

## Choose A Right L3 Switch For Your Network

### Executive Summary

In today's network, it is common that new applications go beyond one IP per user arising from BYOD requirement in WLAN in daily life, or especially IPv4/IPv6 parallel in education vertical. This phenomenon causes symptoms such as slow network performance, and high switch CPU utilization when system runs out of hardware L3 forwarding table. According to this, L3 forwarding table is the key for network design consideration.

### About L3 Switching

A switch switches Ethernet frames between Ethernet devices and keeps a bridge forwarding table that shows what MAC addresses have been seen on what port. Besides traditional routing table, a L3 switch keeps a L3 forwarding table which is composed by IP address, MAC address and switch port. It will learn all the active LAN IP/MAC. Packet flow for hardware wired-speed L3 forwarding is achieved by lookup the L3 forwarding table.

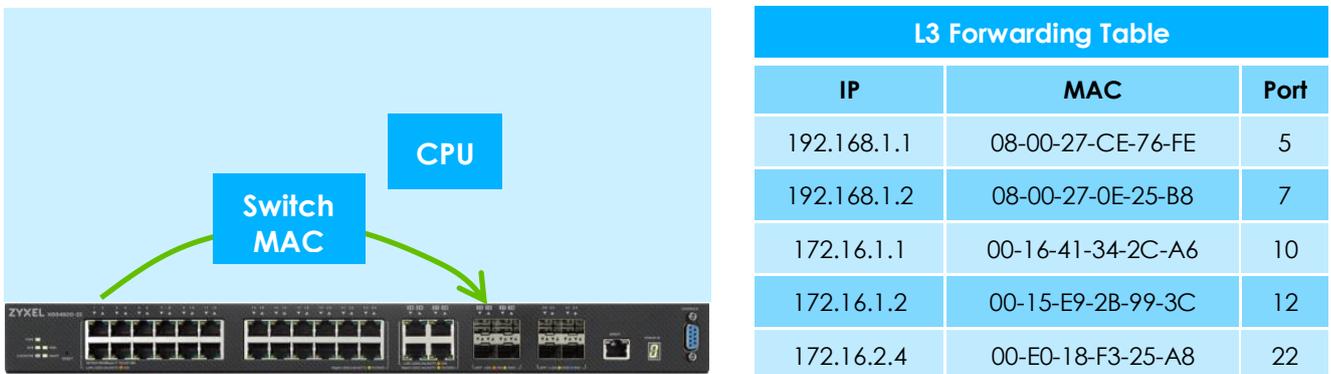


Figure 1: Packet flow for Hardware wired-speed L3 Forwarding

Therefore, L3 forwarding table runs out of room much easier than before because the boosting number of devices required connecting to the network. The network in access layer was one switch port connected to one device which carries one entry before; now one switch port connected to one AP which onboarding multiple mobile devices with more than one entries.

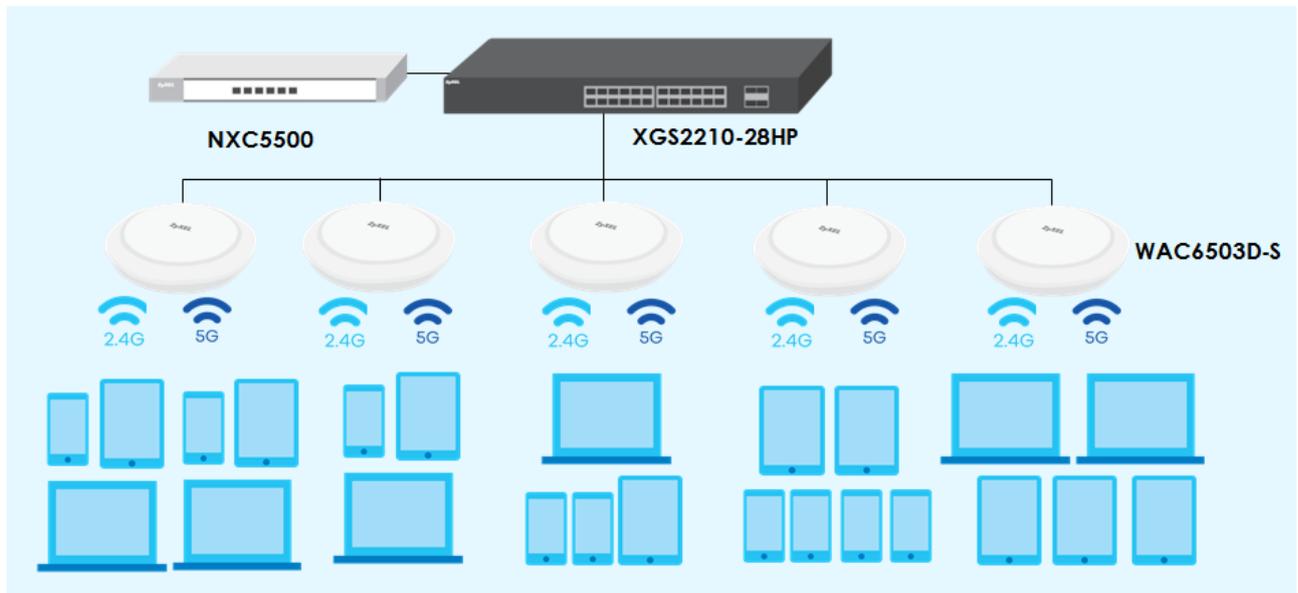


Figure 2: IP Forwarding entries to be learned on Switch Device

Also, IPv4 32-bit address occupies one entry whereas IPv6 64-bit address occupies two entries. Once the L3 forwarding table size fails to cover network clients, the loading will turn to be forwarded by the CPU which will slow the network performance.

