Good job!

You have successfully identified the correct answers.

1. IPv4 was standardized in the 1980s and has several technological limitations, such as lack of end-to-end connectivity and a depleted address space.
2. There are several technical improvements made to IPv6, two of which are a vastly larger IP address pool and a simplified protocol header.
3. The IPv6 header is a fixed length of 40 octets and contains 8 header fields.
4. Several fields in the IPv6 header replaced fields in the IPv4 header. For example, the Hop Limit field replaced the IPv4 header Time to Live field.

You answered 4 out of 4 questions correctly.

v6, which will eventually replace IPv4. To better understand why you need to know the IPv6 protocol, it helps to know the limitations of IPv4 and the advantages of IPv6.

Through the years, additional protocols and processes have been developed to address new challenges. However, even with changes, IPv4 still has three major issues:

- **IPv4 address depletion** – IPv4 has a limited number of unique public addresses available. Although there are approximately 4 billion IPv4 addresses, the increasing number of new IP-enabled devices, always-on connections, and the potential growth of less-developed regions have increased the need for more addresses.
- **Lack of end-to-end connectivity** – Network Address Translation (NAT) is a technology commonly implemented within IPv4 networks. NAT provides a way for multiple devices to share a single public IPv4 address. However, because the public IPv4 address is shared, the IPv4 address of an internal network host is hidden. This can be problematic for technologies that require end-to-end connectivity.
- **Increased network complexity** – While NAT has extended the lifespan of IPv4 it was only meant as a transition mechanism to IPv6. NAT in its various implementation creates additional complexity in the network, creating latency and making troubleshooting more difficult.

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llowing:

- **Increased address space** - IPv6 addresses are based on 128-bit hierarchical addressing as opposed to IPv4 with 32 bits.
- **Improved packet handling** - The IPv6 header has been simplified with fewer fields.
- **Eliminates the need for NAT** - With such a large number of public IPv6 addresses, NAT between a private IPv4 address and a public IPv4 is not needed. This avoids some of the NAT-induced problems experienced by applications that require end-to-end connectivity.

The 32-bit IPv4 address space provides approximately 4,294,967,296 unique addresses. IPv6 address space provides 340,282,366,920,938,463,463,374,607,431,768,211,456, or 340 undecillion addresses. This is roughly equivalent to every grain of sand on Earth.

The figure provides a visual to compare the IPv4 and IPv6 address space.

IPv4 and IPv6 Address Space Comparison

Number Name	Scientific Notation	Number of Zeros
1 Thousand	10^3	1,000
1 Million	10^6	1,000,000
1 Billion	10^9	1,000,000,000

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Number of Zeros
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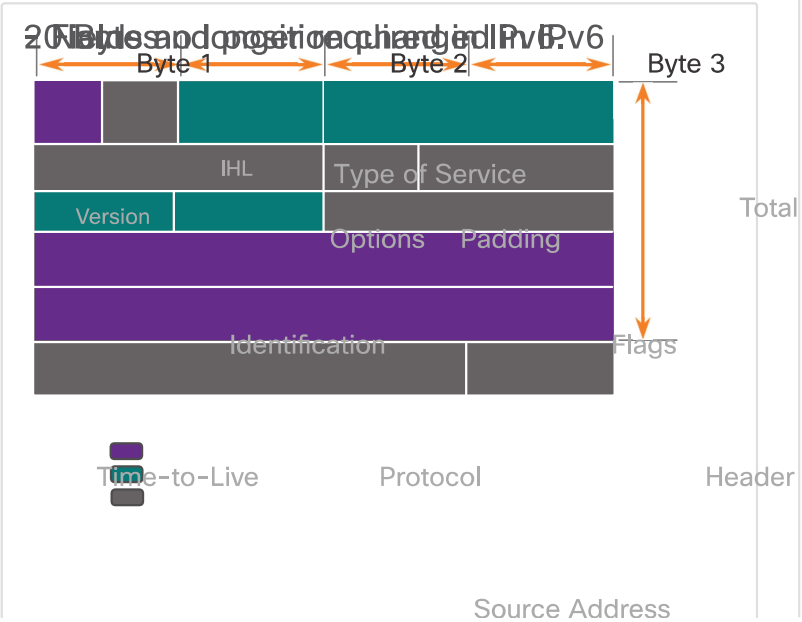
One of the major design improvements of IPv6 over IPv4 is the simplified IPv6 header.

