Maximizing Quality and Performance of Network Through Adaptive Traffic Engineering

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ABSTRACT--Network management systems are to handle traffic dynamics in order to ensure congestion free network with highest throughput. IP environments are able to provide simple facilities for forwarding and routing packets. However, in presence of dynamic traffic conditions efficient management of resources is yet to be achieved. Recently Ning Wang et al. proposed a traffic engineering system which can dynamically adapt to traffic conditions with the help of virtual routing topologies. It has two major functionalities such as offline link weight optimization and adaptive traffic control. The former produces routing path diversities while the latter performs intelligent traffic allocation thus coping with bursts of traffic besides aching best quality of service. In this paper, we implement a custom simulator which demonstrates the proof of concept. The empirical results revealed that the proposed system can handle traffic dynamics efficiently.

Index Terms – Network, handling traffic dynamics, virtual routing topologies, traffic engineering

I. INTRODUCTION

Traffic Engineering is very important for effective network management in all kinds of networks. In offline, network resources are optimized. The offline link optimization takes network resources as input and computed best possibilities for traffic management. In online the dynamic traffic is monitored and the traffic engineering is performed. These approaches may not work efficiently when traffic dynamics are encountered. Link utilization has to be performed and optimized on daily basis. On regular basis Maximum Link Utilization (MLU) is high. A single matrix is not sufficient for efficient TE configuration. In plain IP networks, traffic engineering is considered poor and lot of research is made in this area [1], [2]. The existing techniques for TE are made in offline and they are not efficient to handle traffic dynamics. There are limitations in IP networks where there is no sufficient mechanism to split traffic in case of dynamic load balancing. The traffic dynamics cause congestion in network. This problem has to be addressed [3].

Recently virtual networks are given more importance in research. By enabling the virtual topologies which work on top of physical topologies traffic engineering can be done effectively. The resources required are utilized by the virtual networks. Both physical and logical networks work together. The existing solutions focus on virtual network provisioning in order to support coexistence of heterogeneous platforms, resource sharing, and servicedifferentiation support [4]. However, recently Ning Wang (5) has proposed different solution. They focused on building multiple virtual topologies in order to perform traffic engineering. For achieving this they used Interior Gateway Routing Protocols [6] as protocol that supports co-existence of physical and virtual topologies. They proposed AMPLE (Adaptive Multi-Topology Traffic Engineering) a TE system that has two important components. They are offline link weight optimization and online traffic allocation. The offline component takes network details as input and computes multiple diverse paths that can be used for load balancing [3]. This will result in generating multiple virtual topologies. These topologies are created statically offline. Afterwards the adaptive traffic control performs splitting of traffic for best load balancing. The SE system in [5] uses hop-by-hop monitoring mechanism which is similar to that of [7]

In this paper we implement the TE system presented in [5] through a custom Java simulator. The application simulates the network that demonstrates the offline and online activities which are part of traffic engineering system. The remainder of the paper is structured as follows. Section II reviews literature. Section III provides the mechanism for virtual routing topologies as part of traffic engineering. Section IV presents experimental results while section V concludes the paper.

II. PROPOSED TE SYSTEM

The proposed system is to support traffic engineering in a network to reduce congestion. In this paper, the TE system is implemented through a Java simulator. The system is based on the TE mechanisms presented in [5]. The virtual topologies that are created on top of physical network which is considered to demonstrate the proof of concept can be seen in fig. 1.

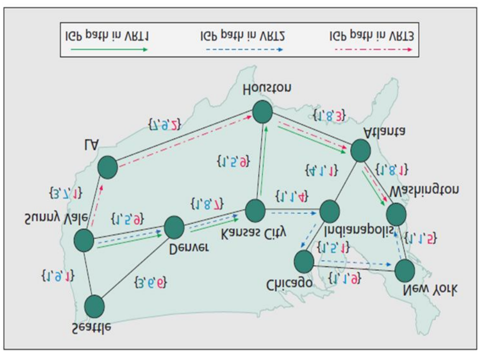

Fig. 1 –Path Diversity through Virtual Routing Topologies

As can be seen in fig. 1, it is evident that there are three virtual routing topologies [8]. These virtual topologies reflect the diversity of paths that can be used to multiple path source routing. The construction of these topologies is carried out offline. This is done by the component in the netork known as “Offline Link Weight Optimization”. This component takes network details as input and generates path diversities. Once the path diversities are computed through offline component, these details are used by online component known as Adaptive Traffic Control takes care of splitting the dynamic traffic into various virtual topologies which have been identified offline. The adaptive traffic control component computes the present link usage and the possible traffic that can be split into various virtual routing topologies. Then it makes decisions on traffic splitting that will result in perfect load balancing besides avoiding congestion in the network. This kind of traffic engineering is desired in modern networks.

The functional overview of the system is presented in fig. 4. It shows the functionalities of both the components such as offline link optimization, and adaptive traffic control.

