Software-defined Networks

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Software-defined networking (SDN) aims to provide a well-defined programming and automation interface to network devices. In moving network control and management from fixed function hardware to software running on standard server platforms, SDNs depart from the traditional, vertically integrated model of network hardware and software. SDNs provide a new opportunity to support more seamless integration of networks with applications and IT processes, and for providing higher-value network services in a variety of environments. In this talk, we will describe software-defined networking technology, its rapid progression in the networking industry, and use several use cases to illustrate the role and value of SDN in shaping the future of networking.

As part of extracting device functions into software, a key feature of SDN is a set of programming interfaces that allow applications and control programs to automate network operations through well-defined, open APIs. This enables much more agile interaction with the network than traditional methods, such as scripted CLIs and proprietary interfaces. Through its open interface model, SDN challenges the traditional network device model in which all complex network functions are essentially fixed, and the only way to customize them for new requirements is to await a new software or firmware release from the device vendor.

The initial focus of SDN has been on separating control plane functions that determine how packets should be handled in the network, from the data plane which provides high-speed data forwarding on each device. Rather than run multiple, distributed instances of the control plane on each switch, for example, SDN moves control plane algorithms to a logically centralized controller that runs a single control plane instance with a global view of the network topology and state. As SDN develops further, it is expected to move beyond the control plane to similarly include software-based interfaces to the management plane as well.

Much of the initial attention on SDN has centered on the OpenFlow protocol, a standard for software-based control of forwarding and packet handling in network switches. OpenFlow allows a central controller to program flow tables on network switches to control how traffic flows are directed or modified. The OpenFlow protocol specification is being standardized in the Open Networking Foundation, which was formed in 2011 by large network operators and a wide variety of networking technology vendors. Through these standardization efforts, and the growing interest in SDN, OpenFlow has become a standard feature from many Ethernet switch vendors. Similarly, OpenFlow controllers, where the control plane software applications reside, are also growing in number, with several open source and commercial offerings now available.

SDN and OpenFlow use cases have been developed in a variety of network environments, including wired and wireless carrier networks, data center networks, and enterprise or campus networks. Some common examples are SDN-based interfaces to automate network service provisioning across the WAN, dynamic fine-grained access control in wireless networks, and virtual networking in multi-tenant cloud data centers.