BLONDER TONGUE
LABORATORIES

IPTV Addressing

Multicast vs Unicast

Address Ranges, IGMP, MPTS vs SPTS

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IP Addressing

- IANA (Internet Assigned Numbers Authority) assigns Public IP addresses
- Two types of IP Address Structures
  - IPV4 (Ex. 192.168.10.100)
    - 32 bits – 4 Octets (0-9)
    - 4.3 Billion addresses
    - Public Address Allocations exhausted 2011
  - IPV6 (Ex. 2001:0db8:85a3:0000:0000:8a2e:0370:7334)
    - 128 bits – 8 hextets – Hexadecimal (0-9, A-F)
    - 3.4x10^38 Addresses (Hundred Decillion)
      - Earth's surface = 7.93*10^17 square inches!
- InterNIC (Network Information Center) has reserved specific Private IP Address Ranges
  - Class A 10.0.0.0-102.55.255.255 /8
  - Class B 172.16.0.0-172.31.255.255 /12
  - Class C 192.168.0.0-192.168.255.255 /16

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IPV4 Addressing - Structure

- IPV4 addresses are 32-bit addresses. Each byte, or 8-bit segment, is divided by a period and expressed as a number 0-255.
- IPV4 addresses consist of two parts, one identifying the Network, and one identifying the Node, or host.
- The **CLASS** of the address determines which part of the address belongs to the network, and which part of the address belongs to the node.
  - All nodes on a given network share the same network prefix but must have a unique host number
    - EX: 168.212.226.204 /24 (/24 tells us the subnet mask)
  - Consider each octet of the address as 8 weighted binary numbers

1	0	1	0	1	0	0	0
128	64	32	16	8	4	2	1

- In this example, the red numbers total 168, the first Octet of the IP address shown above.

IPV4 Addressing - Octets

128	64	32	16	8	4	2	1	Value
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	1	0	0	0	0	16
0	1	1	1	1	1	1	1	127
1	0	1	0	1	1	0	0	172
1	1	0	0	0	0	0	0	192
1	1	1	1	1	1	1	1	255

Example of Binary to Decimal IP Octet conversion

IPV4 Addressing – Subnet Mask

- The Subnet Mask tells us which part of the address belongs to the Network, and which part belongs to the Node or host.
- The most common subnet mask or CIDR (Classless Inter-Domain Routing) is 255.255.255.0, or /24 (24 Ones)
- 11111111.11111111.11111111.00000000 = 255.255.255.0 = /24
  - This subnet mask tells us that the first 3 Octets belong to the Network, and the last Octet is the Host. 168.212.226.204 /24
  - Class A subnet = 255.0.0.0 or /8
  - Class B subnet = 255.255.0.0 or /16
  - Class C subnet = 255.255.255.0 or /24
  - Classless (CIDR) can be between Class A, B, C
    - 192.168.205.10 /26 = 62 hosts
    - 172.16.70.50 /20= 4094 hosts
- www.subnet-calculator.com

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IP Addressing - Classes

- **Class A**
  - First bit of first Octet always 0
  - Range = 1.x.x.x to 126.x.x.x (127.x.x.x reserved for Loopback)
  - Default Subnet – 255.0.0.0
  - 126 different networks
  - 16,777,214 Hosts per network (2^24 -2 (Network Number and Broadcast))
- **Class B**
  - First two in first Octet always 10
  - Range = 128.x.x.x to 191.x.x.x
  - Default Subnet – 255.255.0.0
  - 16,384 Networks
  - 65,534 Hosts per Network (2^16 -2 (Network and Broadcast))

IP Addressing – Classes (Continued)

- **Class C**
  - First 3 bits of first Octet always 110
  - Range = 192.x.x.x to 223.x.x.x
  - Default Subnet – 255.255.255.0
  - 2,097,152 different networks
  - 254 Hosts per network (2^8-2 (Network and Broadcast))
- **Class D (Multicasting)**
  - First 4 bits in first Octet always 1110
  - Range = 224.0.0.0 through 239.255.255.255
  - 224.x.x.x has certain addresses for Router and Switch Management
  - No Subnet Mask
  - Identify which port is used, along with IP Address
    - (Ex.: 225.10.10.10:50000)
- **Class E (Experimental)**
  - Range = 240.0.0.0 through 255.255.255.254
  - No Subnet Mask

IP Addressing – Public, Private, Multicast

- Public IP addresses are provided by Internet Service Provider (ISP), maintained by IANA (get from your ISP)
- Private IP addresses used on closed network:
  - 10.0.0.0 /8
  - 172.16.0.0 /16
  - 192.168.0.0 /24
- Multicast IP Addresses used on private (closed) networks
  - 224.0.0.0 – 239.255.255.255
  - 224.0.0.0 – 224.0.0. 255 – used for Routing Protocols – recommended to avoid these addresses
  - Also indicate PORT number to use when Multicasting IP video
    - Ex: 225.10.10.10:50000