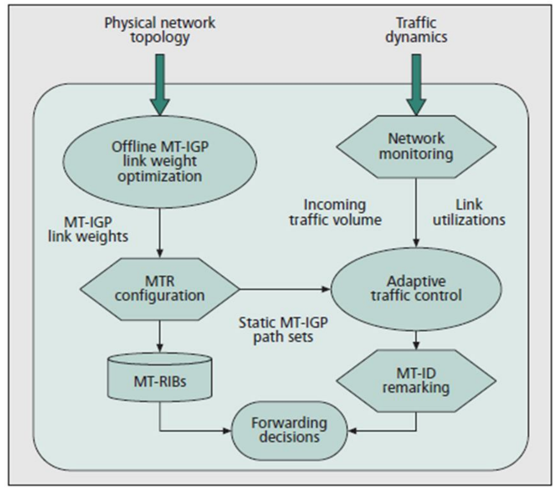

Fig. 2 – Overview of proposed system (excerpt from [5])

As can be seen in fig. 2, physical network topology details are taken by Offline Link Weight Optimization component. Especially it computes link weights and gives to MTR configuration. Afterwards the MT-RIBs provide the comprehensive diverse path details to runtime adaptive traffic control component. The network monitoring observes the link utilizations and incoming traffic volume and performs adaptive traffic controlling activities and finally takes traffic splitting and forwarding decisions that will ensure load balancing in the network besides eliminating congestion.

Steps for TE

The TE is performed based on the steps given below. These steps are part of the TE system that has been described above.

Step 1: Identifying highly utilized network link by using Linked List which has details

Step 2: All source and destination pairs are identified that satisfy a criterion that is feasible traffic flow.

Step 3: On finding feasible traffic flow, the splitting ratio of traffic is determined thus balancing the load

of dynamic traffic.

Listing 1 – Steps for TE

III. PROTYPE IMPLEMENTATION

A prototype application is implemented using Java platform to demonstrate the proof of concept of the proposed TE system. The environment used to build the application includea PC with 4GB RAM, Core 2 dual processor running Windows OS. Net Beans IDE is used to build the prototype application.

IV. EXPERIMENTAL RESULTS

Experiments are made in order to evaluate the efficiency of the proposed traffic engineering system. The experiments are used to record average maximum like utilizations. The network traffic engineering results of the proposed system is compared with other existing traffic engineering systems. As part of experiments maximum like utilization and highest maximum link utilization are computed. It also finds the traffic traces that reflect the n.

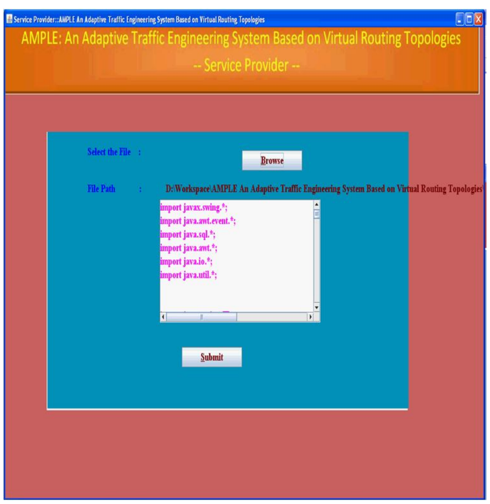

Fig 3 capturing data from user

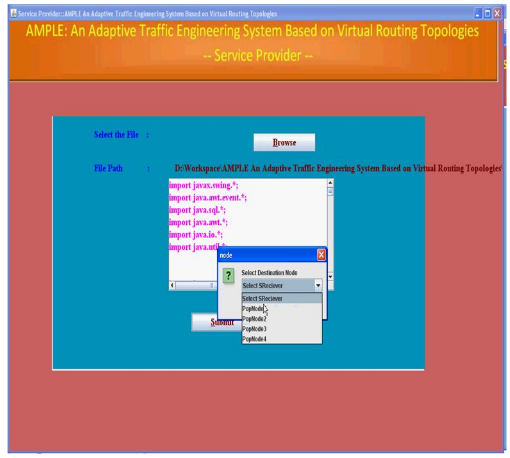

Fig4: selecting the pop node for sending the data

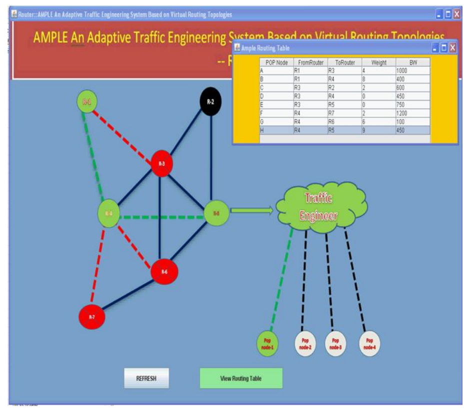

Fig 5: showing virtual routing path

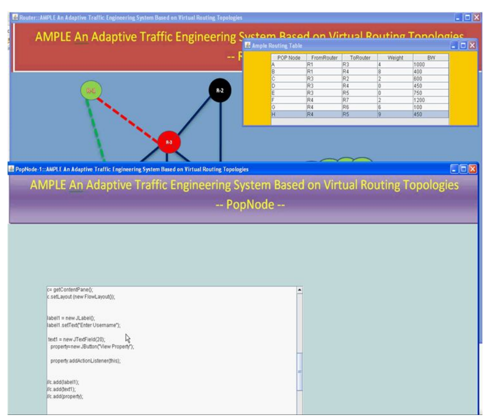

Fig 6: receiving data from traffic engine

V. CONCLUSION

In this paper we have implemented a traffic engineering system presented by Ning Wang et al. [5] that can adapt to dynamic traffic effectively. It has two important parts namely offline link weight optimization and online adaptive traffic management. These two perform the activities such as producing routing path diversities and intelligent traffic allocation. We built a prototype application that simulates the traffic engineering. Traffic engineering is taken care in order to ensure that the network can handle traffic abnormalities well. The empirical results revealed that the application is capable of controlling traffic as expected.

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