THE DIFFERENCE BETWEEN LAYER 2, 3, AND 4 NETWORK SWITCHES

With the rapid development of computer networks over the last decade, high-end switching has become one of the most important functions of a network for moving data efficiently and quickly from one place to another.

Here's how a network switch works: As data passes through the switch, it examines addressing information attached to each data packet. From this information, the switch determines the packet's destination on the network. It then creates a virtual link to the destination and sends the packet there.

The efficiency and speed of a switch depends on its algorithms, its switching fabric, and its processor. Its complexity is determined by the layer at which the switch operates in the OSI (Open Systems Interconnection) Reference Model.

OSI is a layered network design framework that establishes a standard so that devices from different vendors work together.

Network addresses are based on this OSI Model and are hierarchical. The more details that are included, the more specific the address becomes and the easier it is to find.

The Layer at which the switch operates is determined by how much addressing detail the switch reads as data passes through. Switches can also be considered MAC- or IP-level. A MAC-level switch operates in Layer 2 of the OSI Model and can also operate in a combination of Layers 2 and 3. IP-level switches operate in Layer 3, Layer 4, or a combination of the two.

Layer 2 Switches (The Data-Link Layer)

Layer 2 switches operate using the data link (MAC) layer addresses. Link-layer, hardware, or MAC-layer addresses identify individual devices. Most hardware devices are permanently assigned this number during the manufacturing process.

Switches operating at Layer 2 are very fast because they’re just sorting MAC addresses, but they do not look at the Layer 3 portion of the packet to learn anything more.

Layer 3 Switches (The Network Layer)

Layer 3 switches use network or IP addresses that identify locations on the network. A location can be a LAN workstation, a location in a computer's memory, or even a different packet of data traveling through a network.

Switches operating at Layer 3 take more time examining packets than Layer 2 devices and incorporate routing functions to actively calculate the best way to send a packet to its destination.

Layer 4 Switches (The Transport Layer)

Layer 4 of the OSI Model coordinates communications between systems. Layer 4 switches are capable of identifying which application protocols (HTTP, SNTP, FTP, and so forth) are included with each packet, and they use this information to hand off the packet to the appropriate higher-layer software. Layer 4 switches make packet-forwarding decisions based not only on the MAC address and IP address, but also on the application to which a packet belongs.

Because Layer 4 devices enable you to establish priorities for network traffic based on application, you can assign a high priority to packets belonging to vital in-house applications, such as e-mail and video conferencing, with different forwarding rules for low-priority packets such as generic HTTP-based Internet traffic.

Layer 4 switches also provide an effective wire-speed security shield for your network because any company- or industry-specific protocols can be confined to only authorized switched ports or users. This security feature is often reinforced with traffic filtering and forwarding features.

Speed vs. Capability

As the layers increase in switches, so does the CPU power and processing time (latency) of the switch. The trade-off for more control and capabilities in a higher layer switch is less speed and increased power consumption. Lower layer switches are faster and use less processing power. Choosing a switch that matches your network needs creates maximum networking efficiency.

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