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OpenADN: Middleware architecture for cloud based services

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Abstract

Any global enterprise, such as, Qatar National Bank, with branches in many countries is an example of an Application Service Provider (ASP) that uses multiple cloud data centers to serve their customers. Depending upon the time of the day, the number of users at different location changes and the ASPs need to rescale their operation at each data center to meet the demand at that location.

ASPs are facing a great challenge to leverage the benefits provided by such multi-cloud distributed environments without service-centric Internet service Provider (ISP) infrastructure. In addition, each ASP's requirements are different and since these ASPs are large customers of ISPs, they want the network traffic handling to be tailored to their requirements. While the ASP wants to control the forwarding of its traffic on the ISP's network; the ISP does not want to relinquish control of its resources to the ASPs.

In this work we present an innovative architecture, which facilitates ASPs to automate the deployment and operation of their applications over multiple clouds. We have developed Middleware Architecture for Cloud based applications using Software Defined Networking (SDN) concepts. Especially we discuss how the implementation of interface between ASP and ISP control planes as well as implementation of generic packet header abstraction is achieved. Using our system, ASPs may specify the policies in the control plane and the control plane is responsible for enforcing these policies in the data plane. In OpenADN architecture, each application consists of multiple workflows, which are dynamically created and the required virtual servers and middleboxes are automatically created at the appropriate clouds.

OpenADN allows both new applications that are designed specifically for it as well as legacy applications. It implements "Proxy-Switch Port" (pPort) to provide an interface between OpenADN-aware and OpenADN-unaware services. Depending on the available resources in the host, the controller launches a pPort with a pre-configured number of workflows that it can support. The pPort automatically starts a proxy server. The proxy service acts as the interface between OpenADN-aware services and OpenADN-unaware applications. We support both packet level middleboxes (such as intrusion detection systems) and message level middleboxes (such as firewalls). A cross-layer design is proposed in the current architecture that allows application-layer flow of information to be placed in the form of labels at layer 3.5 (packet level) and at layer 4.5 (message level). Layer 3.5 is called as "Application Label Switching" (APLS) layer. APLS is used by the path policy (routing/switching) component while layer 4.5 information is used to initiate and terminate application sessions.

In addition to traditional applications, OpenADN can also be used for other multi-cloud applications such as Internet of Things, Virtual Worlds, Online Games, and Smart Wide Area Network services.