Post 1

Thursday, January 24, 2019 11:09 PM

BASIC SWITCH FORWARDING METHODS AND CONSIDERATIONS

LAN switches: Provides connection point for end users into network: Control of info in LAN environment
Routers: Facilitate movement of info between LAN's: Unaware of individual hosts
Switches function to provide:

QoS	Voice/Video data transfer	Security

Elements of a Converged Network: Collaboration w/voice/IP phones/gateways/video/conferencing
Converged support may include features like:

1. **Call Control:** Telephone/call processing/caller ID/call transfer/hold/conference
2. **Voice messaging:** Voicemail
3. **Mobility:** Receive important calls wherever
4. **Automated Attendant:** Serve customers by routing calls directly to department/individual

Benefits	○ 1 physical network to install/manage: Substantial savings ○ No need for separate installation/management for voice/video/data networks ○ Integrates IT management: Provides PC softphone support/point-to-point video

Cisco Borderless Network: A network that can connect anyone/anytime/anywhere on any device securely/seamlessly

- Designed to address IT/business challenges/work patterns
- Hierarchical infrastructure of HW that is scalable/resilient & policy-based SW solutions

2 Primary sets of services: Network Services || User/Endpoint Services
Borderless network guidelines built upon the following:

1. **Hierarchical:** Understand role of each device/every tier (deployment/operation/management)
2. **Modularity:** Seamless expansion/integrated services/on-demand basis
3. **Resiliency:** Satisfy user expectations (network always on)
4. **Flexibility:** Intelligent traffic sharing

3 Critical Layers within Tiered Designs: Core || Distribution || Access

Core	○ Backbone: Connectivity between distribution switches ○ Fault isolation/high-speed switching ○ Can be combined with distribution (collapsed design)
Distribution	○ Flow control: Allows data flow: Interfaces w/backbone ○ Provides intelligent switching/routing/security ○ Redundancy: Works between access/core layers to provide functions ○ Layer 2 broadcast domains/Layer 3 routing boundaries ○ Differentiated services to various classes of service apps & edge of network
Access	○ Where traffic enters/exists network (end devices connect) ○ Access to user ○ Access switches connect to distribution switches: Implement foundation (routing/QoS/security) ○ Helps apps operate on switched network safely/securely

Bigger network: More layers matter
Flat network: Every device shares BW: Typical w/hubs, which are bad/cause collisions
Role of switched networks:

1. QoS/filtered traffic
2. Additional security
3. Wireless networking/connectivity support
4. Support for new tech such as IP telephony/mobility services

When selecting a switch: Modular/stackable/non-stackable configuration/thickness (rack units)

Fixed	▪ Doesn't support features/options beyond what it comes with (model determines) Example: A 24 port gigabit fixed switch can't support additional ports/configs
Modular	▪ More flexibility in config: Comes w/different sized chassis ▪ Allows for installation of different modular line cards Example: A 24 port line card can be added to modular switch giving it 48 ports
Stackable	○ Can be interconnected using cable: Provides high BW between switches ○ Cisco StackWise tech allows interconnection of up to 9 switches ○ Can be stacked: Operates as 1 larger switch ○ Desirable where fault tolerance/BW are critical (modular costly) ○ Recovers quickly if single switch fails ○ Special port for interconnections ○ Cisco stackable supports StackPower tech (power sharing among stack members)

Business considerations when selecting switches:

- **Cost**

1. **Port Density:** Must support appropriate devices
2. **Power:** Phones/IP phones/compact switches over PoE/chassis support/redundant power supplies
3. **Reliability:** Continuous access to the network
4. **Port speed:** Primary concern to end-users
5. **Frame buffers:** Ability to store frames when congested ports to servers/other areas of network
6. **Scalability:** Opportunity for growth

General Concept of Switching in Networks:

- Switching/forwarding frames universal in networking/telecommunications
- Various types used in LANs/WANs/PTSN (Public Switched Telephone Network)

A device makes a decision based on 2 criteria:

1. Ingress port
2. Destination address

- LAN switch maintains table to determine how to find traffic

Ingress port: Used to describe where frame enters device on a port
Egress port: Where a frame is leaving device from a port
How it works:
1. Message enters ingress port 1 & destination is EA (on MAC/CAM table we'll pretend it's port 4)
2. Switch forwards traffic out of port 4

Only 1 master switching table: Strict association between addresses/ports
Message w/given destination address always exits same egress
Cisco switches forward Ethernet frames based on destination MAC of frames

- Made up of integrated circuits/accompanying SW that controls data passing through

To know which port to use to transmit frame: Must learn which devices exist on each port

- As it learns relationship of ports/devices: It builds MAC address/CAM table

CAM Table: Content Addressable Table: CAM is a special type of memory used in high-speed switching apps

- Switches determine how to handle incoming data frames by maintaining MAC table
- Built by recording MAC address of each connected device to ports
- Uses info in MAC table to send frames for specific device out of designated port
- Switch populates MAC table on **SOURCE** MAC addresses