For example, the IPv4 header consists of a variable length header of 20 octets (up to 60 bytes if the Options field is used) and 12 basic header fields, not including the Options field and Padding field.

For IPv6, some fields have remained the same, some fields have changed names and positions, and some IPv4 fields are no longer required, as highlighted in the figure.

IPv4 Packet Header



The figure shows IPv4 packet header fields that were

were not

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Good job!

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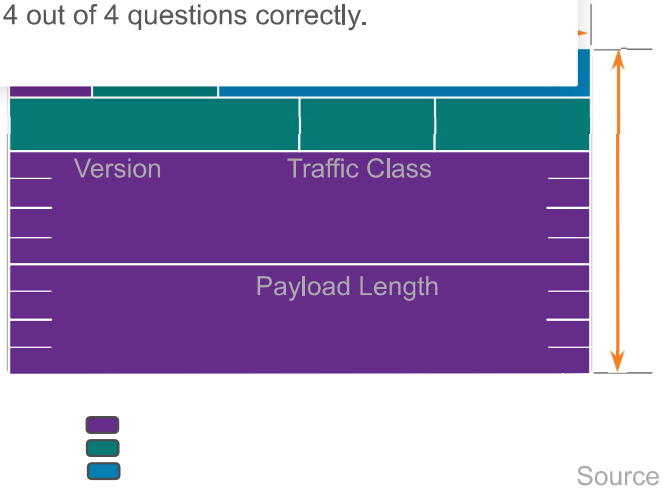

Source IP Addres

The figure shows the IPv4 packet header fields that were kept or moved along with the new IPv6 packet header fields.

Destination IP Addı

8.3.4

IPv6 Packet Header

Legend

- Fields name kept from IPv4 to IPv6
- Name and position changed in IPv6
- Fields no longer required in IPv6

The IP protocol header diagram in the figure identifies the fields of an IPv6 packet.

Fields in the IPv6 Packet Header

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at all packets with the same flow label receive the same type of handling by routers.

- **Payload Length –** This 16-bit field indicates the length of the data portion or payload of the IPv6 packet. This does not include the length of the IPv6 header, which is a fixed 40-byte header.
- **Next Header –** This 8-bit field is equivalent to the IPv4 Protocol field. It indicates the data payload type that the packet is carrying, enabling the network layer to pass the data to the appropriate upper-layer protocol.
- **Hop Limit** – This 8-bit field replaces the IPv4 TTL field. This value is decremented by a value of 1 by each router that forwards the packet. When the counter reaches 0, the packet is discarded, and an ICMPv6 Time Exceeded message is forwarded to the sending host,. This indicates that the packet did not reach its destination because the hop limit was exceeded. Unlike IPv4, IPv6 does not include an IPv6 Header Checksum, because this function is performed at both the lower and upper layers. This means the checksum does not need to be recalculated by each router when it decrements the Hop Limit field, which also improves network performance.
- **Source IPv6 Address –** This 128-bit field identifies the IPv6 address of the sending host.
- **Destination IPv6 Address –** This 128-bit field identifies the IPv6 address of the receiving host.

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Click Play in the figure to view a demonstration of examining IPv6 headers in a Wireshark capture.

8.3.6

Check Your Understanding - IPv6 Packet

Check your understanding of the IPv6 packet by choosing the BEST answer to the following questions.

1. Which three options are major issues associated

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You got it!

- [ ] header supports additional fields for complex packets
- [x] increased the IP address space
- [ ] standardizes the use of NAT
- [ ] supports class-based networks
- [x] uses a simpler header to provide improved packet handling

3. Which is true of the IPv6 header?

You got it!

- [x] it contains 8 header fields.
- [ ] it contains 12 header fields.

4. Which is true of the IPv6 packet header?

You got it!

- [ ] The Hop Limit field replaces the IPv4 Time to

Live field.

Good job!

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8.2 IPv4 Packet

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