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An SDN-based approach for QoS and Reliability in Overlay Networks

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Abstract—We propose an Overlay network architecture for reliable and QoS-aware interconnection between its nodes, without handling Internet routers and without tunneling overhead. The architecture is based on the SDN paradigm. We demonstrate the feasibility and challenges of such a system using mininet and pox controller.

I. INTRODUCTION

Overlay networks have emerged several years ago for different purposes, namely content delivery, privacy, peer-to-peer, on-line gaming, data centers interconnection, among others. Indeed, it is well known that quality-of-service (QoS) is not taken into account by the current Internet *de facto* routing protocol, BGP, and that following non-BGP routes can provide better QoS and overcome connectivity failures due to BGP outages. Overlay networks can thus bypass these issues, without the need of controlling intermediate nodes nor changing an ossified protocol stack. On the other hand, previous work either doesn't provide overlay scalable solutions for QoS-aware overlay networks (see e.g. [1]) or rely on decentralized solutions adding overhead (such as relaying on encapsulation techniques).

To fill this gap, and thanks to the new opportunities the SDN paradigm offers, we have proposed, in [2], an SDN-based architecture to allow QoS-aware and reliable routing in overlay networks. This solution leverages three key features of SDN: 1) a virtually centralized view of the architecture, in order to efficiently perform smart monitoring and routing decisions, 2) a fine-grained, flow-based forwarding capability, 3) a decoupled data and control plane interfaced through a standardized protocol (OpenFlow).

In this paper, we focus on the control of the overlay for achieving a scalable end-to-end QoS aware routing. For this sake, we propose to use the functionalities provided by SDN and in particular the southbound interface OpenFlow to modify, at each controlled switch, packet headers as convenient, for having packets to follow the adequate path, in a per flow basis. This paper demonstrates the feasibility of such an approach under a flexible testbed based on mininet¹, OVS switches², and the pox controller³.

¹An Instant Virtual Network on your Laptop www.mininet.org

²Open Virtual Switch, www.openvswitch.org

³<https://github.com/noxrepo/pox>

II. SYSTEM ARCHITECTURE

Fig. 1 depicts our proposed architecture, which is composed of three main blocks: a traffic engineering one, a monitoring one, and the controller itself. This virtually centralized infrastructure controls an overlay network which is composed of different sites (Overlay Nodes, ON). ONs are OpenFlow-capable switches and are interconnected among them through the Internet, constituting the overlay network. We briefly describe the main key functionalities of the system, while reader is referred to our previous work [2] for more details.

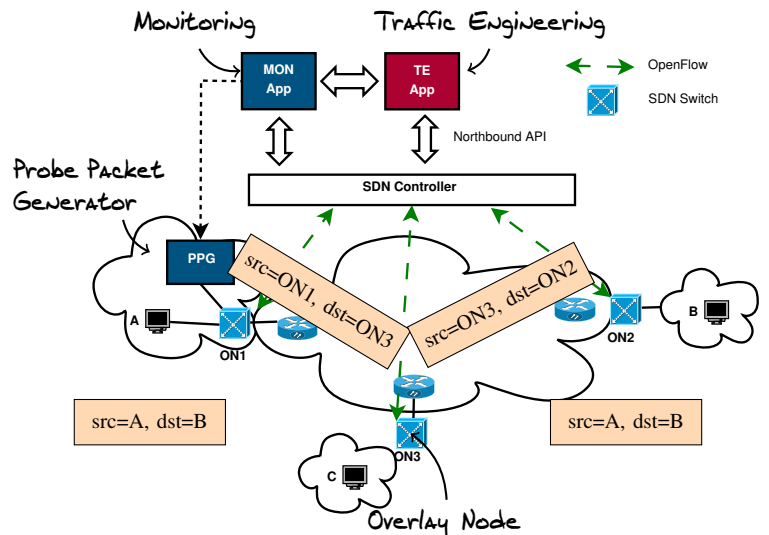


Fig. 1: System description

A. Monitoring and Traffic Engineering

TEApp computes the best paths according to some QoS metrics (e.g delay). MonApp assists TEApp by providing feedback information about network state. Solutions existing in the literature for performance monitoring in SDN, in particular for delay measurement, present a trade-off between accuracy and overloading the network with traffic between controller and switches (see e.g. [3]). They are not convenient to our scenario, where the controller can be far from switches. Our proposed solution is based on equipping each overlay site with a probe packet generator (PPG, for convenience we only show one in Fig. 1) which is commanded by the MonApp. Active monitoring is thus possible thanks to locally-generated probing packets, following instructions from a centralized intelligence.

