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Performance Analysis of Traffic Engineering with Optical Broker using Extended Johnson Algorithm for Load Balancing in Software Defined Data center Networking

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ABSTRACT

Optical networks are promising, which serves as the backbone networks for next generation Internet owed to their potential ability to meet the ever-increasing traffic demands of high Bandwidth (Terabytes or even Peta bytes). The algorithm is developed with Optical Broker designed to organize inter-domain networking across the administrative domains in autonomous structures (AS). The AS can take on for multiple broker services and based on the needs of the AS, service plans are offered. Because of the evolution in applications and services the drive for interactive changes in the toning between the broker agents and ASes will happen. The proposed method of optical broker supports the independence of the AS and presents a combination of centralized and distributed control planes for superior scalability and manageability. These broker services present centralized control plane between ASes, in meantime every AS keep hold of autonomy and control plane for its own intra-AS networking. This paper offers diverse attempts to integrate load balancing in Software Defined Networking (SDN) with optical broker using Extended Johnson Algorithm which is applied for sparse graphs. The Extended Johnson Algorithm mull over edge weights along with node weights of negative cycles which help in handling the traffic in merged circuit and packet switching across the network for better load balance.

Keywords: Autonomous structures (AS), Optical broker, SDN, Bandwidth, Traffic, Circuit and Packet switching.

1. INTRODUCTION

Optical Transport network elements are becoming more intelligent for flexible management. Noteworthy progress in optical technologies, permits transport networks to offer more intelligent and elasticity in multiplexing and switching functions in accumulation to basic data transport and survivability. The expansion in traffic volumes, changing traffic profiles and types of applications impelled service providers to rethink how to optimally engineer their IP and optical backbone networks, but also to relieve the operational and organization overhead. Initially from campus Ethernet networks [1], to present software-defined networking (SDN) [2], represents the data center. Centralized SDN controllers displays value by investigating the entire data center network as an vague and virtualized representation, ahead of time simulating any network changes and then automatically constructing multiple switches on demand provides increased operational efficiency. The SDN notion is shifted from packet switching (L2+) to transport (circuit switching) (L0/L1) networks, helps SDN display its real power by supervising multiple elements from multiple vendors across multiple layers of the network, including the IP and Ethernet layer, the OTN switching layer, and down to the optical transmission layer [3]. Hence SDN needs to extend its control to include the emerging next-generation converged optical transport networks for multi-domain, multi-vendor and multi-layer networks

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as a single virtualized abstracted topology with several software tools and utilities network emulation tools for researchers in the packet switching domain of SDN. The optical broker services provide centralized control plane between autonomous system without being a ruling power of the systems, while each autonomous system retains independence and control plane for its own intra-autonomous system networking. Regular analyze the inter domain link state table with help of optical flow broker to determine existence of congested links.

If likely an exchange universal forwarding path is recomputed for the flow supplying the high load to that particular congested link, thus offering intra-domain load-balancing and lessen the maximum inter-domain link utilization, using Dijkstra's algorithm [4] also proposed extended Johnson algorithm[5] for negative weight consideration . Various parameters like response time, throughput, latency, server load variation, jitter are investigated for load balancing with optical broker in SDN.

The chapter 2 devises about related work in the paper, chapter 3 says about optical broker architecture. Also chapter 4 and 5 reveal about methodology and results with load balancing by Johnson algorithm in optical broker. Finally chapter 6and 7 shows the result analysis and concludes about the importance of the algorithm with optical broker in SDN environment.

