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Human Behavior monitoring with Optimization of Network Resources using Static and Heuristic Approach and Software Defined Network

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Abstract:

As the internet users grown day by day in public domain. There is need of user behaviour analysis and accordingly to predict the actual need of internet bandwidth on time stamp manner. The so called study will help to deal with the actual user bandwidth requirement and efficiency at work. As the software defined network is nowadays playing important role in achieving dynamicity and flexibility in network resource optimization. The software defined networking (SDN) using network functions virtualization (NFV) and open-flow architecture, are supporting this evolution. There by drastically user driven services to guarantee low latency and fast access of user applications on laid network on one hand, and the trend to support personalization of services on the other. The static linear and dynamic heuristic estimation of multimedia data services towards the edge nodes can be helpful in optimization of resources. The software defined network optimization is useful in new policy decisions, to scale up the network media availability and help network administrator at local network. At present these facilities available with enterprise network administrator only.

Key Words- Behavior Management, Organization Research, Software Defined Network, Network Functions, Network Resources Computing, Cloud Resources, Network Resources Allocation, Network Resources Analysis (Bandwidth), OpenFlow etc.

I. Introduction

The limitations in accessing of network functions has led to resources optimization service providers in a pressing concern to cope up with the amount of wasted network resources. The network resources have been laid with state of art infrastructure in many organizations, which are being acquired by users but gets remained underutilized. The better utilization monitoring of these resources will effectively help service providers to increase their efficient utilization multiple times without any kind of enhancement in network infrastructure. This paper presents a software defined network approach on network resource optimization by monitoring a dynamic resource (network bandwidth) can be allocated reliably to the users. The recommender will recommend resource allocation to users based on proposed heuristic model. The proposed heuristic model is based on following parameters of user's network usage based on 1) time of the day 2) day of week 3) weekly average 4) percentage utilization by user 5) on demand user need for specific applications.

II. Previous Work

The various organizations have their own methodologies to monitor the usage and based on that the allocation of resources. Such allocations are mostly static in nature. However, the user-based analysis is not done yet due to the resources such as hosts, local network and devices are not in full control of the service provider. The Enterprise solutions are roughly estimating the user requirement and allocating the resources (e.g. Cloudyn, Cloudcheckr and Cloudability etc). These are few available solutions with leading service providers to monitor and estimate the users need, in these the network resource reservation for users is not considered or predicted.

1. Cloudyn

Cloudyn is such one cloud-based solution for cloud computing utilization. The cloud deployment and optimization in pricing is ensured in this technique, it has also helped in minimizing the usage wise monthly bills. Gaining the insight and visualizing user-based usage and performance parameters as well as trends of usage by user is all in one place solution provided by the new feature of the Cloudyn. It is useful in comparing clouds and research of the deployment's performance.

2. CloudCheckr

CloudCheckr is able to maintain the security of Network Infrastructure and events happening around the service provider network. It provides continuous monitoring and audibility for network assets, users data and configurations and settings by system administrator. The main tasks performed by the CloudCheckr are the cost estimation and spend Optimization and resource monitoring/reporting.

3. Cloudability

Cloudability is basically cost management tool for data intensive applications of user. Main purpose of cloudability is to monitors and tracking the application-based events and to provide in terms of report/alert to system administrator's dashboard. Ultimately the admin can reserve the resources based on demand and optimizes the cost thereby.

III. Implementation

Resource Description**:** The proposed work on software defined network resources monitoring and analyzing for the optimization mainly focus on following parameters.

1. Network

The continuous random applications and the need of bandwidth with performance factors like Quality of Service are major factors affecting the Internet/Intranet deployment. At the same time lack of measurement tools for monitoring network utilization and performance. Network bandwidth and latency are clearly the two key performance parameters and utilization pointers to indicate the modern IP network [1]. The tools to measure the up-to-date bandwidth utilizations and path latencies is critical for numerous important network management tasks. Based on the outcome and results of such factors the user monitoring and profiling can be done. The hand of proactive and reactive resource management and traffic engineering, as well as providing the end-user applications QoS [5][6].

