

Multicasting

1. Broadcast

An old term that is traditionally associated with radio and television. It generally represents an indiscriminate transmission that can be received by anyone who has the correct equipment. Today broadcast is used in IP networks when data are transmitted from one sender node being “heard” by all other nodes in a specific network, such as within a local area network (LAN). That is, it is a point-to-multipoint transmission, with the information being sent to all connected receivers.

2. Multicast

Multicast was originally a product of IP networks. Some applications, such as Internet television, Internet gaming, and IP teleconferencing applications, require data to be delivered from one or multiple senders to multiple receivers. A service whereby data are delivered from one or multiple sender nodes to multiple designated receiver nodes is called multipoint communication or multicast, and applications that involve a multicast delivery service are called multicast applications. On the Internet there are two types of addresses: unicast and multicast. A host or node on the Internet normally has only one unicast address but can be a member of many multicast groups.

3. IP-multicast

IP multicast implements multicast service at the IP routing level, with each individual packet transmitted from the source, duplicated at routers, and then delivered to multiple receivers simultaneously. It is also called native multicast.

4. Overlay Multicast (OM)

An application layer virtual or logical network in which endpoints are addressable and that provides connectivity, routing, and messaging between endpoints. Overlay networks are frequently used as a substrate for deploying new network services or for providing a routing topology not available from the underlying physical network. Many peer-to-peer systems are overlay networks that run on top of the Internet. n Overlay multicast (OM). Overlay multicast implements multicast service at the overlay network layer. Hosts participating in a multicast session form an overlay network and only utilize unicasts among pairs of hosts for data dissemination. The hosts in overlay multicast exclusively

handle group management, routing, and tree construction, without any support from Internet routers. This is also commonly known as application layer multicast (ALM) or end system multicast (ESM).

5. Peercast.

A means of multicasting, broadcasting, or unicasting a data stream via a peer-to-peer network. Peercasting is most often used for P2P broadcasting and P2P multicasting.