When it receives an incoming frame with a destination MAC NOT found in the table:

- Switch forwards frames to all ports (flooding) except ingress
- When destination device responds: Switch adds SOURCE MAC address of frame/port received to the table

Interconnected switches: MAC table contains multiple MAC addresses for a single port connected to other switches

Building MAC Table	1. Switch receives frame from PC 1 on port 1 2. Switch examines source MAC address: Compares it to table ○ If address NOT in table: Associates source MAC of PC 1 w/ingress port 1 on table **1. If MAC table had entry for source:** Resets aging timer (entries kept for 5 min) 2. Switch records source address info: Switch examines destination MAC address

	○ If destination address NOT in MAC table, or broadcast address: 1. Switch floods frame to all ports except ingress 2. Destination device replies to frame w/unicast frame to PC 1 3. Switch enters source MAC of PC 3 & port number of ingress to table. Destination add. of frame & associated egress port is found in table 4. Switch can now forward frames between source/destination devices w/out flooding b/c it has entries in table

Switch Forwarding Methods:

Store-and-Forward	▪ Receives entire frame: Computes CRC ▪ If CRC is valid: Switch looks up destination which determines outgoing interface ▪ Frame is forwarded out of correct port Cisco's primary switch method drops frames that don't pass FCS checks **2 distinguished differences of cut-through:** 1. Error checking 2. Automatic buffering
Cut-Through	▪ Forwards frame before entirely received ▪ At minimum: Destination address of frame must be read before frame can be forwarded ▪ Advantage: Ability of switch to start finding a frame faster/earlier **2 primary characteristics:** 1. Rapid frame forwarding 2. Fragment free

Error Checking: Performs check after receiving frame on ingress port

- Switch compares FCS (Frame Check Sequence) value in last field of datagram against own FCF calculations
- **IF error free:** Forwards frame
- **IF NOT error free:** Frame is dropped

Automatic buffering:

- Buffering provides flexibility to support any mix of Ethernet speeds
- Any mismatch in speeds between ingress/egress ports & switch stores entire frame in a buffer
- It computes FCS check: Forwards it to egress port buffer: Sends it

Rapid Frame Forwarding	○ Makes forwarding decision as soon as it's looked up destination MAC of frame in MAC table ○ Switch doesn't have to wait for whole frame to enter ingress before making forwarding decision ○ Switch (w/ASIC bytes perform functions relative to IPv4 layers 3/4) ○ Doesn't drop most invalid frames ○ Frames w/errors forwarded to other segments on network ○ Can have negative impact on BW ○ Can analyze first 14 bytes (source MAC/destination MAC/other type fields) & examine up to 4
Fragment Free	○ Switch waits for collision window (64 bytes) to pass before forwarding frame ○ Each frame checked into data field to ensure no fragmentation ○ Provides better error checking then cut-through w/no increase in latency ○ Low latency: Appropriate for HPC (high-performance computing) apps: Require latencies of 10ms/less

Collision Domains:

Broadcast domain: Collection of interconnected switches forms single broadcast domain

MAC broadcast domain: ALL devices on LAN that receive broadcast frames from a host

Collision Domains	○ Shared network BW/medium where we have collision: Devices compete for the medium (must take turns) ○ Collision: when 2 electrical signals collide (hubs) ○ Segments share same BW (unidirectional)

	○ When 2 or more devices w/in segment try to communicate at same time: may have collisions ○ Every port on a switch is its own collision domain ○ Full duplex
Broadcast Domains	○ Switches forward broadcasts out each port except ingress ○ Layer 3 device require to separate broadcast domains (router) ○ Routers used to segment collision/broadcast domains ○ A frame with destination MAC is received by all devices in broadcast ○ Layer 2 broadcast domain: AKA MAC broadcast domain ○ While switches filter frames based on MAC: They don't filter broadcast frames ○ May be necessary for locating other devices/network services ○ May reduce network efficiency ○ When switches are connected, domain is increased

How do switches help?

High ort density: Low cost	High speed/internal switching	Large frame buffers	Separate collision domains

Alleviating Network Congestion:

- Switches allow segmentation of LAN into separate collision domains
- Each port of switch represents separate collision domain & provides full BW to device(s) connected
- Provide full-duplex communication between devices
- Interconnect LAN segments (collision domains), use table of MAC addresses to determine segment to which frame is set
- Lessen/eliminate collisions

High port density	○ 24/48 port switches are often 1 rack unit (1.75 inches) in height ○ Operate at speeds of 100Mb/s, 1Gb/s & 10Gb/s ○ Large switches may support hundreds of ports
Large frame buffers	○ Ability to store more received frames before having to start dropping them
Port speed	○ May be possible to support mixture of speeds
Fast internal switching	○ High performance ○ May be fast internal bus/shared memory, which affects performance
Low per-port cost	○ Provide high-port density at lower cost ○ Accommodate designs featuring fewer users per segment; therefore increasing average BW per user