2. Memory

The second parameter is RAM (Random Access Memory) which is used as storage place to hold data. The access of stored files as well reading/writing on the memory between the CPU and the RAM is fast, and everything is kept orderly and easy to retrieve [3]. The memory helps in resource friendly read and write to specified locations. As it is said "unused RAM is a waste RAM" the application running on the cloud use some part of processor and RAM, memory should be used in a efficient way with complete analysis of Memory usage by the application.

3. CPU

It is found that in many applications running the CPU utilization is very low i.e. 10% of the total CPU power [1]. During some extensive applications like searching, encoding or running of background processes the CPU uses spikes abruptly upto 50% of available CPU power. On an average the applications will not use more than 50 % of your CPU power for longer time. So randomly allocating a high processing power for a small application can be treated as waste of

resources and money. Typically, most high-end servers have very low overall CPU usage (less than 10%), therefore the virtualization is nowadays adopted as a solution to maximize resources utilization and reduce the number of physical servers in your organizations [2]. Based on the average CPU processor utilization is the way to set a best metric to measure the business of a server.

4. Storage

The availability of NAS for small organizations and SAN storage to big organizations. The storage management is critical task nowadays. There is chance to manage it efficiently so that resource optimization can be achieved in this. For instance, organizations typically want fast access to databases to fulfil their business needs. Therefore, the main focus is to simplify and standardize the hierarchical access and user monitoring, the way storage is administered, in areas like quota management. Actually, cloud storage is more complex to manage due to involvement of multiple servers [4]. These servers create redundant copies of data, shared across geographically located data servers. So that it can more quickly or easily support organizational needs.

Network Analysis

Understanding network bandwidth and resource utilization is the key to network utilization.

1. Bandwidth Monitoring: -

The actual Bandwidth usage based on the application specific data and ingress-egress routers in the network [6]. The total link bandwidth availability and utilization is critical here for entire network management. Which is helping to decide congestions paths and identifying and relieving the congestion points in network. The real time open port and bandwidth consumption is helpful in reservations of bandwidth also [11].

2. Latency Monitoring: -

The actual network path latencies can be decided by latency monitoring tool. Actual path and number of paths between source-destination pair are important here, e.g., in determining effective communication paths for applications with low latency [7][12].

Here the assumed type of the Software defined network using OpenFlow architecture as shown below fig1.1.

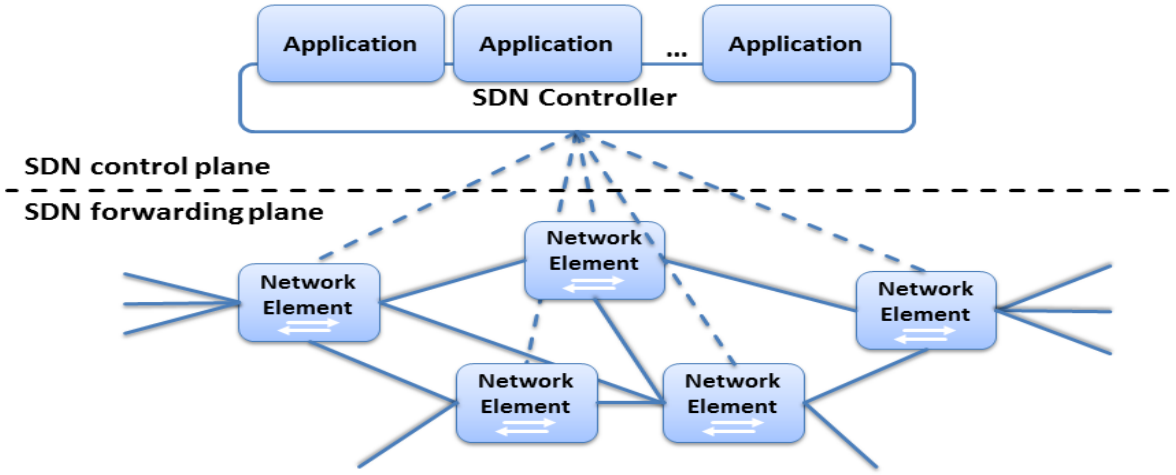

Fig 1.1. Openflow Network Architecture of SDN

The main purpose of the selected network using two approaches such as organization network and public Network. The various parameters can be analyzed such as (FAT Tree is considered here)

