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SDNi- The New and Improved Hybrid Software Defined Networking Architecture for Inter-Domain Routing

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Abstract:
The evolution of the Next Generation Networks have recently received attention by researchers in the academic community and followed –up with various proposed models on this hot topic- "Software Defined Networks". Software Defined Networking supported the centralization of the routing control logic of the management plane for intelligent networks. In this paper, we present a holistic view of the various challenges that comes with the framework and standardization activities while focusing on the technical perspectives rather than the financial and political view of intelligent traffic handling bearing in mind the network loads and other performance metrics. The Hybrid Software Defined Networks (SDN) explores a new direction to this research in Inter-Domain Routing Network Application with the introduction of SDNi main idea and exchanged states. This gives us insight over multiple transports network protocols that controls the internetwork. We analyse the associated trade-offs beginning from the promises of Software Defined Network Interconnection {SDNi} within a domain and gradually explore the benefits and challenges in our survey.

Keywords: *Software Defined Network Interconnection, Hybrid SDN, Inter-Domain Routing*

1. Introduction

Recently, Software Defined-Network –Border Gateway Protocol [SDN-BGP] has been identified by researchers as the enhancement to the de-facto BGP and a paradigm shift from legacy Border Gateway Protocol (BGP) which the current next generation internet fabric is built on. Border Gateway Protocol (BGP) was created three decades ago and has supported our internet which operates with Inter-domain routing protocols. The current Border Gateway Protocol BGP is a path vector protocol with a rigid architecture that presents a barrier to innovation and has stable path problems which has contributed to its large convergence times.

The demand for a high speed at the backbone is a major driver for an efficient and reliable backbone that can deliver on internet applications services such as on-line gaming, multimedia communication and transport Networks services anywhere, anytime. In a recent 5-year report by a major player in the telecommunication industry in the European region – () in September 2015, reveals that the future internet applications growth is forecasted to grow at 70% rate. This is all attributed to the development of a high speed backbone that is scalable to cater for the growing bandwidth needs in Service Providers and Network Operators infrastructures.

Inter-domain routing has revolutionized global connectivity with autonomous systems {AS} being managed by ISP, Governments' and Content Distribution Networks {CDNs} Providers. In Inter-domain routing, all Autonomous Systems (ASes) use the same protocol such as routing information protocol (RIP), Enhanced Interior Gateway routing protocol (EIGRP), Interior Gateway routing protocol (IGRP) etc. in contrast with intra-domain routing where each AS use different protocol such as Border Gateway Protocol (BGP4), External Border Gateway Protocol (EBGP).

Technically, every Next Generation Network Carrier Service provider or network operator look out for reduced {OPEX and CAPEX} in their production network and base effective network operation metrics on nodes and links requirements such as scalability, flexibility in choosing routes on their networks.

However, Software Defined-Network –Border Gateway Protocol [SDN-BGP] has a strong coupling between the architecture that support the protocols and network Infrastructure for network devices unlike Border Gateway Protocol (BGP) which is known for its architectural rigidity. Although it is not known if any of the observed Border Gateway Protocol (BGP) instability has been caused by policy conflicts, in the worst case, such policy could introduce extreme oscillations into the global routing system.

Few of the identified challenges is the large convergence times {-10s d sec up to 10 minutes}, scalability issues due to routing table size and churn of Border Gateway Protocol (BGP) after advertisement. The inter-domain SDNi controller promises to have quite a large CPU Power and capacity which routers do not have and also eliminate the barrier to innovation with sufficient modularity in its architecture. The issue of management, troubleshooting and security are hard fought as manual configuration of several knobs are still great issue.

Stefano et.al [1] proposed an Open Source Hybrid IP/SDN {oSHI} model which combines Quagga for Ospf routing and open vswitch for open flow based switching on Linux platform. In their experimental comparative study between the emulation on minimet and distributed SDN Test beds, Oshi was suitable for large scale similar to the views of the authors in [2] where methodology of reducing the route oscillations was suggested with the Border Gateway Protocol (BGP) sample transactions observed at various outage time.

This paper surveys the recent challenges in on-going software-defined networking emulation networks and Architectural framework. The remainder of this paper is arranged as follows: Section 1 gives us an overview of the Software-Defined Networks, the history of Software Defined Networks and the current need for it. Section 2 relates the introduction with the Motivation for Software Defined Networks, the past, present and future of protocols.

This section discusses the trend in Data Communications, the challenges in traditional Networking and the evolution of programmable networks. Section 3 gives a bird eye-view of the current challenges in the architecture and framework working groups within the industry and academia community. The effort of standardization of Open Flow extensions, what has been done, the Need-Gap analysis of the framework and our proposal? As such, MANET will position itself as a major project to make an architecture that combines CDN networks with Software Defined Network (SDN) Open Flow technology to manage the flow of inter-CDN services. Section 4 is the comprehensive survey of this paper which is a bottom-up approach to analysing issues related to the concept of abstraction. Section 5 of our work concludes this paper.

