Multicast - Assignment

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Multicasting in Computer Networks:

Multicasting in computer network is a group communication, where a sender(s) send data to multiple receivers simultaneously. It supports one – to – many and many – to – many data transmission across LANs or WANs. Through the process of multicasting, the communication and processing overhead of sending the same data packet or data frame in minimised.

Ethernet Multicast:

Ethernet multicast constitutes multicasting at the data link layer of the OSI model for Ethernet networks. Ethernet frames for multicasting are identified by a 1 bit in the LSB (least significant bit) of the first byte of the destination address.

IP Multicast:

IP multicast provides one-to-many communication over an IP network. The destination nodes send join and leave messages that informs the routers whether they are correct recipients of the messages. The sender sends the data packet only once irrespective of the number of users. The routers in the network performs necessary replications so that the packet can reach multiple receivers simultaneously.

IP(V4) MULTICAST ADDRESSING:

The “classful” IP addressing scheme sets aside a full one-sixteenth of the address space for multicast addresses: Class D. Multicast addresses are identified by the pattern “1110” in the first four bits, which corresponds to a first octet of 224 to 239. So, the full range of multicast addresses is from 224.0.0.0 to 239.255.255.255. Since multicast addresses represent a group of IP devices (sometimes called a host group) they can only be used as the destination of a datagram; never the source.

Range Start Address	Range End Address	Description
224.0.0.0	224.0.0.255	Reserved for Special “well-known” multi cast address
224.1.0.0	224.1.0.255	Globally Scoped (internet wide) multi cast address
239.0.0.0	239.255.255.255	Administratively scoped multi cast address

IP V6 MULTICAST ADDRESSING:

Field Name	Size (bits)	Scope ID
Indicator	8	the first eight bit are always ‘1111 1111’ to indicate a multi cast address
Flags	4	To Indicate the nature of the multi cast address. At present first 3 bits are unused. The Fourth bit is Transient Flag. 1- Permanently assigned 2 - well known 3-
Scope ID	4	0 - Reserved 1-Node Local Scope 2- Link Scope Scope 5 - Site Local Scope 8 - Organisation Local 14 - Local Scope 15- Reserved
Group ID	112	Defines a particular group with each scope level

TRANSPORT LAYER FOR IP MULTICAST:

UDP:

The most common transport layer protocol to use multicast addressing is User Datagram Protocol (UDP). By its nature, UDP is not reliable—messages may be lost or delivered out of order. Reliable multicast protocols such as Pragmatic General Multicast (PGM) have been developed to add loss detection and retransmission on top of IP multicast. Multicast, by its very nature, is not a connection-oriented mechanism, so protocols such as TCP, which allows for retransmission of missing packets, are not appropriate. For applications such as streaming audio and video, the occasional dropped packet is not a problem.

TCP:

PGM (originally Pretty Good Multicasting, but changed for trademark reasons to Pragmatic General Multicast),[citation needed] documented in RFC 3208. In this scheme, multicast packets have sequence numbers and when a packet is missed a recipient can request that the packet be re-multicast with other members of the Multicast group ignoring the replacement data if not needed. An expanded version, PGM-CC, has attempted to make IP Multicasting more "TCP friendly" by stepping the entire group down to the bandwidth available by the worst receiver.

Reliable IP Multicasting protocols, such as PGM and SMART, are experimental; the only standards-track protocol is NORM (the standards-track revision of RFC 3941 is specified in RFC 5401, the standards-track revision of RFC 3940 is specified in RFC 5740).

ROUTING:

In multicast routing, the source address (which is a simple unicast address) is used to determine data stream direction. The source of the multicast traffic is considered upstream. The router determines which downstream interfaces are destinations for this multicast group (the destination address), and sends the packet out through the appropriate interfaces. The term reverse path

forwarding is used to describe this concept of routing packets away from the source, rather than towards the destination.

The following are some common delivery and routing protocols used for multicast distribution:

Internet Group Management Protocol (IGMP)
Protocol Independent Multicast (PIM)
Distance Vector Multicast Routing Protocol (DVMRP)
Multicast Open Shortest Path First (MOSPF)
Multicast BGP (MBGP)
Multicast Source Discovery Protocol (MSDP)
Multicast Listener Discovery (MLD)
GARP Multicast Registration Protocol (GMRP)
Shortest Path Bridging (SPB)

DEPLOYMENT:

IP multicast is widely deployed in enterprises, commercial stock exchanges, and multimedia content delivery networks. A common enterprise use of IP multicast is for IPTV applications such as live television distribution and televised company meetings.[citation needed]

In the hospitality industry IP multicast has become common for IPTV distribution in hotels, and in the retail sector IP multicast is now widely used for TV distribution and video advertising applications.

Pay-TV operators and some educational institutions with significant on-campus student housing have deployed IP multicast to deliver one-way streaming media such as high-speed video to large groups of receivers. Additionally, there have been some uses of audio and video conferencing using multicast technologies. These are far less prevalent and are most often relegated to research and education institutions, which often have a greater degree of network capacity to handle the demands.[citation needed] Some technical conferences and meetings are transmitted using IP multicast. Until recently[when?] many of the sessions at the IETF meetings were delivered using multicast.[citation needed]

Another use of multicast within campus and commercial networks is for file distribution, particularly to deliver operating system images and updates to remote hosts. The key advantage of multicast boot images over unicasting boot images is significantly lower network bandwidth usage.