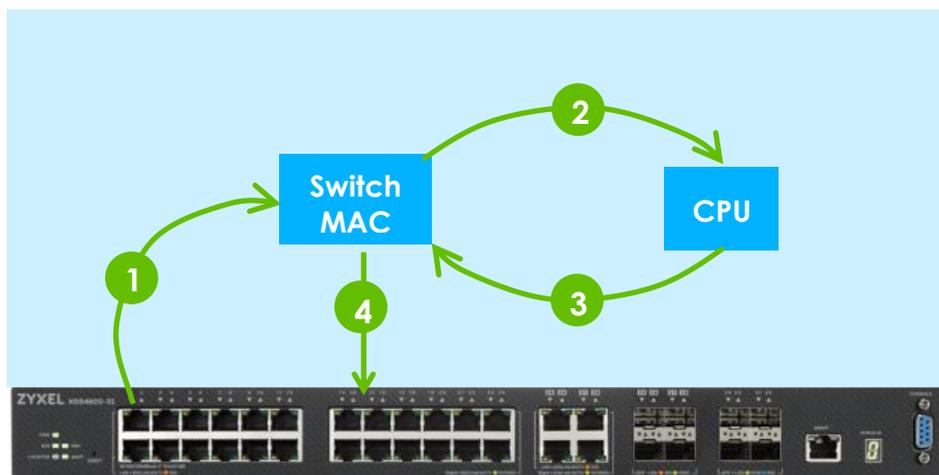


Figure 3: Packet Flow for CPU Forwarding

## How To Plan A L3 Switch

When a device first connected to the network, its IP address will be learned by the L3 switch and stored into L3 forwarding table. The mechanism for a switch to store a new IP into its layer 3 forwarding table is by using a hash algorithm to compute a key for table index based on several attributes associated with this IP information. However, different IP may have same Hash key which results collisions to the same storage location. When there're more entries stored in the forwarding table, the higher collision rate are caused. So it is necessary to save room for your L3 forwarding table. For example,

If 500 IPv4 clients then 1k table is ok;

If 800 IPv4 clients then 1k table can be risky;

If 500 IPv4 +200 IPv6 clients then 1k table is definitely problematic

## L2+, Light L3 Make It Worse

As the flexibility is the essential to plan network infrastructure nowadays, the L2 switch becomes more L2+ by adding "static routing" capability. According to this, L3 forwarding table becomes a killing but invisible factor. Moreover, when L2 Smart switch becomes a L2+ with static routing, it always comes with limited L3 forwarding table size for cost consideration.

Many customers can pick a L2+ Smart switch or LL3 (Light L3) one to enable their routing for what they think is simple network. As explained above, BYOD & IPv6 can surprise the network administrator by using up the L3 forwarding table without notice.

## A Real Case Of An Improper Network Design

On March 2016, Zyxel sponsored a three-day OpenStack hackathon event in Taiwan. In this event, Zyxel supported the WLAN AP, security gateway and L2 PoE switches. Unlike other hackathons held in the past, participants would be relying heavily upon a Wi-Fi network environment in this competition. At the beginning, event host thought their network only need to cover 200 nodes. Therefore, there were more than 200 attendees with their BYOD wireless devices which were much more than event host expected. Each mobile device needed to be connected, posing a major challenge for the existing HP switch which was providing the static routing role. The HP switch was certainly pushed to its routing limits by the large number of devices in use and resulted in unstable connection. To quickly push the network back to normal, it is forced to let Zyxel gateway to take the L3 routing role from HP switch. This is the example that improper network design drags network performance.



Image 1: Opening of the OpenStack hackathon event



Image 2: Zyxel gateway, WLAN controller, L2 PoE switch were used during the event (from top to down)

## Conclusion

Clear information about the table size of a L3 switch is essential for customers to choose the fit one. Also, it is necessary to calculate the needs of your network during design stage.

Zyxel offers smart managed, L2/L2+ and L3 managed switches with L3 forwarding capability for you to plan network in different applications easily. In the following table, there's a gap in L3 forwarding table size between Smart Managed and Layer 2/2+ for application segment.

	XGS4600 Series	XGS4500 Series	XS3700-24	XGS/GS3700 Series	XGS2210 Series	XS1920-12
<b>Switch class</b>	L3	L3	L2+	L2+	L2	Smart Managed
<b>L3 forwarding table (IPv4/IPv6)</b>	8K/4K	2K/1K	1K/512	1K/512	1K/512	512/256

Carefully plan your network to ensure you're choosing the right switch for a L3 switching/routing application.