- Resource Description
  - Network Functions (Device Parameters)
  - Bandwidth and Path parameters
- Network Analysis
  - B/w Monitoring (Optimization Function)
  - Utilization function (Actual Usage)
  - Latency Analysis (Inter Packet Arrival Rate)
  - Network static parameters
  - Network variable parameters
  - Denial of service

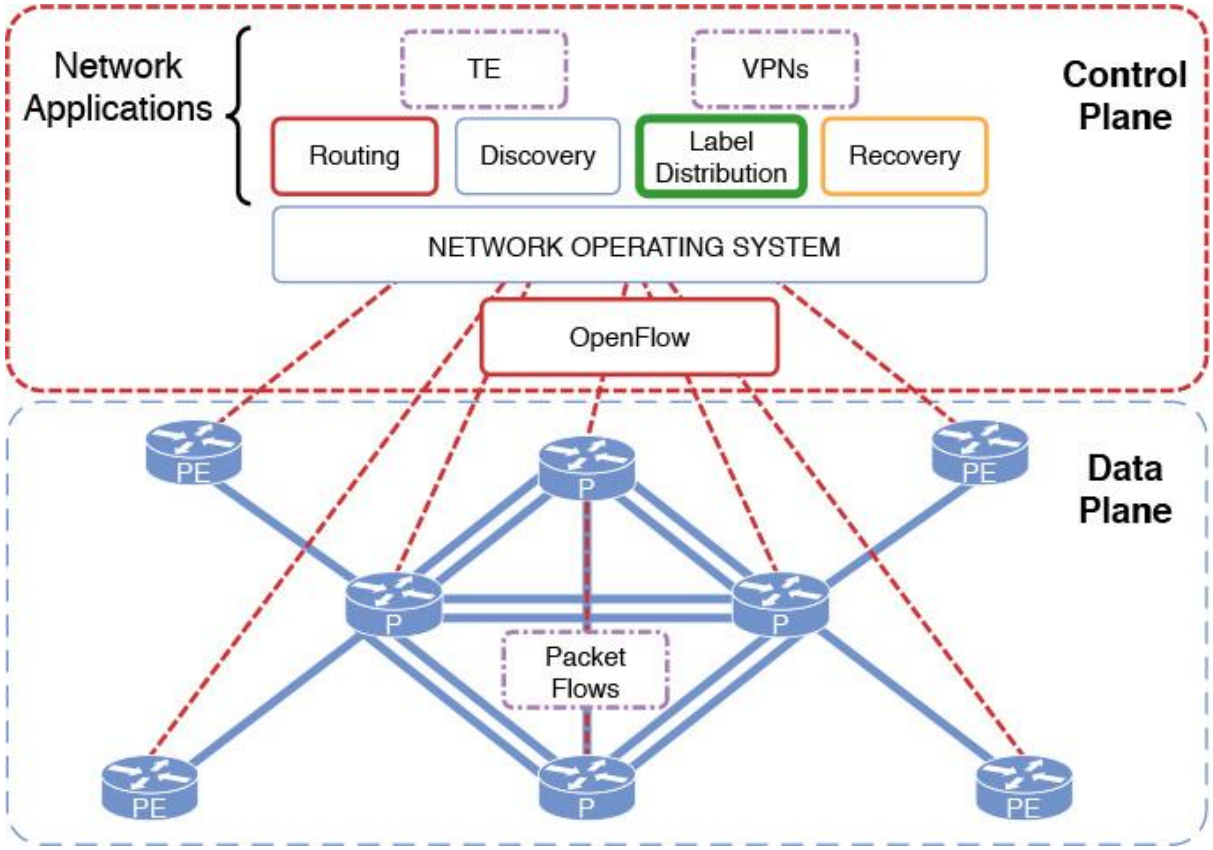

Fig 1.2. Orgnization Network Architecture of SDN

- The proposed method to track actual bandwidth utilization.

