

## Broadcasting & Multicasting

### Broadcasting

- Broadcasting is only allowed in IPv4 UDP.
- Broadcast addresses, assuming that we denote an IPv4 address as {net-id, subnet-id, host-id} and a field containing all 1 bits as -1, are defined as
  - subnet-directed-broadcast address: {net-id, subnet-id, -1} e.g. 128.7.6.255
  - all-subnet-directed broadcast: {net-id, -1, -1} e.g. 128.7.255.255
  - limited-broadcast address: {-1, -1, -1} e.g. 255.255.255.255
- Broadcast addresses are never forwarded.

A UDP packet destined to a broadcast address and a designated port # is translated by the MAC layer to an Ethernet destination address ff:ff:ff:ff:ff:ff: thus every Ethernet card on the network will pick-up the packet. However since the frame type of this Ethernet PDU will be 0800 indicating IPv4 and the UDP packet is destined to a specific port, the hosts that don't use IPv4 or the hosts that are running IPv4 but don't have an application bounded to the specified port will discard the packet at network & transport layer levels.

### Multicasting

- Multicasting is available for UDP on IPv4 as well as IPv6. However not all IPv4 routers are multicast capable as it is optional in IPv4.  
Class D addresses in the range 224.0.0.0 through 239.255.255.255 are multicast IPv4 addresses. The low order 28 bits of the Class D address form the multicast group ids and the 32 bit address is called the group address.
- Mapping of multicast UDP packet to Ethernet PDU is as follows:
  - high order 24 bits of Ethernet address are always 01.00.5e. The next bit is always 0.
  - low order 23 bits are copied from the low order 23 bits of the multicast group address.
  - The high order 5 bits of the group address are ignored in the mapping.  
This means the mapping from multicast IP address to the Ethernet address is not one-to-one and 32 multicast addresses map to a single Ethernet address.

### Scope of Multicast Addresses:

There is no specific field in IPv4 header that is used to indicate, scope of the multicast packet. Either TTL (time-to-live) is used to define the scope or scope is defined administratively.

Scope	IPv4	
	TTL	Administrative
Node-local	0	
Link-local	1	224.0.0.0 to 224.0.0.255
Site-local	< 32	239.255.0.0 to 239.255.255.255
Organizational Local		239.192.0.0 to 239.195.255.255
Global	< 255	224.0.1.0 to 238.255.255.255

When a sender creates a UDP packet addressed to a multicast address and a specific port, the UDP packet is mapped to the Ethernet packet as specified before. The host that has joined the multicast group informs the link layer to read packets destined to the corresponding Ethernet address. Usually most of the cards that are currently in market place don't do a good job of filtering and would read packets destined to all multicast groups. When a process on a host joins a multicast group it sends an IGMP (Internet Group Management Protocol) message to the neighbour multicast routers. These multicast routers then communicate with other multicast routers to indicate what to do when a multicast packet arrives. Multicast routers then make copies of the multicast packets if needed to ensure that the packet reaches all destinations.

NOTE: you can create a multicast program to advertise various services & sessions that you want to advertise. Any host that wants to know what you want to offer can then listen to your service advertisement by joining a multicast group & starting service discovery application at the specified port.

#### Multicast Socket Options:

The API support for multicasting requires only five new socket options (to be used in getsockopt & setsockopt)

Command	Data type	Description
IP_ADD_MEMBERSHIP	struct ip_mreq	join a multicast group
IP_DROP_MEMBERSHIP	"	leave a multicast group
IP_MULTICAST_IF	struct in_addr	specify default interface for outgoing multicast
IP_MULTICAST_TTL	u_char	specify TTL for outgoing messages
IP_MULTICAST_LOOP	u_char	enable or disable loop back for outgoing multicasts.

### IPv4 Addressing Schemes:

Subnet Mask	IP address		network bits/host bits	begins	ends
255.0.0.0	0xxxxxxx	A	8/24	0	127
255.255.0.0	10xxxxxx	B	16/16	128	191
255.255.255.0	110xxxxx	C	24/8	192	223
	1110xxxx	D	(used for multicasting)	224	239
	11110xxx	E	(used for research)	240	255

224.0.0.1 means broadcast to all devices on the link.

224.0.0.2 means broadcast to all routers on this subnet.