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Adaptive Multi-topology Traffic Engineering System Based on Routing Topologies

S.Dhana Lakshmi*1, Mr.Ch.Suresh*2

M.Tech (CSE) Student Department of CSE, Priyadarshini Institute of Technology & Science, Chintalapudi, Guntur(Dist), Ap, India.

Assistant Professor, Department of CSE in Priyadarshini Institute of Technology & Science, Chintalapudi, Guntur(Dist), Ap, India

Abstract

Internet is not a single network. Internet is a collection of networks, each controlled by different administrations. Traffic engineering is a method of optimizing the performance of a telecommunication network by dynamically analyzing, predicting and regulating the link utilization over the network. It handles the unexpected traffic dynamics for achieving better quality of service and overall network performance in wireless sensor networks. The existing Adaptive Multi-topology traffic Engineering (AMPLE) is an efficient traffic engineering and management system that performs effective routing by using multiple virtualized routing topologies using the components: offline link weight optimization that takes the physical network topology as an input and tries to produce maximum routing path diversity across multiple virtual routing topologies for long term operation through the optimized setting of link weights. This article also concentrates creates new path with help of ADC algorithm. This scheme allows a network to operate in the region of low delay, no packet loss and high throughput.

Keywords: AMPLE, ATC, OLWO, TE, WSN.

1. Introduction

Inter-domain Traffic Engineering based on BGP (Border Gateway Protocol). The BGP is an inter Autonomous System (AS) routing protocol. An Autonomous System is an administrative domain. That is a network or group of networks under a common administration and with common routing policies. BGP is used to exchange routing information in the Internet and is the protocol used by default to communicate between Internet Service Providers (ISP). Customer networks, such as universities and corporations, usually employ protocols known as Interior Gateway Protocol (IGP) to exchange routing information within their networks. Examples of IGPs are Routing Information Protocol (RIP) and Open Shortest Path Protocol (OSPF). Customers connect to ISPs, and ISPs use BGP to exchange customer and ISP routes. A network under the administrative control of a single organization is called an Autonomous System (AS). There are two types of routing, intra-domain routing which

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is the process of routing within an AS, and inter-domain routing which is the process of routing among different ASs. BGP is the dominant inter-domain routing protocol on the Internet (BGP). BGP has been deployed since the commercialization of the Internet, and version 4 of the protocol has been in wide use for over a decade. There are two variations of BGP: Interior BGP (IBGP), which is used by ISPs to exchange routing information within an AS; and External BGP (EBGP), which is used to exchange routes among autonomous systems. Figure 1 illustrates the difference IBGP and EBGP. BGP is a simple protocol and it generally works well in practice. Thus, it has played a fundamental role within the global Internet, despite providing no performance or security guarantees.

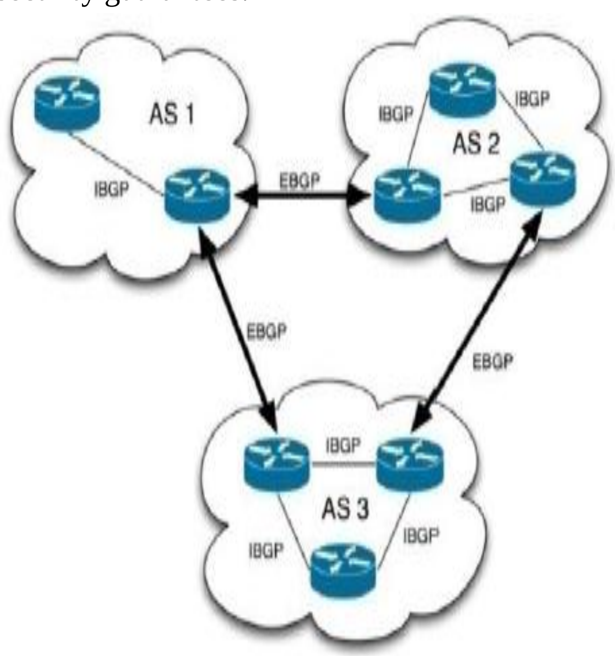

Fig 1.1: EBGP and IBGP

An Autonomous System is also sometimes referred to as a routing domain. An Autonomous System is assigned a globally unique number sometimes called an Autonomous System Number (ASN). The Networks within an Autonomous System Number communicate routing information to each other using an Interior Gateway Protocol (IGP). An Autonomous System shares routing information with other Autonomous System using Border Gateway Protocol (BGP). Previously the Exterior Gateway Protocol (EGP) was used. In future the BGP is expected to be replaced with the OSI Inter-Domain Routing Protocol (IDRP). The BGP is very robust and scalable routing protocol.