  Algorithm {Linear Programming}

  - Start
  - No of services running at host S_1….S_n = 0 and user U_1……U_n = 0
  - If (no of services=200; no of users = 20,000; Total Avl. Bandwidth=Xn) go to step 7 else go to step 4
  - Set for main task S++; U++;(Linear Primal Dual Minimization)
  - 5.Set Heuristic value Ci=Low/Medium/Avg/Best Quality
  - If idle task is running X++
  - % utilization of BW = (∑Sn*∑Un)/100.
  - If BW is free, allocate on demand resources (Ci-upgrade level).
  - Go to step 3
  - End.

The proposed system is deployed in big size organizational environment and results being monitored and some predictions based on heuristic approach are estimated about the software defined approach for OpenFlow network [8].

IV. Methods and Algorithms

The algorithms and mathematical analysis following the static analysis and actual uses analysis of multimedia content to provide evident based recommendations to improve the bandwidth uses.

a) Linearity Principle (Primal-Dual minimization):

Based on data usage pattern of users and available bandwidth the linearity principle is best suited for the dataset.

Minimize f(X)

f(X)= $\sum_{i=0}^{n} gi(xi) < bi$ i=1,2,3….n

Primal (Minimization of input functions)

f(X)=P^{T}.Y P is constant matrix

Y is matrix of variables

$p_{11}Y_1 + p_{12}Y_2 + p_{13}Y_3$+……..+$p_{1n}Y_n < b_1$

$p_{21}Y_1 + p_{22}Y_2 + p_{23}Y_3$+……..+$p_{2n}Y_n < b_2$

.

$p_{m1}Y_1 + p_{m2}Y_2 + p_{m3}Y_3$+……..+$p_{mn}Y_n < b_m$

Applications running on hosts

-p_{mn} m-no of hosts(1-10000),n-no of applications(1-100).

-$y_{i=1….n}$ -the various applications 0/1 running or not

-$b_{i=1….m}$ -the combined bandwidth available to all users

b) Heuristic Prediction Algorithm

Simplex Method- a Non constraint optimization technique is used with high dimensionality data, correlation between the variables can be high resulting in multicollinearity. In the proposed method the heuristic value is estimated for the application dependent constant requirement of bandwidth for the particular session of that instance. These correlated values sometimes form groups or clusters of correlated variables. There are many times when the entire group in the model section if one variable has been selected [9][10].

V. Results

After the continuous monitoring of resources for mentioned type of network (e.g. Fat Tree Network architecture) with high end manageable resources like Firewall, Gateway, controller, level wise switches, limited host control (using IP/MAC) and Port level control available with Network administrator. The administrator can deploy certain rules based on applications allowed to specific user's category (On Demand). The normal network traffic behaviour is continuously observed in time series data. Which is helpful in future resources allocations in heuristic way. The time series data is

helpful which could be of 20,000 odd users and for 200 odd applications running at various hosts in given topology. This data could be varying from institutes/organizations located at different geographical locations with hybrid devices setup controlled by OpenFlow. In general, the educational institute's user data pattern is not abruptly varying. However, there are some instances where demand of resources is more. In such cases service level index of users drastically falls. This environment is helpful for new users in network who demands resources, whether the resources are available at that moment or need to wait for longer.

Table1: Matrix of SDN users network traffic and resources utilization

Sr No	Host (FAT Tree)	Users	No of Appli. Running	Static BW/App (Kbps)	Total BW/Host (Mbps)	Allotted BW/Host (Mbps)	Free Available BW/Host	Performance (Utilization Factor)	SLI
1	H1	200	140	20-120	83	100	20	4	1
2	H2	550	150	20-120	136	150	14	4	1
3	H3	1200	180	20-120	783	1000	220	3	2
4	H4	750	120	20-120	657	1000	350	3	3
5	H5	1470	198	20-120	891	1000	109	4	1
6	H6	1090	134	20-120	678	1000	322	2	2
7	H7	1230	178	20-120	909	1000	91	4	1
8	H8	850	150	20-120	804	1500	700	2	4

(Matrix for Fat Tree Architecture with max 20000 Users all over in network, 8 Dept organization)

*Performance (Utilization Factor): [1: Below 25% ,2: Moderate 50%, 3: Normal 75%, 4: Full 100%]

**SLI-Service Level Index [1: Poor, 2: Average, 3: Good, 4: Best]

The above table indicates that if bandwidth utilization is more the service level index is poor. Means the new users are unable get the bandwidth and hence the applications need to wait for bandwidth availability, else ask for special privileges from administrators; so that the administrator can set the priorities and move the user to special user category through the control plane settings of network functions in SDN. However, the available bandwidth is continuously varying and dynamic in time series. The network administrator using network functions deployment can maintain service level index to such users. The handoff is major concern in this case, so as to maintain the minimum service level for all users, there must be minimum bandwidth allocation per user.