IP multicast has also seen deployment within the financial sector for applications such as stock tickers and hoot-n-holler systems.[10]

While IP multicast has seen some success in each of these areas, multicast services are generally not available to the average end-user.[citation needed] There are two major, related, factors for this lack of widespread deployment. First, forwarding multicast traffic imposes a great deal of protocol complexity on network service providers.[citation needed] Second, core network infrastructure exposes a far greater attack surface, with particular vulnerability to denial-of-service attacks.[citation needed]

The large state requirements in routers make applications using a large number of trees unable to work while using IP multicast. Take presence information as an example where each person needs to keep at least one tree of its subscribers, if not several. No mechanism has yet been demonstrated that would allow the IP multicast model to scale to millions of senders and millions of multicast groups and, thus, it is not yet possible to make fully general multicast applications practical.[citation needed] For these reasons, and also reasons of economics[citation needed], IP multicast is not, in general, used in commercial Internet backbones.

Multicast Streaming - Case Study:

We have a small network with a video server that is streaming a movie and four hosts who want to watch the movie. Two hosts are on the same LAN, the other two hosts are on another site that is connected through a 30 Mbit WAN link.

Unicast Case:

A single HD video stream requires 6 Mbps of bandwidth. When we are using unicast, the video server will send the packets to each individual host. With four hosts, it means the video server will be streaming 4x 6Mbps = 24Mbps of traffic. The main problem with unicast traffic is that it is not scalable.

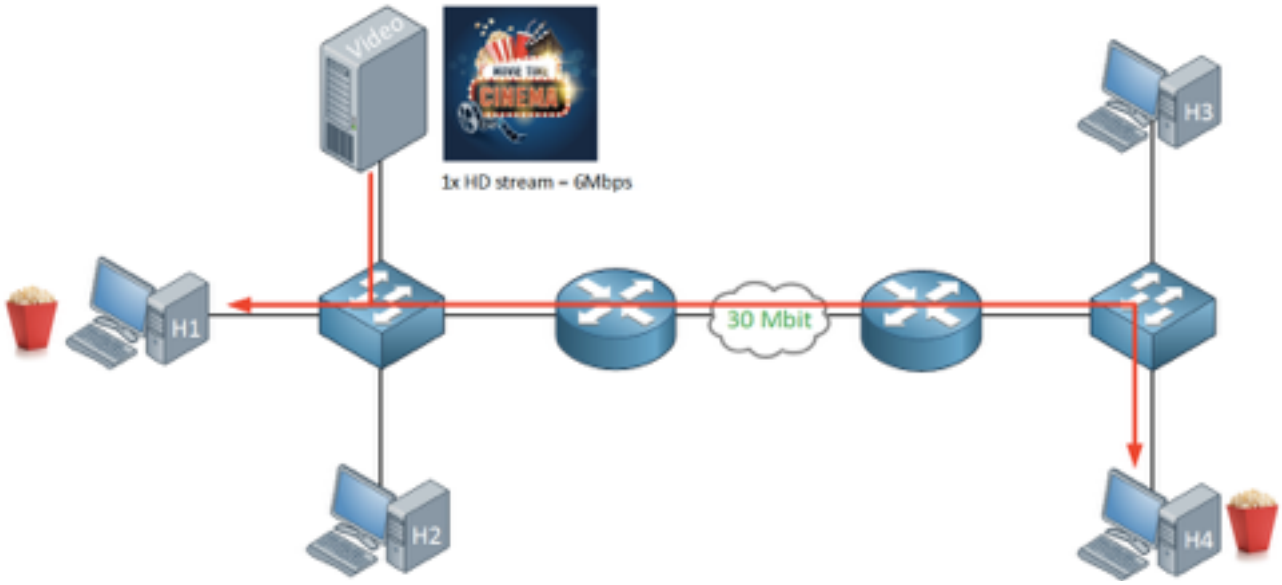
Broadcast Case:

If our video server would broadcast its traffic then the load on the video server will be reduced, it's only sending the packets once. The problem however is that everyone in the broadcast domain will receive it…whether they like it or not. Another issue with broadcast traffic is that routers do not forward broadcast traffic, it will be dropped.

Multicast Case:

Multicast traffic is very efficient. This time we only have two hosts that are interested in receiving the video stream. The video server will only send the packets once, the switches and routers will only forward traffic to the hosts that want to receive it. This reduces the load of the video server and network traffic in general.

When using unicast, each additional host will increase the load and traffic rate. With multicast it will remain the same.



Multicast is efficient but it doesn't work "out of the box". There are a number of components that we require:

1. We need Multi cast Address

2. Hosts that want to receive multicast traffic will use the IGMP protocol to tell the router which multicast traffic they want to receive.

3. To help the switch figure out where to forward multicast traffic, we can use IGMP snooping. The switch will “listen” to IGMP messages between the host(s) and router to figure out where it should forward multicast traffic to.

4. Need a multicast routing protocol. Examples are
DVMRP (Distance Vector Multicast Routing Protocol)
MOSPF (Multicast Open Shortest Path First)
PIM (Protocol Independent Multicast)

Paradox:

What about the Internet? Since multicast is so much more efficient than unicast, large companies like Netflix and Youtube must be using this to stream videos right? Unfortunately multicast on the Internet has never really been implemented. These large video companies use LOTS of unicast traffic to deliver videos to their customers. The only place where you might see multicast on the Internet is your local ISP. They typically use multicast for IPTV to deliver video to their own customers.