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Chapter Goals

- Provide an overview of IPv6, the newest version of the most popular protocol used today.

IPv6

One of the newest major standards on the horizon is IPv6. Although IPv6 has not officially become a standard, it is worth some overview. It is very possible that this information will change as we move closer to IPv6 as a standard, so you should use this as a guide into IPv6, not the definitive information.

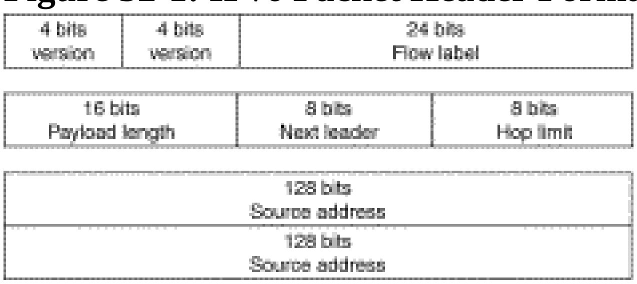
A number of books are now being published that cover in detail this emerging standard; if you are looking for more details you should refer to these books. All the RFCs available on the Internet have the raw details on how this standard is developing. However, these documents are difficult to interpret at first glance and require some commitment to going through any number of RFCs pertaining to many subjects all related to IPv6 development.

Internet Protocol Version 4 is the most popular protocol in use today (see Chapter 31, "Internet Protocols"), although there are some questions about its capability to serve the Internet community much longer. IPv4 was finished in the 1970s and has started to show its age. The main issue surrounding IPv6 is addressing—or, the lack of addressing—because many experts believe that we are nearly out of the four billion addresses available in IPv4. Although this seems like a very large number of addresses, multiple large blocks are given to government agencies and large organizations. IPv6 could be the solution to many problems, but it is still not fully developed and is not a standard—yet!

Many of the finest developers and engineering minds have been working on IPv6 since the early 1990s. Hundreds of RFCs have been written and have detailed some major areas, including expanded addressing, simplified header format, flow labeling, authentication, and privacy.

Expanded addressing moves us from 32-bit address to a 128-bit addressing method. It also provides newer unicast and broadcasting methods, injects hexadecimal into the IP address, and moves from using "." to using ":" as delimiters. Figure 32-1 shows the IPv6 packet header format.

Figure 32-1: IPv6 Packet Header Format



Description of IPv6 Packet Header

The simplified header is 40 bits long and the format consists of Version, Class, Flow Label, Payload Length, Next Header, Hop Limit, Source Address, Destination Address, Data, and Payload fields.

Hexadecimal "Hex"

At its simplest, hex numbers are base 16. Decimal is base 10, counting from 0 to 9, as we do in decimal, and then adding a column to make 10. Counting in hex goes from 0 to F before adding a column. The characters A through F represent the decimal values of 10 through 15, as illustrated in Figure 32-2.

Figure 32-2: Hex Characters A Through F Represent the Numbers 10 Through 15

Decimal	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hex	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Counting in hex goes as follows: 0 1 2 3 4 5 6 7 8 9 A B C D E F 10 11 12 13 14 15 16 17 18 19 1A 1B

1C 1D 1E 1F 20 21 and up, as far as you want to go.

Addressing Description

Let's look at an example of IPv6 address. The address is an eight-part hex address separated by colons (" :"). Each part *n* can equal a 16-bit number and is eight parts long, providing a 128-bit address length (16 ¥ 8 = 128),

Addresses are n:n:n:n:n:n:n:n n = 4 digit hexadecimal integer, 16 ¥ 8 = 128 address.

