IP Multicasting

Multicast delivery enables the distribution of streaming media by allowing different receiving devices on the IP multicast to receive a single stream of media content from the Content Engine simultaneously. This can save significant network bandwidth consumption, because a single stream is sent to many devices, rather than sending a single stream to a single device every time that this stream is requested.

This multicast delivery feature is enabled by setting up a multicast address on the Content Engine to which different devices, configured to receive content from the same channel, can subscribe. The delivering device sends content to the multicast address set up at the Content Engine, from which it becomes available to all subscribed receiving devices.

To take advantage of multicasting, all devices, including Content Engines and routers, as well as clients, must be multicast-enabled. For this reason, multicasting is mostly used in local networks where routers can be configured for multicasting. Multicast delivery over the Internet can only be accomplished when all the devices that participate in the multicast have been enabled for multicasting.

Unusable IP Multicast Addresses

The Internet Assigned Numbers Authority (IANA) controls the assignment of IP multicast addresses. IANA has assigned the IPv4 Class D address space to be used for IP multicast. Therefore, all IP multicast group addresses fall in the range from 224.0.0.0 through 239.255.255.255. However, some combinations of source and group addresses should not be routed for multicasting purposes.

Table B-1 lists the unusable multicast address ranges and the reasons they should not be used.

Table B-1   Unusable Multicast Address Assignments

Address Range	Reason
224.0.1.2/32	Known insecure service address. See the "Insecure Services" section on page B-4.
224.0.1.3/32	Reserved for the discovery of resources within the administrative domain. See the "Limited Scope Addresses" section on page B-4.
224.0.1.22/32	Known insecure service address.
224.0.1.35/32	Reserved for the discovery of resources within the administrative domain.
224.0.1.39/32	Reserved for the discovery of resources within the administrative domain.
224.0.1.40/32	Reserved for the discovery of resources within the administrative domain.
224.0.2.2./32	Known insecure service address.

Table B-1   Unusable Multicast Address Assignments (continued)

Address Range	Reason
224.77.0.0/16	Used to copy files between servers and clients in a local network. See the "Copying Files Between Servers and Clients" section on page B-4.
224.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches. See the "Layer 2 Multicast Addresses" section on page B-5.
225.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
225.1.2.3/32	Used to copy files between servers and clients in a local network.
225.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
226.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
226.77.0.0/16	Used to copy files between servers and clients in a local network.
226.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
227.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
227.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
228.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
228.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
229.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
229.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
230.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
230.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
231.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
231.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
232.0.0.0/24	Source-specific multicast address. See the "Source-Specific Multicast Addresses" section on page B-5.
232.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
233.0.0.0/8	GLOP address. See the "GLOP Addresses" section on page B-5.
233.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.

Table B-1   Unusable Multicast Address Assignments (continued)

Address Range	Reason
233.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
234.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
234.42.42.42/32	Used to copy files between servers and clients in a local network.
234.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
234.142.142.42/31	Used to copy files between servers and clients in a local network.
234.142.142.44/30	Used to duplicate files between clients and servers in a local network.
234.142.142.48/28	Used to copy files between servers and clients in a local network.
234.142.142.64/26	Used to copy files between servers and clients in a local network.
234.142.142.128/29	Used to copy files between servers and clients in a local network.
234.142.142.136/30	Used to copy files between servers and clients in a local network.
234.142.142.140/31	Used to copy files between servers and clients in a local network.
234.142.142.142/32	Used to copy files between servers and clients in a local network.
235.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
235.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
236.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
236.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
236.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
236.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
237.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
237.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
238.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
238.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
239.0.0.0/8	Administratively scoped address that should not be passed between administrative domains. See the "Limited Scope Addresses" section on page B-4.

Table B-1   Unusable Multicast Address Assignments (continued)

Address Range	Reason
239.0.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.
239.128.0.0/24	Local address that maps to an Ethernet multicast address range and may overwhelm the mapping table of LAN switches.

Some of these addresses have been reserved for use by multicast applications through IANA. For example, IP address 224.0.1.1 has been reserved for the Network Time Protocol (NTP).

IP addresses reserved for IP multicast are defined in RFC 1112, *Host Extensions for IP Multicasting*. More information about reserved IP multicast addresses can be found at the following location: http://www.iana.org/assignments/multicast-addresses.

Note   You can find all RFCs and Internet Engineering Task Force (IETF) drafts on the IETF website (http://www.ietf.org).

Insecure Services

Applications that use multicast addresses in the 224.0.1.2/32, 224.0.1.22/23, and 224.0.2.2/32 ranges have been demonstrated to be vulnerable to exploitation, which has led to serious security problems.

Copying Files Between Servers and Clients

Some applications are used to copy files between servers and clients and to otherwise maintain groups of personal computers. These applications are intended to be used on a local subnet or within an administrative domain, but the default addresses used by the software are not within the administrative addresses used by the administratively scoped addresses listed in Table B-1.

