate 3125 Mbps. It consists of five colleges. Each college consists of five departments. Each department consists of five labs, and each lab consists of five users. By using the max-min fairness algorithm among the colleges the result is obtained in figure 4.

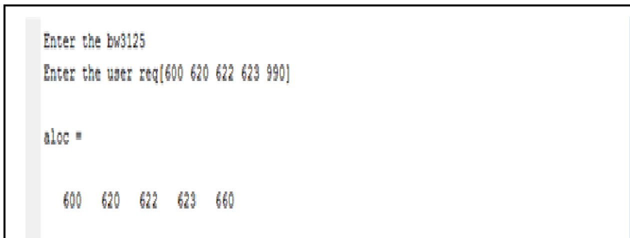

Fig. 4. Max-min fairness algorithm among the colleges

From the previous, result was clear the problem in college5. By using the max-min fairness algorithm among the departments of college5 the result is in figure 5.

ISSN 2229-5518

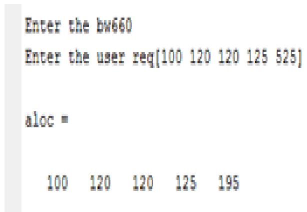

Fig. 5. Max-min fairness among the departments of college 5

Referring to the result in figure 5, it is obviously the problem in department 5. By using the max-min fairness among the labs the departments the result as in figure 6

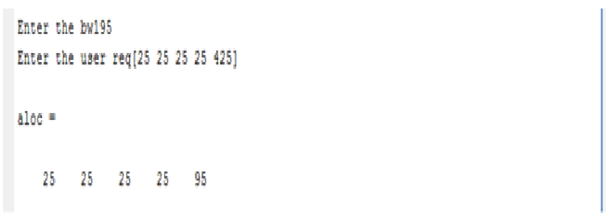

Fig. 6. Max-min fairness among the labs of department5

According to the result in figure 6, it is clearly that the problem in lab5, finally by using max-min fairness among the users, the result as in figure7

Fig. 7. Max-min fairness among users in lab5

From previous results, the control of the end user who causes the problem was done as in figure (8). From the figure, each entity requests specific demand of bandwidth, if this demand is less than or equal to the quota, then it will be given it demand. On another hand when the entity requests more than the quota as in figure 4, then max-min fairness algorithm is used to allocate the bandwidth for all colleges, departments, laboratories, and users. The case in which the demand above quota is appearing in college 5, department 5, laboratory 5, and user 5, for example, user 5 its request is 405, and it has given 75 (405/75).

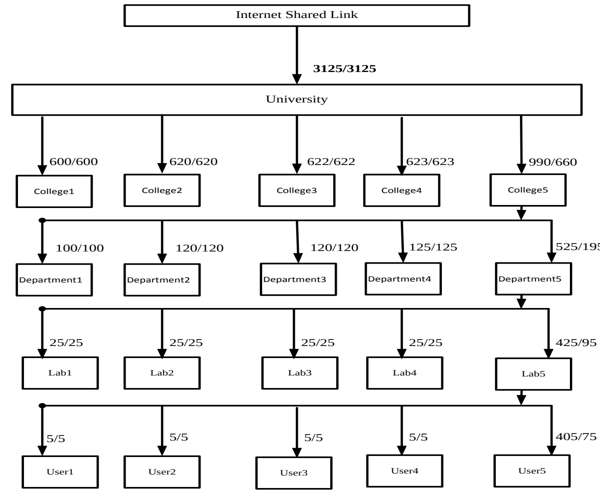

Fig. 8: Bandwidth allocation results

By using the max-min fairness algorithm we keep for the best fairness and utilization of the bandwidth among users. Results of using max-min fairness as in the Table (1)

TABLE 1

RESULTS OF USING MAX-MIN FAIRNESS

College/dept/lab/user	Quota	Demand	Allocation
College1	625	600	600
College2	625	620	620
College3	625	622	622
College4	625	623	623
College5	625	990	660
The sum	**3125**	3455	3125
Department1	125	100	100
Department2	125	120	120
Department3	125	120	120
Department4	125	125	125
Department5	125	525	195
The sum	625	990	**660**
Lab1	25	25	25
Lab2	25	25	25
Lab3	25	25	25
Lab4	25	25	25
Lab5	25	425	95
The sum	**125**	525	**195**
User1	5	5	5
User2	5	5	5
User3	5	5	5
User4	5	5	5
User5	5	405	75
The sum	25	425	95

The previous table clears the quota, demands and allocation for each college, department, lab and user.

ISSN 2229-5518

5 Conclusion

This paper concerns fair resource's allocation to avoid a user level abuse and congestion avoidance on university networks. The results clearly show that the using of the max-min fairness algorithm can give an efficient allocation of the bandwidth among different University level.

REFERENCES

1. Singh, V.K. and P.G. Scholar, *QoS-based Techniques: Investigation and Optimization.* International Journal of Engineering Science, 2016. **5242**.
2. Pham-Thi, H., et al. *QoE-driven bandwidth allocation method based on user characteristics*. in *Network Operations and Management Symposium (APNOMS), 2014 16th Asia-Pacific*. 2014. IEEE.
3. Ogryczak, W. *Fair Optimization--Methodological Foundations of Fairness in Network Resource Allocation*. in *Computer Software and Applications Conference Workshops (COMPSACW), 2014 IEEE 38th International*. 2014. IEEE.
4. Shenker, A.G.M.Z.S. and I. Stoica, *Choosy: Max-Min Fair Sharing for Datacenter Jobs with Constraints.* 2013.
5. Chou, J. and B. Lin. *Optimal multi-path routing and bandwidth allocation under utility max-min fairness*. in *Quality of Service, 2009. IWQoS. 17th International Workshop on*. 2009. IEEE.
6. Wang, R., et al. *QoS-aware multipathing in datacenters using effective bandwidth estimation and SDN*. in *Network and Service Management (CNSM), 2016 12th International Conference on*. 2016. IEEE.
7. Xu, R., et al. *Towards Application-Aware In-Network Bandwidth Management in Data Centers*. in *Trustcom/BigDataSE/I SPA, 2016 IEEE*. 2016. IEEE.
8. Noughabi, E.A.Z., B.H. Far, and B. Raahemi. *Predicting Students' Behavioral Patterns in University Networks for Efficient Bandwidth Allocation: A Hybrid Data Mining Method (Application Paper)*. in *Information Reuse and Integration (IRI), 2016 IEEE 17th International Conference on*. 2016. IEEE.
9. Burke, M., *Ellacoya networks releases data on broadband subscriber and application usage in Europe*. 2005, September.
10. Schulze, H. and K. Mochalski, *Internet study 2007.* ipoque GmbH, White Paper, 2007.
11. Qin, T., et al., *CUFTI: Methods for core users finding and traffic identification in P2P systems.* Peer-to-Peer Networking and Applications, 2016. **9**(2): p. 424-435.