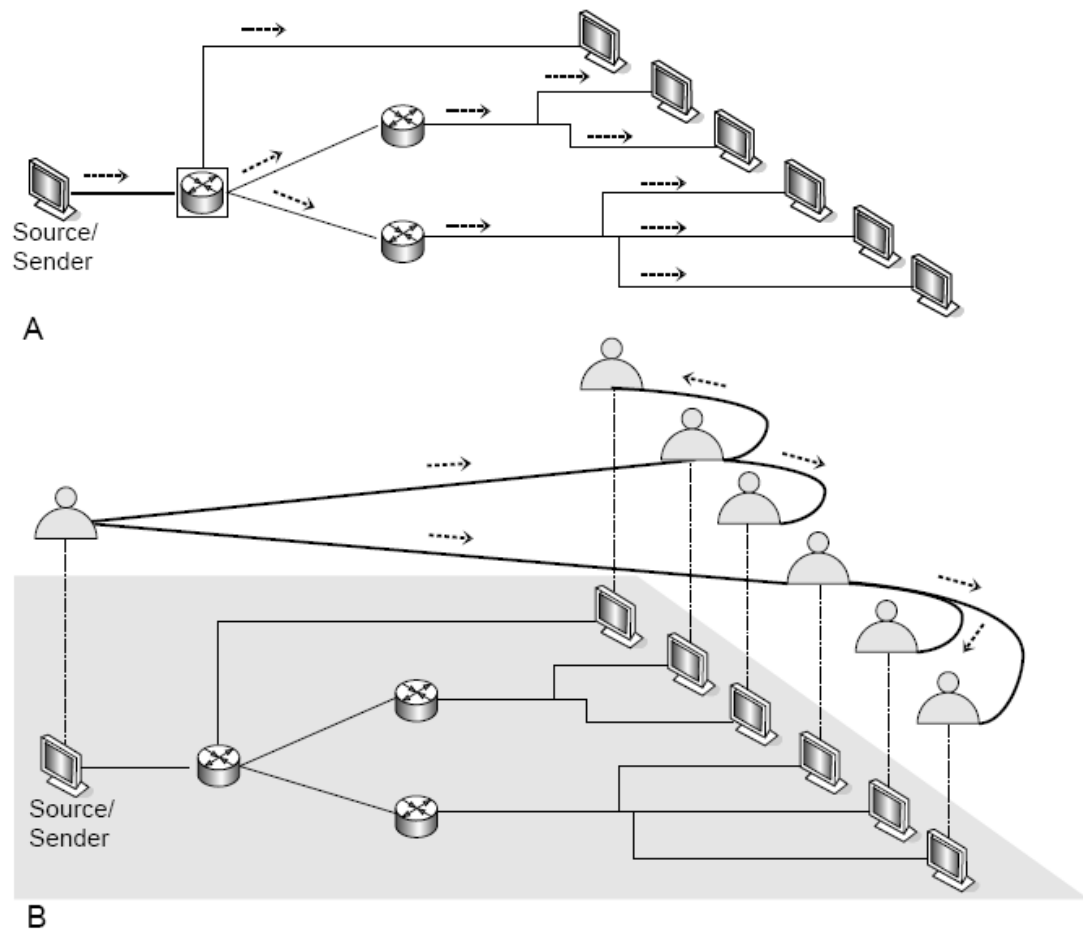


FIGURE 9.3 IP multicast versus overlay multicast.

6. IP Multicast vs. Overlay Multicast

IP multicast and overlay multicast (OM) are the two primary existing multicast approaches. Protocol-Independent Multicast (PIM), Distance Vector Multicast Routing Protocol (DVRMP), and Core-Based Trees (CBT) Multicast Routing are several standardized IP multicast protocols called host-group multicast protocols (HGMPs). In a HGMP, one group address per multicast group is created, and each router stores the state for each active group address. In addition, control protocols are implemented to manage group membership. Compared with overlay multicast, IP multicast can realize higher performance and transmission efficiency. However, due to a variety of factors, including cost of deployment, inter-domain deployment issues, and the need for pricing models, to date IP multicast has not been deployed by many service providers, especially in wide area networks. Overlay multicast (OM), on the other hand, is much easier to deploy since it does not rely on router deployment. In OM, an overlay network is built on top of available network services. Peers self-organize into distributed networks that are overlaid on top of the IP networks. The multicast group members (i.e., peers) are connected via the overlay network. Multicast functions, such as group management, multicast routing, and data replication, are performed at the overlay network layer by forming a unicast tree or mesh at the application layer, overlay networks. In general, the overlay multicast application layer sits on top of a structured or an unstructured overlay network layer that rests on top of the network layer. Multicast groups are formed among the peers in the overlay network, that is, built on top of the overlay infrastructure in the application layer. Some OM systems form an overlay only among the group members that participate in the multicast session. At the overlay network layer, some basic peer communication functionalities are provided. For instance, peer discovery, message routing algorithm, overlay network reliability, and overlay security are often implemented at the overlay network layer, whereas multicast is achieved through message forwarding among the members of the multicast groups using unicast across the underlying network or Internet. The generality of the overlay also makes it possible for a single overlay to be shared by many different multicast sessions. This has the advantage of sharing the cost of overlay construction and maintenance among many different applications.