Limited Scope Addresses

Limited scope addresses are also called administratively scoped addresses. These addresses are described in RFC 2365, *Administratively Scoped IP Multicast*, to be limited to a local group or organization. Companies, universities, or other organizations can use limited scope addresses to have local multicast applications that will not be forwarded outside their domain. Routers typically are configured with filters to prevent multicast traffic in this address range from flowing outside an autonomous system (AS) or any user-defined domain. Within an autonomous system or domain, the limited scope address range can be further subdivided so that local multicast boundaries can be defined. This subdivision is called address scoping and allows for address reuse between these smaller domains.

Source-Specific Multicast Addresses

Addresses in the 232.0.0.0/24 range are reserved for source-specific multicast (SSM). SSM is an extension of the Protocol-Independent Multicast (PIM) protocol that allows for an efficient data delivery mechanism in one-to-many communications.

GLOP Addresses

RFC 2770, *GLOP Addressing in 233/8*, proposes that the 233.0.0.0/8 address range be reserved for statically defined addresses by organizations that already have an AS number reserved. This practice is called GLOP addressing. The AS number of the domain is embedded into the second and third octets of the 233.0.0.0/8 address range. For example, the AS number 62010 is written in hexadecimal format as F23A. Separating the two octets F2 and 3A results in 242 and 58 in decimal format. These values result in a subnet of 233.242.58.0/24 that would be globally reserved for AS 62010 to use.
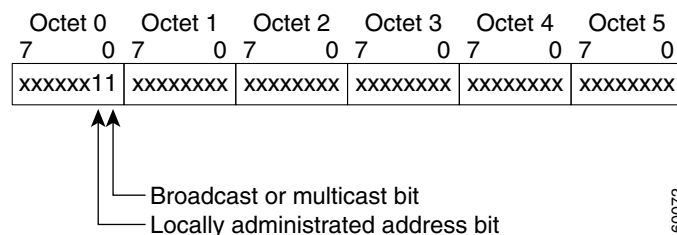
Layer 2 Multicast Addresses

Historically, network interface cards (NICs) on a LAN segment could receive only packets destined for their burned-in MAC address or the broadcast MAC address. In IP multicast, several hosts need to be able to receive a single data stream with a common destination MAC address. Some means had to be devised so that multiple hosts could receive the same packet and still be able to differentiate between several multicast groups.

One method to accomplish this is to map IP multicast Class D addresses directly to a MAC address. Today, using this method, NICs can receive packets destined to many different MAC addresses—their own unicast, broadcast, and a range of multicast addresses.

The IEEE LAN specifications made provisions for the transmission of broadcast and multicast packets. In the 802.3 standard, bit 0 of the first octet is used to indicate a broadcast or multicast frame. Figure B-1 shows the location of the broadcast or multicast bit in an Ethernet frame.

Figure B-1   IEEE 802.3 MAC Address Format

This bit indicates that the frame is destined for a group of hosts or all hosts on the network (in the case of the broadcast address 0xFFFF.FFFF.FFFF).
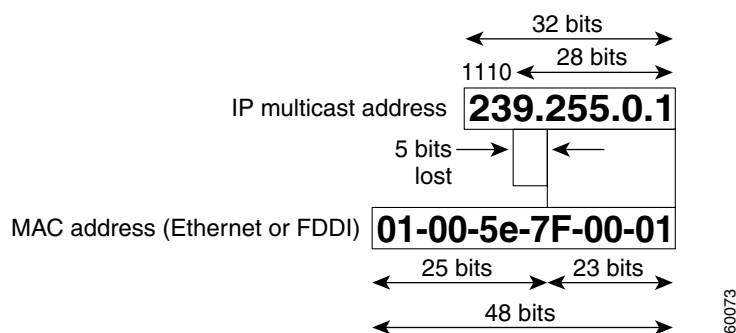
IP multicast makes use of this capability by sending IP packets to a group of hosts on a LAN segment.

Ethernet MAC Address Mapping

IANA owns a block of Ethernet MAC addresses that start with 01:00:5E in hexadecimal format. Half of this block is allocated for multicast addresses. The range from 0100.5e00.0000 through 0100.5e7f.ffff is the available range of Ethernet MAC addresses for IP multicast.

This allocation allows for 23 bits in the Ethernet address to correspond to the IP multicast group address. The mapping places the lower 23 bits of the IP multicast group address into these available 23 bits in the Ethernet address (see Figure B-2).

Figure B-2   IP Multicast to Ethernet or FDDI MAC Address Mapping

Because the upper five bits of the IP multicast address are dropped in this mapping, the resulting address is not unique. In fact, 32 different multicast group IDs map to the same Ethernet address (see Figure B-3). Network administrators should consider this fact when assigning IP multicast addresses. For example, 224.1.1.1 and 225.1.1.1 map to the same multicast MAC address on a Layer 2 switch. If one user subscribed to Group A (as designated by 224.1.1.1) and the other users subscribed to Group B (as designated by 225.1.1.1), they would both receive both A and B streams. This situation limits the effectiveness of this multicast deployment.

Figure B-3   MAC Address Ambiguities