Multicast vs Unicast IP Streams

- Multicast IP address range – 224.0.0.0 through 239.255.255.255.
- It is Recommended to start Multicast streams at 225.0.0.0, as the 224 range includes some IP addresses used specifically for routers and IGMP management
- Multicast IP addressing of IP streams allows one source to deliver IP packets to multiple receivers that request it, without overloading the network
- Multicast sends one copy of data packets out, and it is routed only to those receivers requesting it
- Both the source and receiver point to the same Multicast IP address (i.e., 225.168.2.20)
- For Unicast IP Streams, source points to receiver IP address, and receiver points to source IP address (i.e. 192.168.2.30 <-> 192.168.2.50)

Internet Group Multicast Protocol (IGMP)

- IGMP = Internet Group Multicast Protocol
- IGMP v3 is the latest. Backward compatible to v2 and v1 network components
- IGMPv1 was original protocol, became Internet Standard for all devices
- IGMPv2 added “low leave latency”, reducing time for a multicast router to learn that there are no members of a particular group attached to that network segment
- IGMPv3 adds features for “source filtering” so devices on a network segment do not get multicast packets from a source, when there are no receivers interested in getting that data

IGMP Feature Summary

Feature	IGMPv1	IGMPv2	IGMPv3
1st Octet value for Query message	0x11	0x11	0x11
Group address for General query	0.0.0.0	0.0.0.0	0.0.0.0
Destination address for General query	224.0.0.1	224.0.0.1	224.0.0.1
Default Query Interval	60 sec	125 sec	125 sec
1st octet value for Report	0x12	0x16	0x22
Group address for the report	Joining multicast group address	Joining multicast group address	Joining multicast group address and source address
Is report suppression mechanism available	Yes	Yes	No
Can max response time be configured	No , fixed at 10 sec	Yes,0 to 25.5 sec	Yes,0 to 53 min
Can a host send a leave group message	No	Yes	Yes
Destination address for leave group message	-	224.0.0.2	224.0.0.22
Can a Router send Group-specific query?	No	Yes	Yes
Can a Host send Source and group specific reports?	No	No	Yes
Can router end Source and Group specific Queries?	No	No	Yes
Rule for Electing a Querier?	None (depends on multicast routing protocol)	Router with the lowest IP address on the subnet	Router with the lowest IP address on the subnet
Compatible with other Versions of IGMP?	No	Yes, only with IGMP v1	Yes, with both IGMP v1 and v2

Managed Switch Settings for Multicast

- IGMP Snooping Querier Enabled (1 per network)
  - The IGMP Snooping Querier is used to support a Layer 2 Multicast domain of snooping switches in the absence of a Multicast router.
    - For example, where Multicast content is provided by a local server, but the router (if one exists) on that network does not support Multicast.
- IGMP Snooping Enabled (Every Switch)
  - When IGMP snooping is enabled, the switch detects the IGMP messages exchanged between the IPv4 router (or Querying Switch) and the multicast hosts attached to the interfaces. It then maintains a table that forwards IPv4 multicast traffic to the ports that need to receive them.
- IP Multicasting Enabled (Every Switch)
  - IP multicasting is an efficient way to use network resources, especially for bandwidth-intensive such as audio and video. IP multicast routing enables a house (source) to send packets to a group of hosts (receivers) anywhere within the IP network by using a special form of IP address called the IP multicast group address.
  - The sending host inserts the multicast group address into the IP destination address field of the packet, and IP multicast routers and multilayer switches forward incoming IP multicast packets out all interfaces that lead to members of the multicast group. Any host, regardless of whether it is a member of a group, can send to a group. However, only the members of a group receive the message.

MPTS vs SPTS Streams

- **MPTS – Multiple Program Transport Stream**
  - Multiple programs on one IP address/port, similar to putting multiple programs on one QAM channel
  - Primarily used for transporting multiple IP streams from one location to another
  - Can be used to deliver programming to customer. VLC Media Player will show MPTS programs, and allow you to pick which one to view
  - Uses much more bandwidth than SPTS, and delivers unnecessary programming to customers
- **SPTS – Single Program Transport Stream**
  - Each program gets its own IP address/port
  - When customer requests that program, ONLY that program is sent, so much smaller bandwidth across IP network
- When setting up devices to transport QAM and IP, typically MPTS will be used to maximize bandwidth on QAM network