The fig 1.3 graph indicates the number of users under each host organization and number of running applications. Also, the actual bandwidth allotted and utilised as per the time series data of a particular day. Likely, the monthly and yearly time series data can be analysed to estimate the pattern and behaviour of users under the host organization. Based on this data the heuristic algorithm can predict

the user application bandwidth utilization. Also, the service level index can be indicated to individual users based on this data analysis and monitoring. However, it is found that using openflow and mininet actual link capacity and rules updation using Software defined networking for optimization of resources is helpful here. Using python programming the usage matrices updated and stored as time series data. However, the service-based multimedia applications can be benefited using the above analysis and optimization techniques.

V. Applications

The software defined network and Network functions virtualization combinely can be useful in actual network management, such as big enterprise network bandwidth/bandwidths with thousands of local network users to efficiently monitor resources and utilization of the same with optimized settings at administrator level of local network. Following are the possible ways to manage the same

- Service level index
- Service based control plane
- Auction Based Services for multimedia applications
- Service hand-off mechanism
- BW Availability before application-Recommender

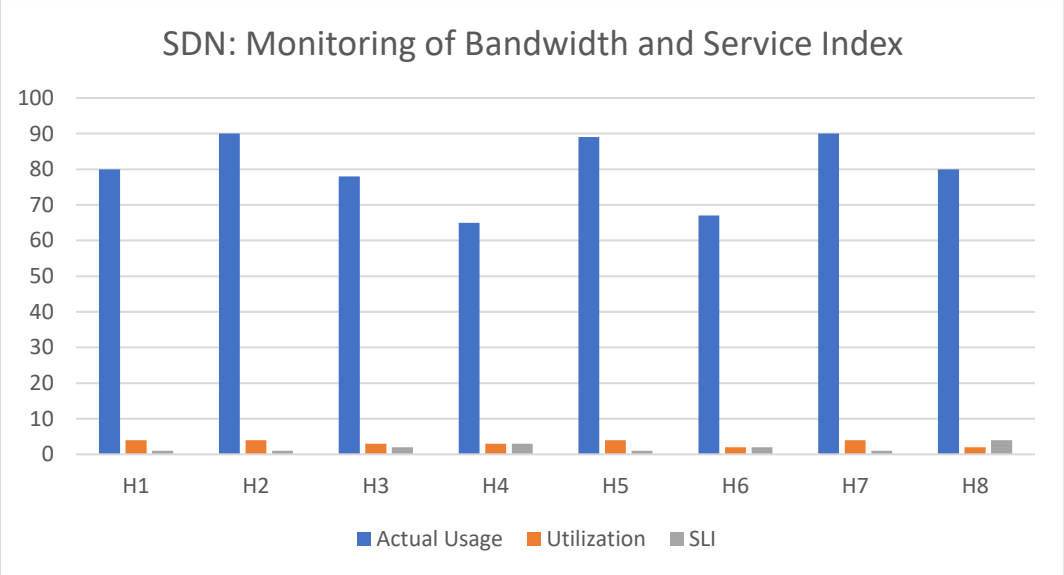

Fig 1.3 Time series Chart of actual bandwidth utilization and Service Index

VI. Conclusion

Software Defined Network is very popular in easy management and reliability like hardware based costly solutions many organizations opting for. The proposed technique is useful to monitor the

resource utilization of per user per application and timewise. The linearity algorithms can be used for monitoring the resources. The resources allocation matrix generation has been implemented in a simulated environment. Further, the system can be generalized based on applications/users in a real time software defined network, the open-flow architecture with fat-tree network is preferred here as a solution to many complex intranet networks.

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