2. RELATED WORK

The SDN enables to design our own protocol on top of SDN switches. The intelligent of network administrator or researcher can easily put on the network devices such as load-balancing methods. N. Handigol, et.al, [6] proposed the Plug-n-Serve system implementing a load-balancing algorithm, called LOBUS (LOad-Balancing over UnStructure networks), using OpenFlow for unstructured networks. LOBUS preserves the network topology and link status, and meanly chooses the client-server pair that defers the lowest total response time for each arriving newly request. In 2013, H. Long, et al., [7] proposed a load-balancing algorithm, named LABERIO (LoAd-BalancEd Routing wIth OpenFlow), to minimize latency and response time and to maximize the network throughput by better utilizing a vailable resources. In 2014, Dan Marconett et.al[8] proposed Optical Flow Broker, are the hierarchical brokers improve scalability and inter-domain global coordination, while allowing domain controllers to manage intra-domain forwarding decisions. Siamak Azodolmolky et al.[9] investigated the architecture of a Software-Defined Network (SDN) emulation platform for transport optical networks and investigate its usage in a use-case scenario. In 2010, Vinesh Gudla et al. [10] states that OpenFlow is presented as a unified control plane and architecture for packet and circuit switched networks. A simple proof-of-concept testbed is created, where a transport in TCP flow takes place dynamically in bidirectional wavelength circuit. In 2010 Theophilus Benson et al. [11] preliminary empirical study of end-to-end traffic patterns in data center networks that can inform and help evaluate research and operational approaches. In 2014, H.Hasan and J.Cosmas[12]states Enhanced Interior Gateway Routing Protocol (EIGRP) algorithm inside routers will be applied along with simple smart load distribution algorithm inside a controller which results a network that has the characteristics of the OpenFlow protocol. In 2015 Bindhu et al. [5] proposes the Extended Johnson Algorithm for congestion control by taking into consideration not only edge weights but also node weights with negative cycles in SDN .

3. OPTICAL BROKER ARCHITECTURE

Intra and Inter Data center networks are using Optical networks technologies which are based on optical packet switching, wavelength division multiplexing (WDM), optical circuit switching, and optical orthogonal frequency division multiplexing (OFDM) technologies. Several new challenges were posed as unique features and capabilities for virtualization in today networking environment. Hence require new solutions different from that for the current all-electrical packet switching the traffic engineering problem produces intelligent ways of distributing traffic onto optical paths and electrical packet-switched paths. The difficulty of Virtual

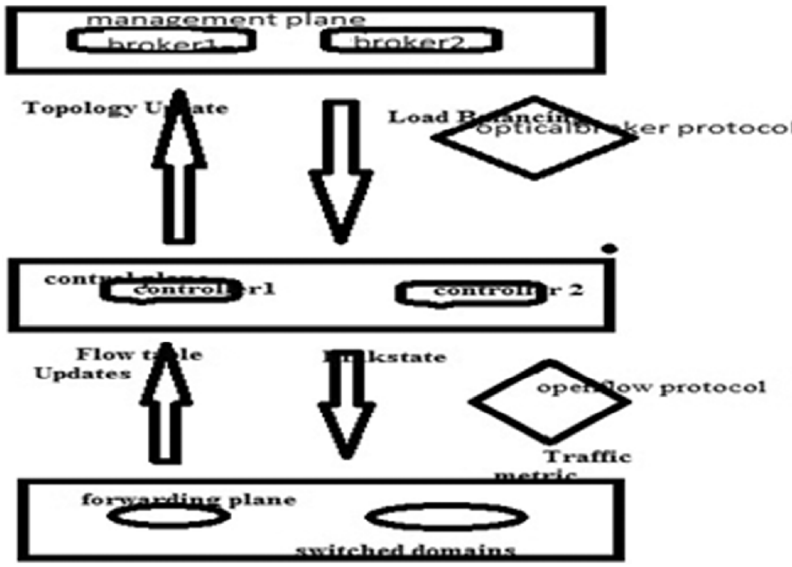

Figure 1: Optical Broker Architecture Model

Data Center (VDC) network set in, where a tenant demands a certain number of Virtual Machines (VM) and bandwidth between these VMs in total to the computing and server resources, is also considered in placement of VMs and its impact on traffic load on optical and electrical networks. The optical Broker architectural model characterize a domain as a set of OpenFlow switches with a single controller, handle the flow tables of all switches contained by that domain. The figure 1, controllers every so often collect the link state information, the parameters like link utilization, end to end (ETE) delay[8], and traffic loss ratio, to determine intra domain forwarding decisions on a per-flow basis. The datas are then stock up in the controller's local link state table and keep posted to the associated brokers if they linked to inter-domain links. Periodically broker agents examine their inter-domain link state table to find out congested links existence. Sometimes an alternate global forwarding path is reorganized for the flow contributing the highest load to that congested link, hence provide intra-domain load-balancing and reduce the maximum inter-domain link utilization by different load balancing algorithm methods for higher throughput, better latency and response time. Optical Interconnect in Intra-data center is better to accommodate energetic and efficient applications than inter data center. Apart from inter connect architecture, attention is required in quality of delivery services in data center networks. These algorithm produce better outcomes in efficient utilization of network resources with high throughput in shortest paths recognition in a sparse weighted, dense and directed graph.