1080:0:0:0:8:800:200C:417A Unicast address

FF01:0:0:0:0:0:0:101 Multicast address

Broadcasting Methods

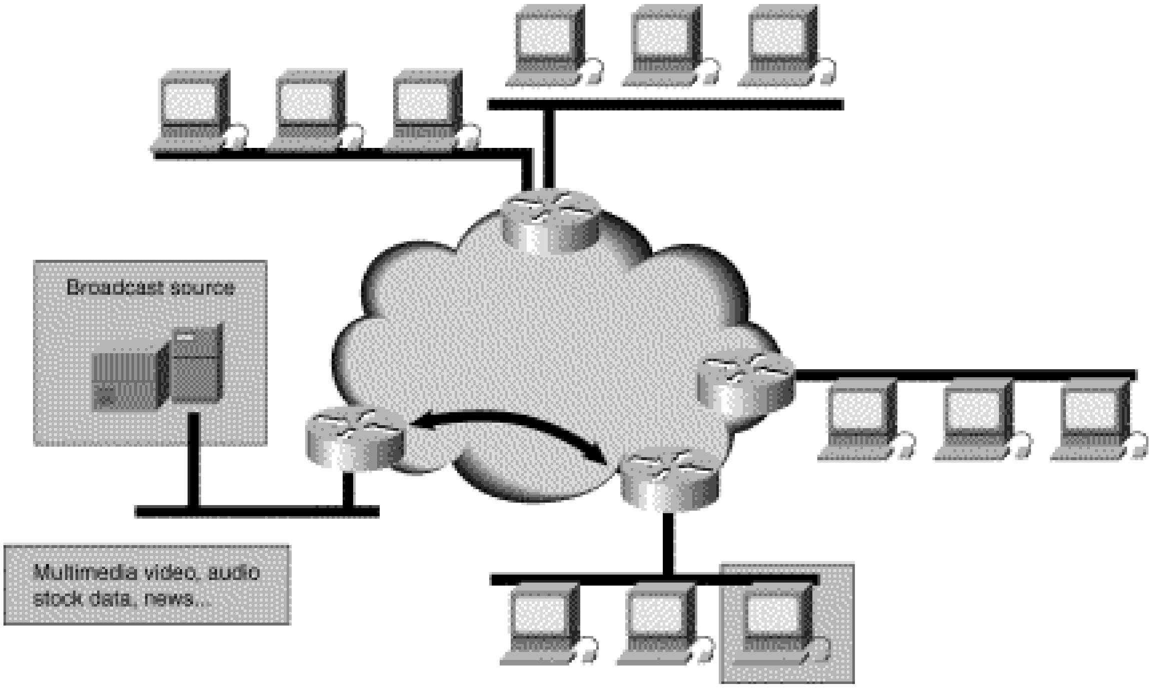
Included in IPv6 are a number of new broadcasting methods:

- Unicast
- Multicast
- Anycast

Unicast

Unicast is a communication between a single host and a single receiver. Packets sent to a unicast address are delivered to the interface identified by that address, as seen in Figure 32-3.

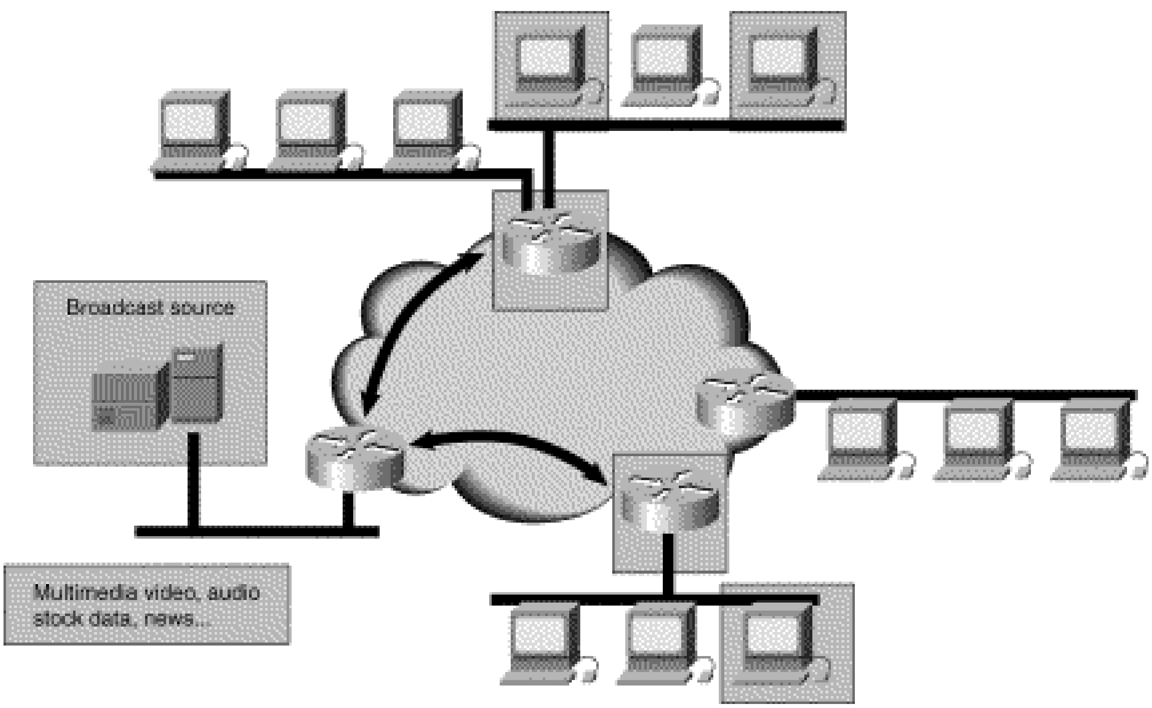
Figure 32-3: Unicast Sends Packets to a Specified Interface



Multicast

Multicast is communication between a single host and multiple receivers. Packets are sent to all interfaces identified by that address, as seen in Figure 32-4.