2. Background and Related Work

We begin this paper with a comprehensive survey on Software-Defined Network work using a bottom-up approach in Diego Kreutz et.al work [1], they discussed the future of Networking from a theory based approach by introducing the motivation for Software Defined Network (SDN) from the perspective view of complexity and management problems on the planes and the ongoing research effort such as switch designs, controller platforms, resilience and scalability, performance evaluation, security and dependability. Bridging the legacy networking and new Software Defined Network (SDN) gap which will lead to Service Providers migration to SDN as the technology and research matures. This issues led to another term –Software-Defined Environment {SDE} as Cloud providers, network operators and carrier service providers will have to deal with in the future. However, the issue of SDN Controller Interconnection prospect was not discussed which the goal of this new research is.

We propose an emulation framework that thrives on graph creation using open source tools such as minimet platform.

S. Stefan, P. Luigi et al. [2] developed a model and emulation framework for BGP Evolution, in their model, Multi-domain SDN was proposed to be outsourced to an external contractor to provide inter-domain routing services facilitated through a Multi-as Network Controller. The need for a self-aware system was justified by Gelenbe, E. [3] in his work on software-defined self-aware network proposed a Cognitive Packet Network (CPN) which is able to improve the quality of services at Backbone Networks and analogous to the view of S. Vissicchio, L. Vanbever O. Bonaventure [4], where they discussed OpenFlow and implemented it with the management and control functions on each network switch controller which is server cluster external to the network.

N. Amaya S. Yan et.al, N. [6] reviewed the application of SDN over space division multiplexing (SDM) Optical Networks, along with their benefits and presented a comprehensive experimental demonstration in a programmable SDM optical networks. They arguably conclude that with the advantage of Software-Defined Networks (SDN) Controlling Automatic bandwidth and Quality of Transmission (QoT) provisioning over SDM infrastructure was feasible to set-up services according to user requirements with good end-to-end performance provided the three path computation elements (PCE) is adhered to.

R. Munoz et.al [7] buttressed the concept as they provided an overview of three path computation elements (PCE) deployment model in the software defined network (SDN) control architecture. They identified some limitations and addressed it. Consequently, the formal decoupling of the path computation from the rest of the control plane in centralized and dedicated PCE's with an open standard allowed more flexibility in the SDN architecture deployment scenario. Albeit the integration of the PCEs within SDN/OpenFlow centralized control model allowed reuse of the algorithm developed.

In addition, the investigation of Software Defined Network (SDN) is an exciting area being explored by both the industry and academia. Industry activities focuses on investigating how to implement open flow switches and routers, centralise control plane and establish packet communication to the backbone networks or infrastructure. [8], [9]. In academia, typical research fields are the applications of SDN for inter-domain routing functions such as providing route reflector [10], monitoring traffic engineering, [9], [10], studying security mechanism, [11] monitoring data quality, [12] and devising experimental applications for he monitoring SDN WAN orchestration.

2.1. Motivation for SDNi: The past Present and Future

The main motivating factor for Software Defined Network Controller Interconnection is the Software Defined Network (SDN) partitioning Software Defined Network interconnection (SDNi) which is known for its scalability in terms of network devices and controller. BGP4 is the only inter-domain routing protocol currently in use world-wide which currently has issues such as lack of

security, ease of misconfiguration, and poorly understood interaction between local policies, poor convergence, lack of appropriate information hiding, non-determinism and poor overload behaviour.
Some proposal model is on centralizing the routing control logic of many Autonomous Systems ASes with the benefits of inter-domain routing in multiple ways while other models focuses on multi-domain approach. The management plane will handle separate responsibilities to fulfil the main conceptual idea of Software Defined Network. This SDN partitioning will secure each domain on its own thereby contributing to privacy across the network.
These new issues drive the research on new routing methods. Our goal is to adhere to this imminent driver in the software defined next-generation network research domain as it appears as closely as possible.

3. Emulation Framework

The network design modelling is based on SDN Inter-Domain Routing Emulation (SIREN) which is a hybrid based SIREN is a python based network emulation framework for hybrid BGP-SDN Experiments. The SIREN as shown in figure 1.0 below is made up of 3 module elements. The first module is the Minimet which occupies a large portion of the block. The BGP framework portion houses the External Border Gateway Protocol (ExaBGp) and Quagga emulator while the SDN portion consist of Open Flow, Exa BGP and POX as depicted in the figure 1.0

3.1. SDNi Design Consideration

SDN simulation with the following features. This is based on Minimet, Quagga, POX and ExaBGP. The Siren emulator is based on the minimet platform simulation. the types of Abstraction. The prospect of a programming language in the NOS and a focus on Python programming language as a choice language for this work and its application in measuring Large-Scale Networks.
Rather than doing all the horrible scripting, one of the motivation from SDNi is there are obstructions on the industry part it philosophical one of them is better programming instructions which we don't really have and the mechanism to push those out which makes thing horrible even though the API Push those out and one thing is a bit of control being able to describe the network with high level to build what you want it to look like. Using design API to push that out.

