3.4 SWITCHING VS. ROUTING

martedì 5 marzo 2024 09:15

Switching : to copy incoming packets to the appropriate outgoing link buffer. (according to a lookup table)

OSI Layer 3 (networking) → Data plane

The routing is the activity of preparing correct information in the packets and in the switch tables to implement the flow route from start to end node

Layer 3 (networking) → control plane

At Layer 3 of the OSI model, also known as the Network layer, both the data plane and the control plane undertake essential roles that facilitate the routing and delivery of packets across a network. These functions are crucial for the scalability and reliability of internet communications. Here are examples of functions for each plane at this level:

Plane / OSI Layer	Data Plane	Control Plane	Management Plane
Layer 2 (Data Link Layer)	- Frame switching- MAC addressing- Error detection and correction- Flow control	- Spanning Tree Protocol (STP) for loop prevention- VLAN configuration and management- Link aggregation control (LACP)	- Network switch management- Port security and switch configuration- Layer 2 QoS settings- MAC address table management
Layer 3 (Network Layer)	- Packet forwarding/routing- Fragmentation and reassembly- Handling TTL (Time to Live)- IP addressing	- Routing protocols (OSPF, BGP, EIGRP)- Path selection and route propagation- Network topology discovery	- Router configuration- IP address management- Policy-based routing- Access control list (ACL) management
Layer 4 (Transport Layer)	- Segmentation and reassembly of data- End-to-end connection management- Data flow control- Error detection and recovery	- Establishment, maintenance, and termination of connections- Congestion control algorithm signaling- Port management and connection multiplexing	- Quality of Service (QoS) configuration for transport protocols- Transport protocol parameter tuning- Session policies enforcement- Security settings such as TLS configuration

Data Plane Functions at Layer 3

1. Packet Forwarding: The primary function of the data plane at Layer 3 is to forward packets based on their destination IP addresses. This involves looking up the destination address in the routing table to determine the next hop for the packet and forwarding the packet to that next hop.
2. Fragmentation and Reassembly: If a packet is too large for the Maximum Transmission Unit (MTU) of the outgoing link, the data plane is responsible for fragmenting the packet into smaller units suitable for transmission. These fragments can then be reassembled back into the original packet by the data plane at the receiving end.
3. Error Handling and Diagnostics: The data plane generates and processes ICMP (Internet Control Message Protocol) messages for error reporting and diagnostic purposes, such as "destination unreachable" or "time exceeded" messages.
4. Packet Filtering: Based on configured firewall rules or Access Control Lists (ACLs), the data plane can filter packets, deciding which packets are allowed to pass through a router and which should be dropped. This is a fundamental aspect of network security.

Control Plane Functions at Layer 3

1. Routing Protocol Operation: The control plane runs routing protocols (e.g., OSPF, BGP, EIGRP) that dynamically learn and disseminate routing information. These protocols enable routers to build and maintain accurate routing tables, adapting to changes in the network topology to ensure optimal path selection.
2. Routing Table Management: Beyond learning routes, the control plane manages the routing table, including adding, updating, and removing routes. It also determines the preferred routes based on metrics provided by routing protocols, ensuring the best path is chosen for packet forwarding.
3. Network Address Translation (NAT) Configuration: The control plane configures NAT rules, which modify the source or destination IP addresses of packets as they pass through a router. NAT is crucial for conserving IPv4 addresses and allowing multiple devices on a private network to share a single public IP address.
4. Quality of Service (QoS) Configuration: The control plane establishes QoS policies that prioritize certain types of traffic to ensure that critical applications (like voice and video) have the bandwidth and low latency they require. This involves classifying traffic and applying appropriate policies to control plane-generated traffic as well.

These examples demonstrate how the data plane and control plane at Layer 3 work in tandem to route and deliver packets efficiently while managing and configuring network infrastructure to support robust, secure, and scalable communications.