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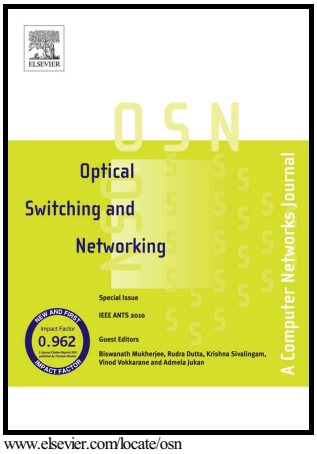

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A New Method for Providing Network Services: Service Function Chain

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***Abstract*—Service deployment and management have been a challenge for the network operators because of the characteristics of traditional methods for service configuration and service deployment: unchangeable configuration and ossified deployment. Based on the ideas of Service Function Chain (SFC), Network Functions Virtualization (NFV), Software Defined Network (SDN), and Path Computation Element (PCE), we introduce a method that can not only maintain the services in a flexible and scalable way, but also place services in a topology-independent way and steer traffic among different services. We abstract the service path selection problem as a grey system theory problem and propose an algorithm to give a proper service composition selection and traffic steering method. We also validate the usability of our paradigm in prototype and efficiency of the proposed algorithm in simulation environment.**

Keywords—service deployment; virtulization; path selection; traffic streering

I. INTRODUCTION

At present, there are many network service functions, such as firewalls, load-balancing, transactional proxies (for example spam filters), content filter, HTTP header enrichment, deep packet inspection (DPI), intrusion detection systems (IDS)/Intrusion Prevention System (IPS), network address translation (NAT)/Port Address Translation (PAT), accounting, and content caches. These services are deployed in enterprise networks, broadband access networks, and more recently in data centers. However, there are some problems due to the traditional service deployment approach. The main two are as follows.

The services are typically configured as long as they are placed. And once configured, it is very hard to reconfigure them. Managing the operations of these services, such as adding/deleting services or increasing capacity of a service, often requires reconfiguration of multiple routers, switches and application servers — a process that is inflexible, complex, unscalable and prone to inconsistent configurations—often delaying deployment of services.

Typically, the services are deployed in static or semi static environments and one service chain per service, with no reuse of existing components， which is very ossified and inefficient. The deployment of traditional middle-boxes (such as firewalls/DPI), which relays on the path of packets, is closely associated with the network topology. Even worse, common deployment models have service functions inserted on the data-forwarding path between communicating peers. The ossified way of service deployment makes it impossible to reuse and change the service components.

So it is urgent to design a service function chain that not only maintains the services in a flexible and scalable way, but also places the services in a topology-independent way and can steer traffic among different services. A Service Function Chain [1] is a system or method to steer traffic through a set of services. The design requirement of SFC is also the technical problems to be solved. For example, the traffic should passes along a service path or chain, which is assigned to a received packet based on a path-selection algorithm and classification of the packet. Next time if a new user wants a set of services which is different from the former one, he just needs to reuse some components and adds some new ones, and the system will combine them into a chain for the user. By this way, different users can have different combinations of services simultaneously without changing the topology.

Software Defined Network is a novel framework that enables network programmability and decouples control plane and forwarding plane [2]. Path Computation Element is a flexible instrument to overcome visibility and distributed provisioning inefficiencies [3]. Network Functions Virtualization aims to leverage standard IT virtualization technology to consolidate many network equipment types onto a universal x86 hardware platform [4]. In the proposed method, services run on the Virtual Machines (VMs). And this makes it easier to configure the services, such as add/delete/open/close services in a flexible way—we just need to manipulate the virtual machines, which is very simple.

From this point of view, to some extent, service deployment is equal to virtual machine deployment. There are a large number of articles in virtual machine embedding [5], which have many achievements. In [6], the authors study how to reduce energy consumption in virtual network embedding, and propose algorithms to place virtual machines in an energy-saving way. The work in [7] takes into account traffic engineering considerations to make a better decision for placement and selection of network services. The work presented in [8] proposes using traffic-aware virtual machine placement to improve the network scalability. Xia et al. [9] proposes a paradigm to perform traffic steering in the optical domain, among network functions, using the technology