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What's the Impact of Virtualization to ALTO?
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Abstract

This draft presents a use case of Application Layer Traffic Optimization (ALTO) with the emergence of Network Function Virtualization (NFV). The Application-Layer Traffic Optimization (ALTO) Service provides network information (e.g., basic network location structure and preferences of network paths) with the goal of modifying network resource consumption patterns while maintaining or improving application performance. The emerging Network Functions Virtualisation (NFV), as currently being in progress in ETSI NFV, leverages standard IT virtualisation technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage.

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1. Introduction

This draft present a use case of Application Layer Traffic Optimization (ALTO) with the emergence of Network Function Virtualization (NFV). The Application-Layer Traffic Optimization (ALTO) Service provides network information (e.g., basic network location structure and preferences of network paths) with the goal of modifying network resource consumption patterns while maintaining or improving application performance. Typical deployment scenarios of ALTO include P2P and CDN, in which P2P tracker or CDN request router queries ALTO server for network map and cost map, in order to make decisions on which peer to select for content sharing.

The emerging Network Functions Virtualisation (NFV), as currently being in progress in ETSI NFV, leverages standard IT virtualisation technology to consolidate many network equipment types onto industry standard high volume servers, switches and storage. The NFV architecture in ETSI ongoing work includes an NFV Management and Orchestrator (M&O), the VNF(Virtualized Network Function) and the VNFI(Virtualized Network Function Infrastructure), as is shown in Figure 1. The NFV M&O is responsible for creating and managing the VNFs on the VNFI. Interactions between NFV M&O, VNF and VNFI are beyond scope of this draft.

With the trend of various network functions being virtualized, there will be impacts on cost and network characteristics of the service endpoints. Under the ALTO architecture, we analyze the problems and the necessity of extending the ALTO protocols to faithfully reveal

the network to the clients. The central problem this draft would like to investigate is: what's the impact of virtualization to ALTO.

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                     |  NFV M&O  |
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                |                      |
                |                      |
           +----+----+           +-----+-----+
           |   VNF   |-----------|    VNFI   |
           +---------+           +-----------+
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Figure 1: NFV Architecture in Brief

This draft analyzes the impacts of virtualized endpoints to application layer traffic optimization and presents a usecase of ALTO in CDN and P2P network with the peers as a VNF(Virtualized Network Function). .

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

We use the following terms defined in [RFC5693]. Application, Peer, ALTO service, ALTO server, ALTO client, ALTO query, ALTO Reply.

And the following terms used in this document have their definitions from the NFV end to end architecture [NFVE2E].

NFV: network function virtualization. NFV technology uses the commodity servers to replace the dedicated hardware boxes for the network functions, for example, home gateway, enterprise access router, carrier grade NAT and etc. So as to improve the re-usability, allow more vendors into the market, and reduce time to market. NFV architecture includes a NFV controller (orchestrator) to manage the virtual network functions and the infrastructure resources.

NF: A functional building block within an operator's network infrastructure, which has well-defined external interfaces and a well-defined functional behavior. Note that the totality of all network functions constitutes the entire network and services infrastructure of an operator/service provider. In practical terms,

a Network Function is today often a network node or physical appliance.

VNF: virtual network function, an implementation of an executable software program that constitutes the whole or a part of an NF that can be deployed on a virtualization infrastructure.

VM: virtual machines, a program and configuration of part of a host computer server. Note that the Virtual Machine inherits the properties of its host computer server e.g. location, network interfaces.

SLA: Service Layer Agreement.

3. Impact of Virtualized Endpoints

This section analyzes the impact of virtualization when application or service endpoints are deployed on virtualized infrastructure.

It is generally believed that generic computing equipment is difficult to accomplish the same capability of specilized and dedicated equipment. Operator network normally consists of many dedicated equipment, and the services running on them are not vitualized. NFV initiatives investigate the use cases, architecture and requirements of moving network functions to the virtualized infrastructure.

We analyze the impacts of virtualized endpoints to application layer traffic optimization for the following aspects.

