An Efficient System for Traffic Control in Networks Using Virtual Routing Topologies

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ABSTRACT: *Traffic Engineering (TE) is an important aspect of contemporary network management. Offline traffic engineering approaches aim to optimize network resources in a static manner, but require accurate estimation of traffic matrices in order to produce optimized network configurations for long-term operation. In order to avoid network congestion and subsequent service disruptions, handling traffic dynamics is one of the key tasks performed by many contemporary network management systems. In this paper, we introduce AMPLE (Adaptive Multi-toPoLogy traffic Engineering), a holistic system based on virtualized IGP routing topologies for dynamic traffic engineering. The fundamental idea behind this approach follows the strategy of offline provisioning of multiple diverse paths in the routing plane and online spreading of the traffic load for dynamic load balancing in the forwarding plane.*

Keywords: *AMPLE, OLWO, Routing, Topology.*

I. INTRODUCTION

Today's traffic engineering practices mainly depend on off-line settings that use traffic demand estimates to derive network configurations. However, because of their static nature, these practices do not take network and traffic dynamics into account and can lead to sub optimal overall performance. To cope with unexpected traffic variations and network dynamics, approaches that can dynamically adapt routing configurations and the traffic distribution are required [1]. Here, Offline link weight optimization(OLWO) component takes the physical network topology as input and tries to produce maximum routing path diversity across multiple virtual routing topologies for long term operation through the optimized setting of the link weights. Once the optimized link weight configuration has been enforced onto the network, the Adaptive Traffic Control (ATC) component performs very short timescale traffic splitting ratio adjustment for adaptive load balancing across diverse IGP paths in the engineered VRTs, according to the up-to-date monitored traffic conditions [2]. In AODV technique, when a source node generates a packet for particular destination node, it broadcasts the route request packet which is identified by the combination of source sequence number and broadcast ID [3].

An intermediate node only processes a route request if it has not received a previous copy of that request. When an active route link breaks, a route error packet is sent by the upstream node of the broken link to the source node. Upon receipt of an error, the source node initiates a new route discovery process if it still has packets to send to destination node [4]. To deal with this back routing process, the proposed system uses AOMDV (Ad hoc On-Demand Multipath Distance Vector) technique [5].

II. EXISTING WORK

In Existing System, IGP-based TE mechanisms are only confined to offline operation and hence cannot cope efficiently with the significant traffic dynamics. There are well known reasons for this limitation: IGP-based TE only allows for the static traffic delivery through native IGP paths, without flexible traffic splitting for dynamic load balancing. In addition, changing IGP link weights in reaction to emerging network congestion may cause routing re-convergence problems that potentially disrupt the ongoing traffic sessions. In effect, it has been recently argued that dynamic or online route re-computation is to be considered harmful even in the case of network failures, let alone for dealing with traffic dynamics [6].

The existing system does not achieve better performance in minimizing the MLU. Even if multiple traffic matrices with various pattern characteristics are considered in link weight optimization, unexpected traffic spikes may still introduce poor TE performance. AMPLE encompasses 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 the second one is adaptive traffic splitting ratio adjustment across these routing topologies for achieving dynamic load balancing in case of unexpected traffic dynamics [7] but these everything done only in MT-IGP. Figure 1 shows the AMPLE system.

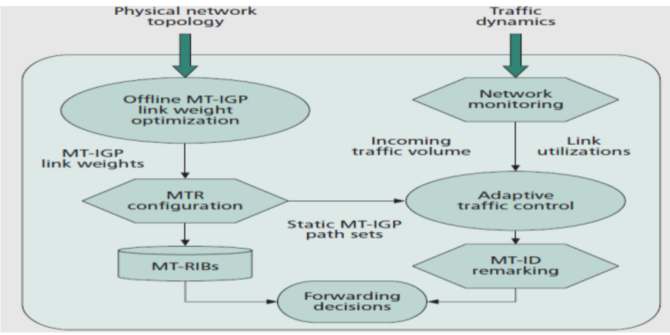

Figure 1: AMPLE System Overview

III. PROPOSED WORK

The proposed system consists of two complementary components: offline link weight optimization that 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 the link weights. Based on these diverse paths, adaptive traffic control performs intelligent traffic splitting across the individual routing topologies in reaction to the monitored network dynamics at short timescale. According to our evaluation with real network topologies and various traffic traces, the proposed system is able to cope almost optimally with unpredicted traffic dynamics and, as such, it constitutes a new proposal for achieving better quality of service and overall network performance in the IP networks.

A. Virtual Traffic Allocation

In virtual traffic allocation, the diverse MT-BGP paths according to the link weights computed by OLWO. Monitored network and traffic data such as incoming traffic volume and the link utilizations. At each short time interval, ATC computes a new traffic splitting ratio across various 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 traffic engineering manager who has complete knowledge of the network topology and periodically gathers the up-to-date monitored traffic conditions of the operating network. These new splitting ratios are then configured by the traffic engineering manager to individual source PoP nodes, who use this configuration for remarking the multi-topology identifiers (MTIDs) of their locally originated traffic accordingly.