2. Related Work

AMPLE includes two distinct tasks, the first one is offline network dimensioning through link weight optimization for achieving maximum intra-domain path diversity across multiple MT-IGP routing topologies, and second one is adaptive traffic splitting ratio adjustment across these routing topologies for achieving dynamic load balancing in case of unexpected traffic dynamics. MT-IGPs are used as the underlying routing protocol for providing traffic agnostic intra domain path diversity between all source-destination pairs. With MT-IGP routing customer traffic assigned to different virtual routing topologies (VRTs) follows distinct IGP paths according to the dedicated IGP link weight configurations within each VRT. More specifically each source node can adjust the splitting ratio of its local traffic

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according to the monitored traffic and network conditions in order to achieve sustainable optimized network performance. It is worth mentioning that the computing of new traffic engineering manager. This TE manager has the knowledge about the entire network topology and periodically gather the overall network status such as the current utilization of each link and traffic matrices based on which the new traffic splitting ration is computed and thereafter enforced at individual source nodes.

A) Example for providing Path Diversity in the Network

Path Diversity generally describes that the source node have multiple routes to reach the destination. The number of paths for a packet to transmit between two points

- ✓ Inside an Autonomous System network (ISP)
- ✓ Fully link and Point of Presentation (POP) disjoint paths.
- ✓ Observed at IP level.

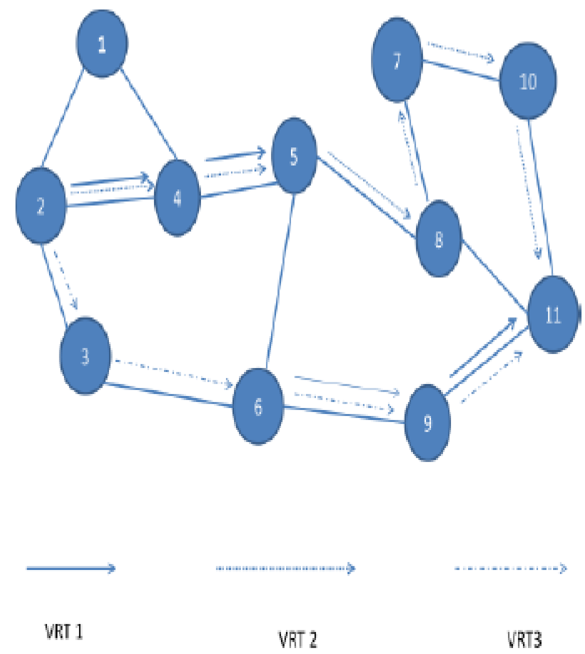

Fig. 2.1: Path diversity in a network

The above figure depicts an illustration of how path diversity can be achieved for S-D pairs in the PoP level in the above network topology with three VRTs, by considering as an example from node 1 to node 2.

For example if the link between node 5 and node 6 is highly loaded , some traffic originally carried through the green path can be shifted to the other two by adjusting the traffic splitting ratio across the three VRTs at node 2. The ultimate goal is to splitting across multiple routing topologies at individually source PoP nodes in reaction to the monitored traffic condition.

3. Proposed Work

In proposed system using BGP protocol. This system consists of three complementary components: one is Offline link weight optimization that takes as input

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the physical network topology and tries to produce maximum routing path diversity across multiple virtual routing topologies for long term operation through the optimized setting of link weights. Depend on these diverse paths, the second adaptive traffic control performs intelligent traffic splitting across individual routing topologies in reaction to the monitored network dynamics at short timescale. The third one is Admission control algorithm using dynamically created a new path with help of virtual routing topologies and traffic traces, the proposed system is able to cope almost optimally with unpredictable traffic dynamics and as such, it constitutes a new proposal for achieving better quality of service and overall network performance in IP network using BGP. In our proposed system, AMPLE has a high chance of achieving inter network performance with large number of routing topologies, although this is yet to be further verified with traffic traces dara from other operational networks.

3.1 Virtual Traffic Allocation

A Monitored network and traffic data such as incoming traffic volume and link utilization. At each short time interval ATC computes anew traffic splitting ratio across individual VRTs for re-assigning traffic in an optimal way to the diverse BGP paths between each S-D pair. This functionality is handled by a centralized TE manager who has complete knowledge of the network topology and periodically gathers the up-to date monitored traffic conditions of the operating network. New splitting ratios are then configured by the TE manager to individual source PoP nodes, who use this configuration for remarking the multi-topologies identifiers of their locally organized traffic accordingly.