1. Performance. The NFV framework is claimed to be able to instantiate and configure any given VNF over the underlying infrastructure so that the resulting VNF instance performance is conforming to the expressed requirement. Using appropriate VNF configuration schemes [I-D.song-opsawg-virtual-network-function-config], the operator or service provider can express their performance requirement. From this point, it the same as physical and non-virtualized service endpoints. The difference is that the service assurance of virtualized endpoints is more difficult to ensure.

2. Portability. Different from physical equipment, NFV framework is able to provide the capability to load, execute and move VNFs across different but standard mutlivendor environments, and have to support an interface to decouple VNF associated software instances from the underlying infrastructure. Portability has impacts on the mobility and network location of the service points, which in the turn will impact the service point selection process and service continuity.

3. Elasticity. The NFV framework is able to allow VNFs to be scaled with SLA requirements, on-demand scaling or automatically scaling. With the elasticity capability, VNF endpoints capability with respect to computing and networking are dynamic. The ALTO discovery and selection process will be impact to reflect such dynamic information.

4. Resilience. NFV framework provides the necessary mechanisms to allow VNF to be recreated after a failure. In addition to OAM in traditional non-virtualized environment, the NFV M&O will manage the metrics such as packet loss rate, latency, delay variation of flows, maximum time to detect and recover from faults. All of these information will be valuable to ALTO client.

5. Energy efficient. Studies have indicated that NFV could potentially deliver up to 50% energy saving compared with traditional appliance based network infrastructure. In service point selection, this could be a criteria when the service provider is interested in saving power.

6. Service assurance. Dedicated carrier-grade devices normally have requirements like 99.999%, but the such high availability is still challenging for VNFs. The ALTO server should be aware of the assurance level of these virtualized endpoints.

7. Network infrastructure maintenance. The VNFs may be bridged and linked using the virtualized switches on the computing node. The network layer performance and availability metrics are only possible to collect when the OAM have established the tunnels to the these virtual network infrastructure. For example, normal PING can only reflect the physical computing node availability, but cannot reflect the VMs bridged using virual switchs and hidden with tunnel encapsulations.

4. ALTO usecase with NFV

The emergance of NFV means that some legacy devices which used to work on a physical server, now can be moved to a VM and work as a VNF. Under such circumstance, the NFV M&O can act as a Dynamic Network Info provider for ALTO.

The following paragraph will present a usecase of ALTO in CDN with NFV. In the CDN network, the user agent first makes initial request to the Request Router. The Request Router will first query the ALTO server for network and cost map to select an appropriate surrogate. The Request Router then responds to the UA with a redirection to the selected surrogate. The UA then connects directly to the suggested surrogate to obtain the content.

When a certain surrogate changes to a VNF and is managed by a NFV M&O, The NFV M&O can dynamically update the network and cost info of the surrogate to the ALTO server. In the meantime, the NFV M&O should also keep ALTO server informed about the virtualized nature of the VNF surrogate, since its performance might be lower than physical devices. In the migration stage of NFV, in which VNF and physical devices coexist in the network, ALTO server may consider the virtualized nature of VNF as a rating criteria that should inform the clients. Clients may choose physical devices instead of VNF surrogates due to consideration of performance.

In the P2P scenario, similar situations can also happen when peers become VNFs. In this case, NFV M&O should also inform ALTO server about the virtualize nature of the VNF peers. And P2P trackers can take such nature into consideration when selecting peers to obtain content.

5. Interaction Architecture of ALTO and NFV

A vertical architecture is proposed in this draft for ALTO and NFV interaction, in which NFV M&O is in responsible of info update to the ALTO server, as is shown in Figure 2.

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                        | ALTO server |
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                        |  NFV M&O  |
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                 |                      |
            +----+----+           +-----+-----+
            |   VNF   |-----------|    VNFI   |
            +---------+           +-----------+
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Figure 2 ALTO and NFV interaction architecture

In this architecture, NFV M&O can automatically update fine or coarse grained VNF info to the ALTO server timely. The virtualized nature of the VNFs should be informed to the ALTO server by NFV M&O as a rating criteria. In the meantime, details of VNF can be updated to the ALTO server by NFV M&O according to privacy privilege configured by the user.

6. Informative References

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