Chapter 12
Recent Advances in Traffic Forwarding Techniques

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ABSTRACT

Advanced service oriented routing and forwarding schemes are nurturing fast recently, thus paving the way to implementations that can overcome complications related to multi-vendor networking environments. Some of these proposals are improving and optimizing the existing traffic engineering functionalities where the forwarding planes are still under a distributed signaling control system, others are more network architecture level changes where the forwarding plane is totally centralized controlled through a centralized control plane. At the same time some of these proposals are the hybrid of the both. This chapter describes these advances by focusing on the aspects of forwarding scheme changes introduced in each of these areas.

INTRODUCTION

To build the service-oriented and application-aware Traffic Engineering (TE) paths, there are a lot of new challenges and requirements that need to be considered. The list of these requirements is still extending as new services are to be deployed. A non-exhaustive list of requirements is provided below: The new traffic forwarding solutions should have a structure that can cope with emerging "agile" requirements.

1. The new traffic forwarding solutions should have a structure that scale better instead of providing only a portion of the functionalities needed by the users/operators.
2. The new traffic forwarding solutions should have a structure that has better performance.
3. The new traffic forwarding solutions should require changes on the existing hardware as less as possible.
4. The new traffic forwarding solutions should enhance the security of the network instead of weakening the security of the network.

5. The new traffic forwarding solutions should have a structure which provides a practical and smooth transition strategy from the existing network architecture to the new architecture.

By improving and optimizing the existing distributed networking solutions, some of these new requirements can be met, but some of the new requirements need a centralized controlled system to implement a complete solution. For example, Entropy Label (EL) is a technique where the existing network architecture principle is kept intact and the new load balancing functionality is provided through adding a new layer of labels to be used in the traffic forwarding path. The Software-Designed Networking (SDN) is a typical example for the cases where a centralized controller is needed to dynamically build the service-oriented traffic engineering paths with a claim of ensuring simplicity and scalability. In some cases, a hybrid scheme (i.e., distributed system and centralized controlled system) can also satisfy certain new requirements nicely. For example, a source routing based traffic engineering path is a hybrid approach, where the basic routing and forwarding information can be propagated through distributed IGPs (Interior Gateway Protocols), and the path can be calculated through a centralized controller.

This chapter first describes new advances in forwarding schemes which are focused on improving and optimizing existing traffic forwarding functionalities, and then presents reasons why service-oriented routing and forwarding features are needed. The chapter also describes the new requirements for the traffic forwarding, once the forwarding paths (e.g., tunnels) are built to be service-driven instead of reachability oriented. The chapter also describes how the new forwarding schemes satisfy these new requirements. Also, this chapter discusses the challenges that arise when the new forwarding schemes are deployed during the transition from a reachability-based routing network to a context-based routing network.

The recent advances in traffic forwarding areas which are covered in the later sections of this chapter are:

a) MPLS (Multi-Protocol Label Switching) Multiple Topology (MPLS-MT)
b) Entropy Label (EL)
c) Network Virtualization Overlay (NVO3)
d) Segment Routing (SR)
e) Using PCE as the Central Controller of Traffic Engineering Tunnels (PCECC)
f) Service Function Chaining (SFC)
g) Open Flow
h) Protocol Oblivious Forwarding/Protocol Independent Forwarding (POF/PIF)

The immediate goal of the above techniques is to satisfy the new requirements that result from service-driven traffic engineering paths. At the same time, these solutions ambitions to make the control plane as simple as possible while minimizing the changes in the forwarding plan as much as possible.

To achieve the final goal of improving the performance of the network and reducing the complexity of the network from the point view of forwarding, these new forwarding techniques evolve the forwarding architectures to make them scale, to provide higher granularity/flexibility of steering, to provide easier manageability/operation, and to provide better security.

Each of the advanced forwarding technologies introduced in this chapter enriches the current set of networking solution tools from different angles so that the aforementioned final goal can be achieved with a smooth transition from today's network to tomorrow's network and a flexibility of deployment for the existing and new users.

For example, MPLS-MT can address the security issue by providing service separation through end-to-end disjoined topologies corresponding to each service with strict security requirements. Still, how to actually enforce polices to realize this separation is a very sensitive and may have

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