

A scalable Software Defined Network (SDN) framework for global IP Traffic Engineering

Mots clés :

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Résumé du projet de recherche (Langue 1)

In the current Internet architecture data-plane (raw packet forwarding) and control plane (policy based decision on where and what to forward) are bundled monolithically in current networking devices (routers, switches, firewalls, etc.). This limits the development of new functionalities in the network. At the same time the global BGP (Border Gateway Protocol) routing infrastructure lacks support for efficient traffic engineering and multi-homing. In particular, current network routing protocols are « node centric » and not « system centric » and do not allow for optimization of explicit objectives (in particular Traffic Engineering objectives) [5]. Furthermore, current equipments (boxes and protocols) have to be configured individually - usually manually - preventing the network to keep pace with the dynamic changes required by today's multi-homed networks, mobile applications, and cloud services. Thanks to the recent increase in computing power, storage space, and development of big-data analytics, a new paradigm based on the physical separation of the different networking software elements (Data Plane vs Control Plane vs Management Plane vs Service Plane) is emerging: Software Defined Networks (SDN) [1]. This architecture offers many opportunities to solve or at least leverage the over-mentioned issues. At the same time, SDN poses many challenging problems that need to be addressed: one of the most stringent being scalability with a centralized management plane [6]. In this context, we plan to investigate SDN focusing on inter-domain traffic engineering: the opportunities of this architecture but also current limitations and implementation issues (scalability, convergence, support of flexible policies, etc.). The work to be carried out can be split in three distinct but overlapping phases. In a first phase traffic engineering for multi-homed networks will be studied, analyzed, modeled, in order to derive clear requirements and guidelines. In a second phase, taking advantage of the SDN paradigm, the different network elements necessary to implement the requirements identified in the first phase will be defined, as long as their physical distributed interactions. In the third phase, a simple proof-of-concept prototype will be implemented, on the one hand to validate the outcomes of the first phase, while on the other hand assessing the design carried out during the second phase, in particular concerning effectiveness of the proposed mechanism, their efficiency, and their scalability properties. ----- [1] G. Gibb, H. Zeng, N. McKeown, Outsourcing Network Functionality. In proceedings of ACM SIGCOMM Workshop on Hot Topics In Software Defined Networks (HotSDN'12), Helsinki (Finland), August 2012. [2] Border 6 -- Enhanced BGP and Traffic Engineering in Multi-Homed Environments. Online at: <http://www.border6.com/> [3] Case Study: The Google SDN WAN. Online at: <http://www.computing.co.uk/ctg/analysis/2235886/case-study-the-google-sdn-wan> [4] Software Defined Network Research Group. Internet Research Task Force (IRTF). Online at: <http://irtf.org/sdnrg> [5] E.Crabbe, V.Valancius. "SDN at Google: Opportunities for WAN optimization". IETF 84 sdnrg meeting. [6] D. Levin, A. Wundsam, B. Heller, Nikhil Handigol, Anja Feldmann. Logically Centralized? State Distribution Trade-offs in Software Defined Networks . in HotSDN 2012, Helsinki, Finland, 2012. [7] Yi Wang, Ioannis Avramopoulos, and Jennifer Rexford, "Design for configurability: Rethinking interdomain routing policies from the ground up," in IEEE Journal on Selected Areas in Communications, April 2009.

Résumé du projet de recherche (Langue 2)

Multi-homing has become a current practice for stub networks, however Traffic Engineering (TE) in this context still remains an open key challenge in the Internet. Complex TE objectives of carriers cannot be implemented easily with current BGP protocols [7]. Even so, the current research in the context of Software Defined Networks is more focusing on remote configuration API and wide area networks centralized management, rather than on traffic control, with the exception of flow load balancing in high bandwidth backbone networks [3]. Hence the outcome of the work could potentially shape the future of SDN-based traffic engineering, in particular in multi-homed environments.

Informations complémentaires (Langue 1)

SDN is becoming a very "hot topic" in networking for both academy and industry [4]. There are strong collaboration opportunities with European and US partners.

Informations complémentaires (Langue 2)

The work will be carried out in collaboration with Border 6 [2], leveraging on their expertise in the field of traffic engineering, in particular for multi-homed networks, as well as their management and measurement infrastructure --- on which the final prototype could be tested (in particular with real traffic measurements).