Software-Defined Networking
for Wi-Fi
White Paper
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Introduction

The explosion in the number and diversity of wireless devices in today’s enterprise networks has increased the pressure on performance and management issues. It could be said that the primary method of network access has now shifted from wired to wireless. To address the challenges networks are looking to software-defined networking (SDN) approach to keep pace with required performance demands.

This paper examines how Wi-Fi networks are moving to SDN-type structures to solve various challenges, and how Accton’s Personal Virtual Access Point (PVAP) concept has advantages over SDN and can transform the performance and management of secured enterprise wireless networks.

SDN in the Data Center

The demand placed on data center networks has developed rapidly over recent years. To deliver the flexibility and scalability to cope with today’s dynamic traffic flows, data centers have turned to emerging software-defined networking (SDN) architectures. In an SDN environment, the network control is essentially separated from the forwarding hardware and centralized in SDN controllers. This removes the network control from individual devices and enables a network to appear as one logical entity. Communications between the control plane and data forwarding plane is typically structured on the OpenFlow protocol, which enables devices in the network to be dynamically configured on a per-traffic-flow basis. The result is that SDN architectures replace current static network infrastructure with an agile, scalable, and manageable system that can incorporate various vendor-independent physical and virtual devices.
Wi-Fi Networks with Controllers

In a similar trend as data center networks, enterprise Wi-Fi networks have evolved towards an architecture that mirrors SDN. Wi-Fi networks have moved away from stand-alone access points to controller-based architectures with separate control and data planes. A large number of physical and virtual access points (VAPs) are typically managed from the central controller, providing a more efficient and manageable network. By implementing Accton’s concept of personal virtual access points (PVAPs) on the controller, a Wi-Fi network can be transformed into an SDN-like structure without changing any hardware or adding OpenFlow devices.

Personal VAPs

Most enterprise APs can support a large number of virtual access points (VAPs) per radio, and each VAP can support a similar number of wireless clients. A personal VAP (PVAP) provides a connection for a single client only. In current enterprise wireless networks, where APs are managed from a wireless controller, Accton’s implementation of PVAPs can provide some of the following benefits:

- Enhanced security
- Higher modulation rates for multicast/broadcast packets
- Improved power saving
- Enhanced QoS performance
- Data tunnel flexibility
- Seamless roaming with high-speed handovers
- Improved network load balancing
VAP Roaming

The concept of PVAPs in a controller-based network offers an elegant solution to 802.11 roaming problems. With PVAPs for each client existing as software constructs in the controller, the whole PVAP can roam between APs as the client moves through the network area. Similar to an SDN architecture, PVAPs basically separate the network software element (VAP) from the hardware element (AP), which enables the controller to move a complete PVAP (BSS context, including the BSSID, sequence number, unicast/broadcast keys etc.) from one AP to another. This “PVAP roaming” means that clients no longer need to roam in the traditional sense, and thus seamless connectivity is delivered with AP handovers reduced to less than 150 ms.

PVAP roaming is the responsibility of the controller and independent of clients. The controller essentially knows the signal strength being received by all clients in the network, which enables it to decide when and where PVAPs need to roam.
**Location Tracking and Services**

With the location of a client PVAP being known by the controller, it essentially means that the controller can be used to track clients as they roam through the network. The location tracking offers the possibility of additional services in the network. Clients can be automatically notified if they roam into restricted areas, or passed information relevant to specific locations. In fact, there are many applications for location tracking across manufacturing, healthcare, and other businesses. These services can implemented through software on the controller using PVAPs, without the need for additional network hardware.

**Radio Resource Management**

The implementation of Accton’s PVAP concept to provide SDN-type control to Wi-Fi networks extends into the important area of radio resource management. Although wireless controllers include radio resource management functions in their software, it typically only operates within strict vendor-dependent limits. Alternatively, open SDN networks may have an API facility that integrates third-party software for radio resource management functions. However, Accton’s PVAPs have the potential to provide complete transmit power and modulation control for each client individually, without the normal controller limitations. In addition, the PVAPs can be quickly moved from one AP to another for channel management or load-balancing reasons.
BYOD Management

A major concern of current enterprise Wi-Fi networks is the management of “bring your own device” (BYOD) policies. Most corporations want to encourage BYOD, where employees use their own wireless smartphones, tablets, or other devices in the workplace, but are concerned about security, capacity, and performance issues. In an SDN-structured environment, the SDN virtual switch would apply access control lists (ACLs) and quality of service (QoS) for BYOD users to control network access and security. For controller-based networks using PVAPs, the BYOD management is handled much more easily within the PVAPs. That is, the controller applies ACLs and QoS for each individual BYOD client within its own PVAP. For more enhanced management of BYOD devices, the wireless controller can set up a data tunnel for each PVAP.

Conclusion

The implementation of SDN architectures in today’s data centers is a clear indication of the future of networking. The secure enterprise wireless LAN has also evolved in a similar direction with the use of wireless controllers now common. Although it is possible to extend SDN architectures to cover the wireless LAN, Accton’s concept of PVAPs on a central wireless controller already incorporates many SDN features with some additional advantages. Improved network performance, enhanced security, and seamless roaming are just some of the benefits that PVAPs bring. When you add location tracking, better radio resource management, and tighter control of BYOD users, it is clear that Accton’s PVAPs can offer SDN-like advantages through current wireless controllers and APs.