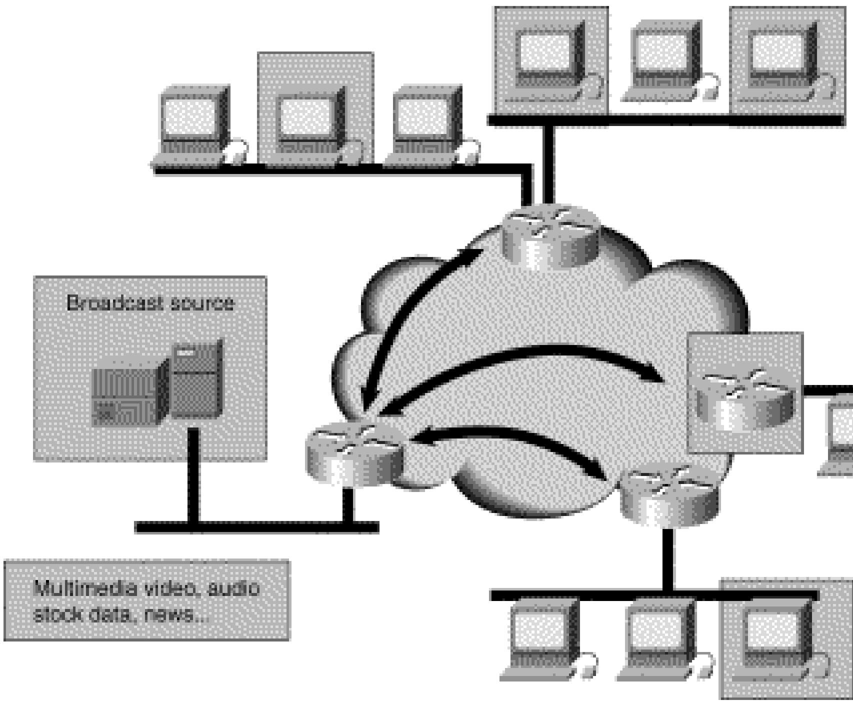
Figure 32-4: Multicast Sends Packets to a Subnet, and Defined Devices Listen for Multicast Packets



Anycast

Packets sent to an anycast address or list of addresses are delivered to the nearest interface identified by that address. Anycast is a communication between a single sender and a list of addresses, as shown in Figure 32-5.

Figure 32-5: Anycast Sends Packets to Specified Interface List and Can Contain End Nodes and Routers



Summary

Some of the benefits of IPv6 seem obvious: greater addressing space, built-in QoS, and better routing performance and services. However, a number of barriers must be overcome before the implementation of IPv6. The biggest question for most of us will be what the business need is for moving from current IPv4 to IPv6. The killer app has not appeared yet, but it may be closer than we think. The second consideration is the cost—it may not have much to do with hardware replacement cost. All the larger routers have upgradable OSs IOS; the only necessity is the commitment to upgrading IOS. More likely to do with training and support of minor IP devices such as printers and network faxes, they will support the new address space. IPv6 has schemes to support old and new, however, so this may not even be a barrier. The last issue to consider is training: This will need to happen sooner or later because we all need to start thinking about 128-bit addressing based on MAC addresses in HEX. This involves all new ways of addressing and will be an uncomfortable change for many people.

This conclusion may seem negative, but the greater good will overpower all the up-front issues. The issue is not whether you will have to move to IPv6, but when! We all need IPv6; the increased address space, which is quadrupled, is needed for the growth of IP appliances that we are starting to hear about weekly. IP-ready cars are already shipping today. This requires mobility, which is addressed in IPv6.

Of course, a number of very important features have not been discussed in this section, including QoS, mobile IP, autoconfiguration, and security. All these areas are extremely important, and until IPv6 is finished, you should keep referring to the IETF Web site for the most current information. Several new books on IPv6 also are starting to show up on bookstore shelves and should provide the deeper technical detail on address headers and full packet details.

Review Questions

Q—*What is the current standard?*

A—IPv4.

Q—*What is the main reason for IPv6 being developed?*

A—The main issue surrounding IPv6 is addressing, or the lack of addressing. Many people believe that we are nearly out of the four billion addresses available in IPv4. IPv6 could be the solution to many problems, but IPv6 is still not fully developed and is not yet a standard.

Q—*How many bits does the new expanded addressing provide?*

A—The expanded addressing moves us from 32-bit address to a 128-bit addressing method.

Q—*What other benefits does expanded addressing provide?*

A—It provides newer unicast and broadcasting methods. Expanded addressing also injects hexadecimal into the IP address and moves from using "." to using ":" as delimiters.

Q—*What are the new broadcast methods included in IPv6?*

A—Unicast, multicast, and anycast.

Q—*What is unicast?*

A— Unicast is a communication between a single host and a single receiver.

Q—*What is multicast?*

A—Multicast is communication between a single host and multiple receivers.

Q—*What is anycast?*

A— Anycast is a communication between a single sender and a list of addresses.

For More Information

http://www-6bone.lbl.gov/6bone

www.cisco.com/ipv6

http://www.ietf.org/html.charters/ipngwg-charter.html

http://playground.Sun.COM:80/pub/ipng/html

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