B. Offline Link Weight Optimization(OLWO)

OLWO is used to determine the definition of "path diversity" between PoPs for traffic engineering. Let's consider the following 2 scenarios of MT-BGP link weight configuration. In the first case, highly diverse paths are available for some Pop-level S-D pairs, while for some other pairs the individual paths are completely overlapping with each other across all VRTs. In the second case, none of the S-D pairs have any disjoint paths, but none of them are completely overlapping either. Obviously, in the first case if any "critical" link that is shared by all paths becomes congested, then its load cannot be alleviated through adjusting traffic splitting ratios at the associated sources, as their traffic will inevitably travel through this link no matter which VRT is used. Hence, our strategy targets the second scenario by achieving "balanced" path diversity across all the S-D pairs.

The ultimate objective of OLWO is to provision offline maximum intra-domain path diversity in the routing plane allowing the ATC component to adjust at very short timescale the traffic assignment across individual VRTs in the forwarding plane. While OLWO focuses on static routing configuration in a long timescale, the ATC enable short timescale control in response to the behaviour of network traffic. At each short-time interval, ATC computes a new traffic splitting ratio across the individual virtual routing technique (VRTs) for reassigning traffic in an optimal way between each source and destination (S-D) pair.

C. Adaptive Traffic Control

In ATC (figure 2), Measure the incoming traffic volume and the network load for the current interval as compute new traffic splitting ratios at each 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 the dynamic load balancing. An efficient algorithm for adaptive adjustment of the traffic splitting ratio at individual PoP source nodes. These parameters are used in the adaptive traffic algorithm. The algorithm consists of the folllowing steps. We define an iteration counter "*x*" which is set to zero initially.

ATC Parameters:

- t(u,v) – traffic between PoP node u and v.
- ϕ u,v(r) – traffic splitting ratio of t(u,v) at u on routing topology r, 0.0≤ ϕ u,v(r)≤1.0.

Step-1: Identify the most utilized link "lmax" in the network. This can be helpful for updated in the traffic engineering information base.
Step-2: For the set of PoP S-D pairs traffic flows that are routed through "lmax" in at least one but not all the routing topologies, Full Degree of Involvement is equal to zero, consider each at a time and compute its new traffic splitting ratio among the routing topologies until the first feasible one is identified. A feasible traffic flow means that, with the new splitting ratios, the utilization of "lmax" can be reduced without introducing new hot spots with utilization higher than the original value.
Step-3: If such a feasible network traffic flow is found, accept the corresponding new splitting ratio adjustment. Increment the counter k by one and go to Step-1 if the maximum "X" iterations have not been reached (i.e. x ≤ X). If no feasible traffic flow exists or x = X, the algorithm stops and final result values for the computed traffic splitting ratios.

D. Network Monitoring

Monitoring agent gathers data on the locally originated traffic volume from all the access routers (ARs) attached to the customers at the PoP. In a periodic fashion (e.g. hourly),the central traffic engineering manager polls individual monitoring agents within each PoP and collects their locally monitored traffic volume and link utilizations. Traffic engineering information base (TIB) is needed by the traffic engineering manager to maintain necessary network state based on which new traffic splitting ratios are computed.

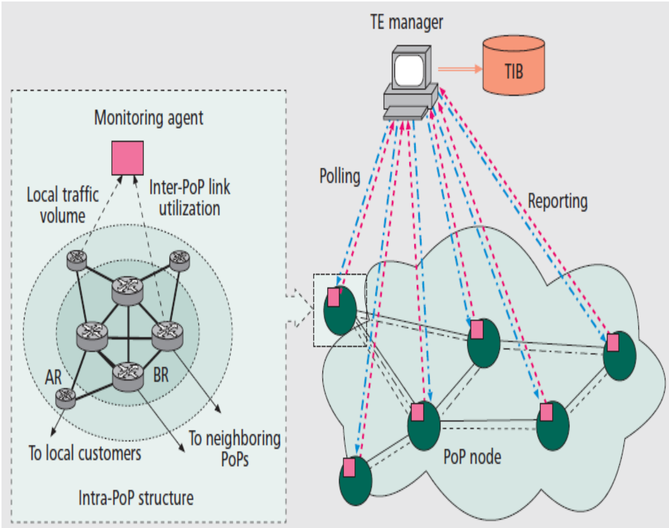

Figure 2: Network monitoring and ATC

IV. CONCLUSION

The traffic engineering system works as follows: First, optimized MT-IGP link weights are configured on top of the underlying MT-IGP platform and remain static until the next offline ofline link weight optimization(OLWO) cycle. During this period, ATC(adaptive traffic control) adaptively re-balancing the load according to the traffic dynamics in very short time scales. The traffic engineering manager updating the traffic volume between each S-D pair in the SDPL and link utilization information stored in the LL of the TIB. The alternate path is chosen for the packet Transfer based on the obtained link utilization information from the source to destination ends.

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