3.2. Network Model

The network Model is made consist of modules. which is another step towards extending the value proposition of SDN on inter-domain level or multi-domain level as we propose a model to explore maximally redundant techniques for fast re-routing on the IP layer and the possibility of an autonomic approach to Managing Cognitive Hybrid Software defined Networks.
This simulation was carried out with Clustering Techniques which enables us to visualize and monitor the routes at various stages. Two use-case was developed as shown in figure 2.0 and Figure 3.0. In the use cases 1, In the legacy BGP world,

3.3. Proposed Architecture

Graphs and other numbered figures should appear throughout the text as close to their mention as possible. Figures shouldn't infringe upon the page borders.
Figures and tables must be centered in the column. Large

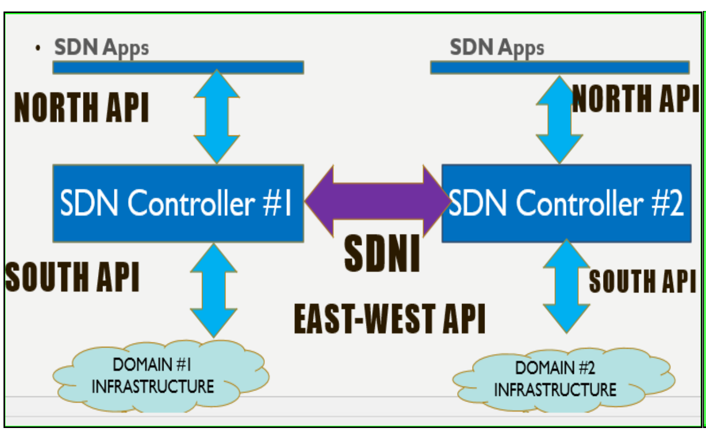

Figure 1: Emulation framework for hybrid BGP-SDN

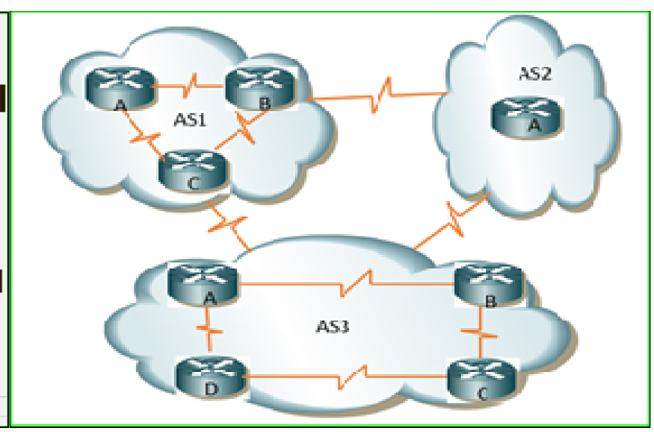

Figure 2: legacy EBGP PEERS

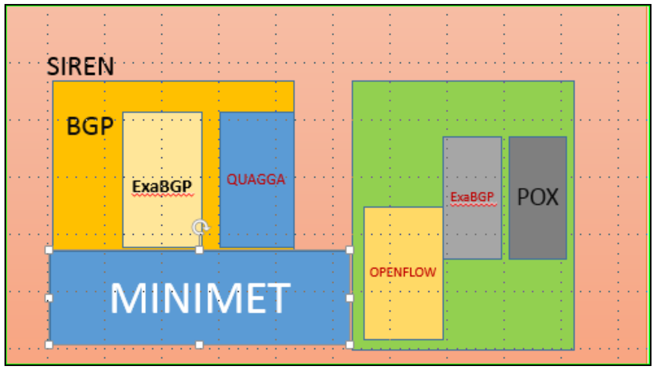

Figure 3: A sample line graph using colours which contrast well both on screen and on a black-and-white hard copy

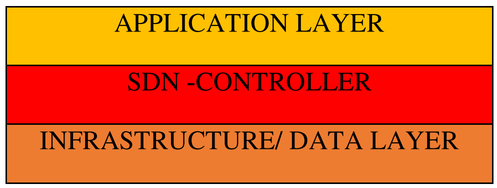

Figure 4: SDNI Design Model

3.4. Evaluation

Results The following graphical notations shows

SDN can help reduce BGP convergence time in certain cases. This simulation is an IDR convergence time versus level of IDR centralization in a 16-node clique. The results are based on 10 runs per parameter set. Figure 1 shows the route announcement stage. AT this stage, the figure 2 reveals the route failover stage ……. Figure 3 shows the route withdrawal stage where the percentage of SDN nodes and the convergence time is

4. Our Contribution

Further research direction with the use of SIREN to come up with prolific use cases ….

SIREN -python based network emulation framework for hybrid BGP-SDN Experiments.

5. Conclusion

In an effort to anticipate the future evolution of this new paradigm, we discuss the main network emulation tool challenges of SDNi.

In particular, we addressed the cross-layer issues {debugging, testing and simulation} as well as new opportunities in Traffic Engineering which thrives on Intelligent traffic handling bearing in mind the network loads and other performance metrics and the probable means of solving this Interoperability issues on Border Gateway Protocols with aim of reducing the convergence time to {-2s} at the Backbone Networks. The promises of hybrid SDNi within domains gradually explore the technical benefits and transition roadmaps and migration path to SDNs for ISPs and network operators respectively.

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