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.

The number of middleboxes (e.g., Firewalls, Intrusion detection systems, load balancers, etc) deployed in modern enterprise application environments is comparable to the number of routers. Market reports suggest that the market size of application delivery controllers or network appliances is 2.25 billion dollars for optimization and acceleration middle boxes and 6-10 billion dollars for security.

Figure 1: Distributed Multi-Cloud Environment

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appliances. Middleware infrastructure is an essential component of modern Internet-based application environments and it is important to re-think application delivery in the context of cloud computing.

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 OpenADN - a middleware architecture for cloud based applications - using six innovations: software defined networking (SDN), cross-layer communications, OpenFlow, rule-based delegation, late binding with session, message, and packet level affinity, and secure multi-tenancy. Software defined networking is a new concept in computer networking. It allows centralized control and programmability of a large number of networking devices. Although, the concept was developed for use inside a data center, we have extended it for use between many globally distributed cloud-based data centers.

As shown in Figure 2, we have implemented an interface between ASP and ISP control planes as well as a generic packet header abstraction. 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.

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.

This research project will contribute to Qatar National Vision 2030 that encourages of ICT initiatives. Through this vision, Qatar needs to be at the forefront of the latest revolutions in computing, networking, Internet, and Mobility. The latest in computing is cloud computing. The latest in networking is software defined networking. Mobile applications form the majority applications on the Internet. This research proposal addresses the latest research issues in each of the areas mentioned above. This project is timely since there is limited research, in Qatar on supporting application delivery (in general) in the context of cloud-based application deployment environments.