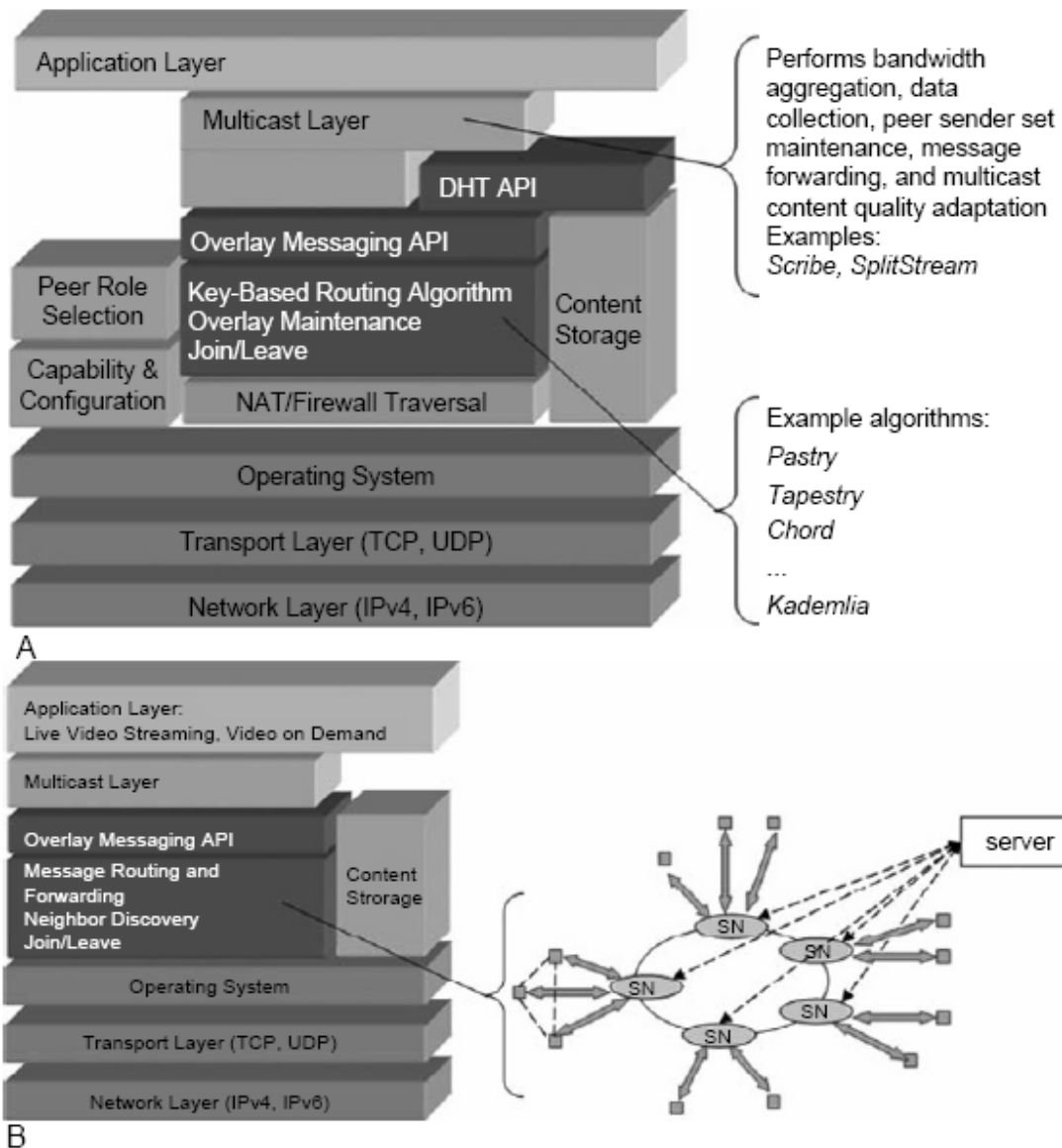


FIGURE 9.4 OM elements within the protocol stack.

7. Hybrid Multicast

To reduce the performance penalty of OM, Zhang proposed a hybrid multicast framework called Universal Multicast (UM). The basic idea is to fully utilize native IP multicast wherever available and automatically construct an overall multicast session via unicast tunnels between regions of the network supporting native IP multicast, called islands. Isolated IP multicast islands in LANs, especially in enterprise networks and campus networks, exist, even though universal deployment has been slow. To take advantage of the IP multicast performance gain, these available IP multicast islands can be utilized to build an UM wherever possible. To provide ubiquitous multicast delivery services, unicast tunnels between IP multicast islands are built. Multicast messages are transmitted via native IP multicast protocols within the islands and encapsulated in unicast packets to transmit through the tunnels from one island to another. Since native group management protocols don't extend beyond the islands, a mechanism to coordinate the membership across the islands is needed. For hybrid multicast, typically at least two types of protocols are needed: an intra-island and an inter-island group management protocol. P2P OM protocols can be utilized as the inter-island multicast protocol; the Internet Group Management Protocol (IGMP) may be used for the intra-island subgroup multicast. An alternative or even complementary approach to using multicast tunneling is to use an overlay to adaptively combine native multicast regions with overlay multicast. Peers that are members of a multicast group that are in a common native multicast region can map their multicast paths to the native multicast protocol. He and Ammar have analyzed a hybrid architecture combining host-group multicast with multi-destination multicast. Combining these elements, we can see a hybrid multicast architecture that uses native multi-destination routing for small groups for overlay performance enhancement, native host-group routing for larger groups, and overlay multicast to combine native islands into single group sessions. To leverage performance and cost, today the information technology (IT) industry and the telecommunications industry are also looking into the feasibility of hybrid peer-to-peer system for Internet video and IPTV services. Some popular approaches include content popularity weighted and managed overlay-based approaches. In a content popularity weighted approach, popular content is offloaded from the server and the low-cost peer-to-peer overlay is used to improve system scalability. The long tail content, on the other hand, is served primarily by the content server to ensure reliability and QoS. Managed overlay takes control of content delivery via server or content delivery networks (CDNs). The servers act like the supernodes in hybrid P2P networks. Consumers (peers) supply bandwidth and storage when needed.