3.2 Offline link weight optimization

It takes as input the physical network topology and tries to produce maximum routing path diversity across multiple virtual routing topologies for long term operation through the optimized setting of link weights.

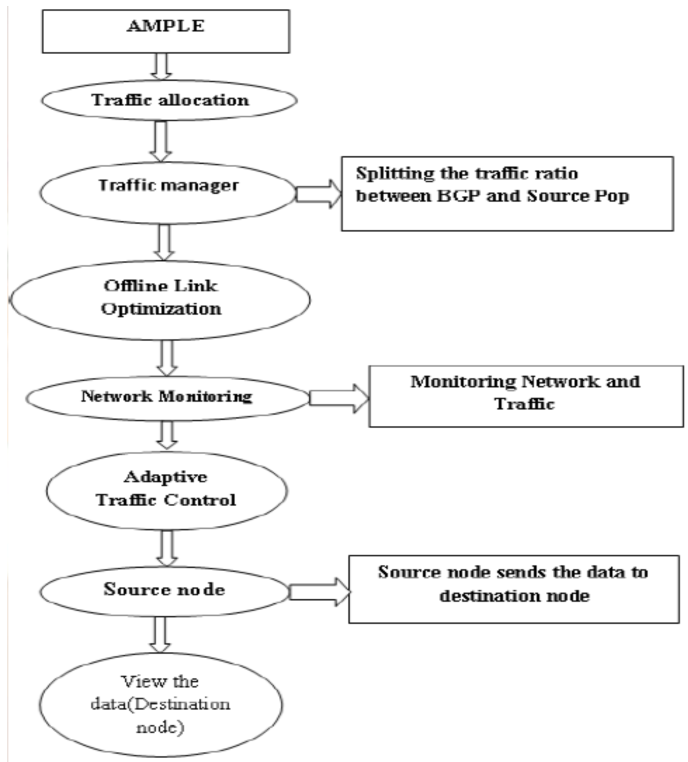

Fig.3.1 AMPLE structure

The above figure gives an overall structure of the proposed AMPLE TE system with offline MT-BGP Link Weight Optimization and Adaptive Traffic Control (ATC) and admission control algorithm (ADC) consisting the key components. As previously mentioned the ultimate objective

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of OLWO is to provision offline maximum intra-domain path diversity in the routing plane, allowing the ATC component to adjust at short timescale traffic assignment across individual VRTs in the forwarding plane. While OLWO focuses on state routing configuration in a long timescale, the ATC component provides complementary functionality to enable short timescale control in response to the behavior of traffic that cannot be usually anticipated.

3.3 Network Monitoring

Network monitoring is responsible for collecting up-to-date traffic conditions in real-time and plays an important role for supporting the ATC operations. AMPLE adopts a hop-by-hop based monitoring mechanism that is similar to the proposal. Network monitoring agent deployed at every PoP node is responsible for monitoring: The volume of the traffic originated by the customers PoPs. The central TE manager polls individual monitoring agent within each PoP and collects their locally monitored traffic volume and link utilizations. These samples are then used by the central TE manager for updating its maintained traffic engineering information base and computing traffic splitting ratios for the next interval.

3.4 Adaptive Traffic Control

The optimized MT-IGP link weights produced by OLWO, adaptive traffic control (ATC) can be invoked at short time intervals during operation in order to re-optimize the utilization of network resources in reaction to traffic dynamics. The optimization objective of ATC is to minimize the maximum link utilization, which is defined as the highest utilization among all the links in the network. In this section we present a lightweight but efficient algorithm that can be applied for adaptive adjustment of the traffic splitting ratio at individual PoP source nodes to achieve this goal.

- ✓ It measures the incoming traffic volume and the network load for rhe current interval as described in the previous section.
- ✓ Compute new traffic splitting ratios at individual pop source nodes based on the splitting ratio configuration in the previous interval, according to the newly measured traffic demand and the network load for dynamic load balancing.

4. Conclusion

In this article we present an adaptive MT-BGP traffic engineering based virtual routing topologies. TE system based on virtualized BGP routing that enables short timescale traffic control against unexpected traffic dynamics using multi-topology BGP based networks. The hole work contains three major components, namely Offline Link Weight Optimization (OLWO), Adaptive Traffic Control (ATC) and admission control Algorithm. The admission control algorithm achieved low delay and high throughput instead of frequently changing BGP link weights then create own path based on virtual topologies, but we use multi-topology BGP routing protocol that allows adaptively splitting traffic across multiple routing topologies.

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