4. LOAD BALANCING WITH OPTICAL BROKER

Inter related task in SDN with optical broker is early flow forwarding and periodic load balancing .Constant check takes place in flow table in SDN if there is no identical flow table access whenever a new packet arrives at switch it forwards that packet to its domain controller main portion in SDN. The original load balancing algorithm does not yield the same result just by adding node weights into edge weights. Since node weight is measured only at the outgoing edge of an intermediate node on the path. Node weights plus edge weights imply that an extra node weight of the destination node is added into the total weight of every shortest path, making the algorithm revisit the wrong result. Therefore extended Johnson algorithm is very useful in deriving the best routing path to send a packet from a precise source node to destination node where significant latency occurs as the packet goes through intermediate nodes and edges (or links). The network congestion is avoided, by sending each request to the nearest server with the link load lower than a pre-specified threshold . Hence this extended Johnson algorithm re-weight all edges to make them positive, relevant Dijkstra's algorithm for each vertex is used.

5. PROCEDURE IN LOAD BALANCING ALGORITHM

The following methodology takes place in load balancing techniques in inter and intra domain optical broker architecture.

- Cross checking takes place at domain controller to find out packet destination is for switch or host neither contained by its own managed domain nor forwards the packet to its allied broker case through optical broker control channel port, by the message *GLOBAL_ROUTE_REQ*.
- The broker always updates its own global inter-domain link state table by exchange of the *NETWORK_STATE* messages and status information with other peer brokers.
- The link utilisation as the cost metric uses to facilitate global load balancing, to compute a global most favourable route the broker has the adequate information.
- *GLOBAL _ROUTE _UPDATE* message in the inter domain links used and packet match rules for the new flow pack. Hence a new forwarding path is choseb for forwarding the packet to each peer broker.
- Every broker sends a *FLOW_TABLE_MOD* message to the respective controller to construct an intra domain path to hold the new inter domain path .Since the controller manages a domain in the global path thereby restrict the scope of global forwarding choices to appropriate domains.
- The new flow is forwarded to the exact next hop domain by constructing an intra domain path by original domain plane with appropriate edge and node switches for new packet arrival.
- As brokers regularly analyze the network state for congested inter domain links these load balancing decisions occurs.
- On time, the broker agents re-compute swap global inter domain routes for high traffic flows to maintain the reduction of highest congested link to the utilization threshold.

6. RESULT ANALYSIS

Simulation software: The network modelling software OMNeT++[13] simulation is used to build the project. OMNeT++ [14] is an object oriented simulation that depends on both C++ and Network Description (NED) [15] languages. The OpenFlow protocol uses the Flowbroker switch with Abilene topology. For the implementation, the openflow.h header file is created to model the protocol and its specified messages.

The figure 2 represents generalised fat tree topology of optial broker with GLOBAL_ROUTE_REQ.

The figure 3 says about ping values of the OpenFlow switch at a location when load balancing take place with transmission sequence count as 2.0

Figure 2: Optical broker architecture under load balancing

Figure 3: Ping value of optical broker with SDN controller

The figure 4 represents about Ethernet Mac values at on location about 40,000 packets transmitted and received with no congestion, the frames processed /sec with packet loss ratio is been specified.

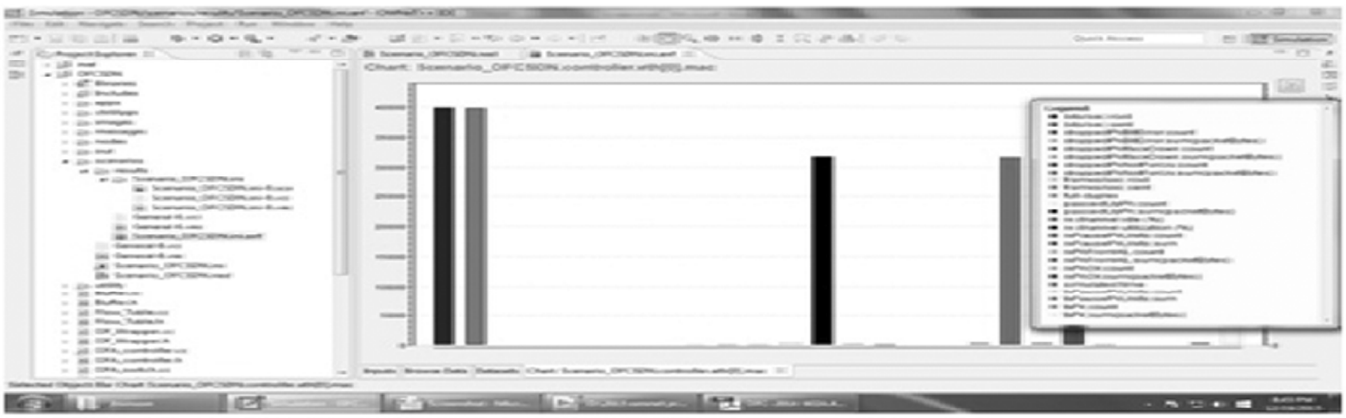

Figure 4: SDN controller with optical broker MAC o/p

The figure 5 says about time taken by packet to move from source to destination is around 150ms.

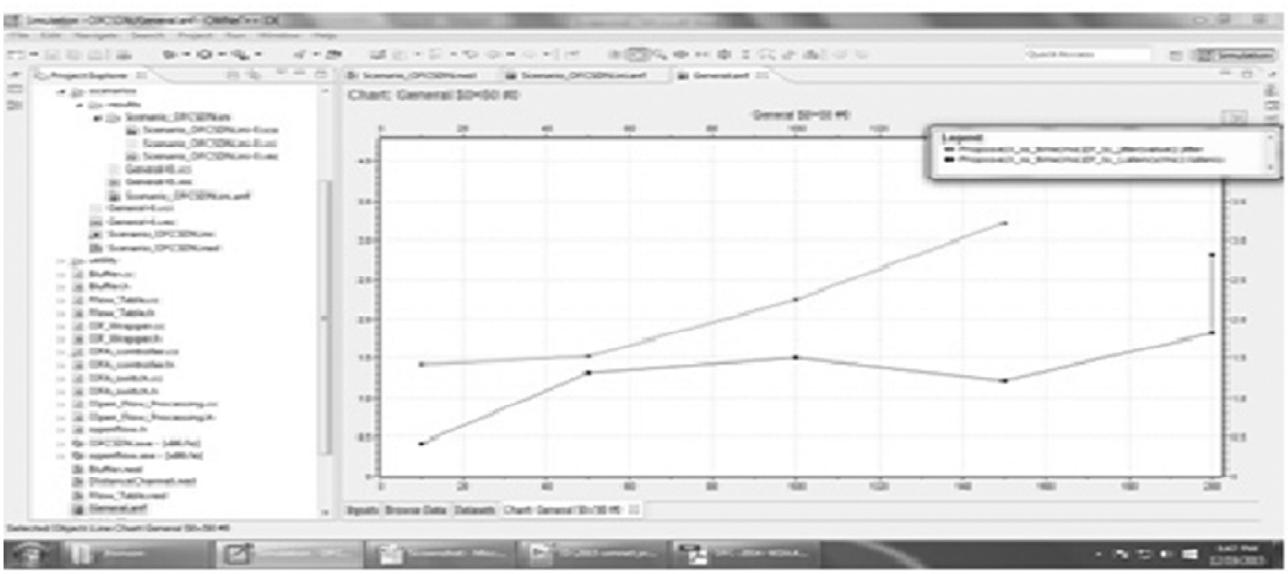

Figure 5: Latency of SDN controller with optical broker

CONCLUSION

This paper describes a performance analysis of various parameters used in load balancing method in virtual environment based on OpenFlow technology. OpenFlow method grants flexibility for the realization of different load balancing strategies, which is conveniently used in software-defined network to achieve different load balancing strategies in different network environment. Also Latency time increase, almost stabilize with higher node capacity. The algorithm results in efficient utilization of network resources with high throughput in shortest paths identification in a sparse weighted, dense and directed graph.

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