OSI Network Layer

Network Fundamentals – Chapter 5

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Objectives

- Identify the role of the Network Layer, as it describes communication from one end device to another end device
- Examine the most common Network Layer protocol, Internet Protocol (IP), and its features for providing connectionless and best-effort service
- Understand the principles used to guide the division or grouping of devices into networks
- Understand the hierarchical addressing of devices and how this allows communication between networks
- Understand the fundamentals of routes, next hop addresses and packet forwarding to a destination network

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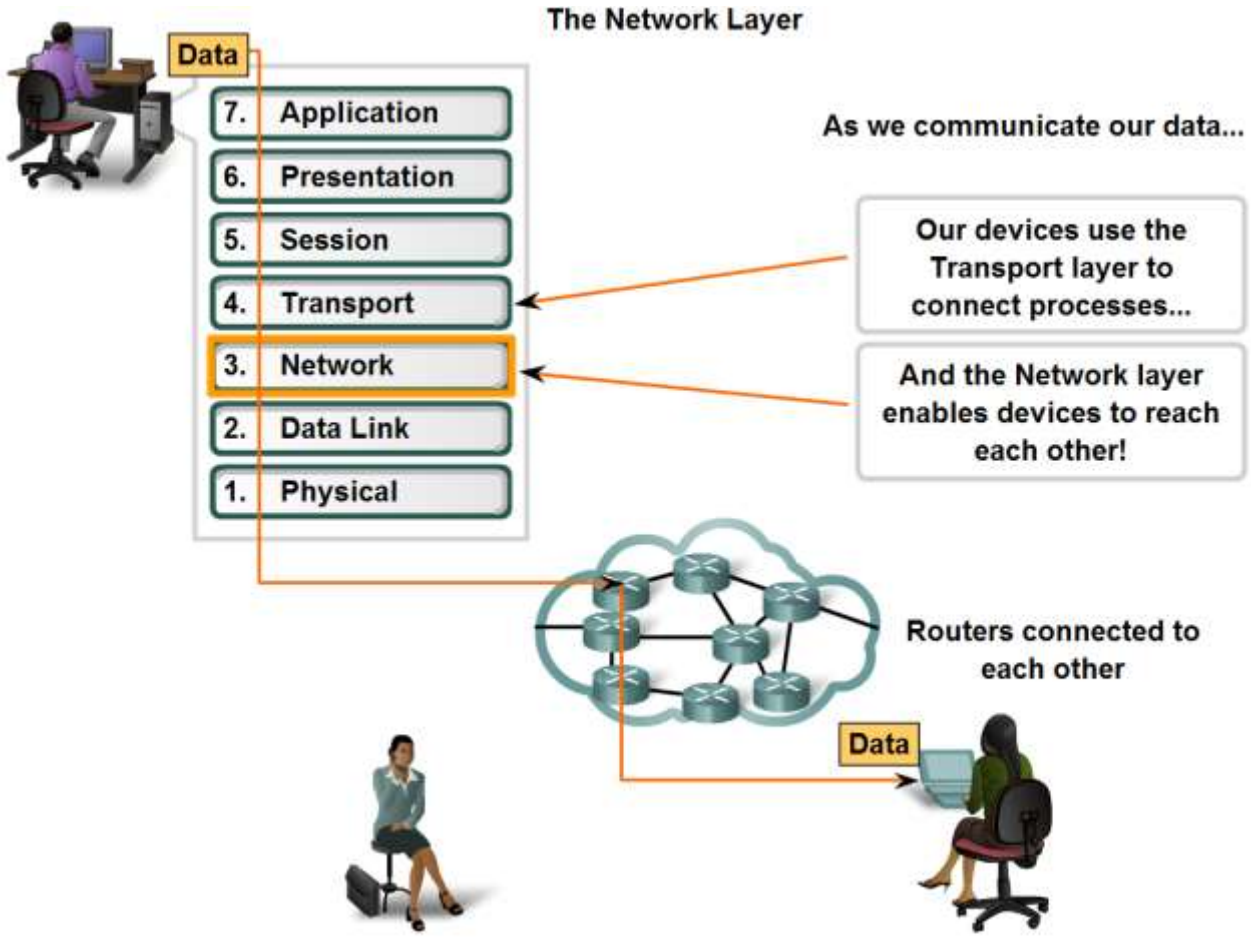
Network Layer Protocols and Internet Protocol (IP)

- Define the basic role of the Network Layer in data networks



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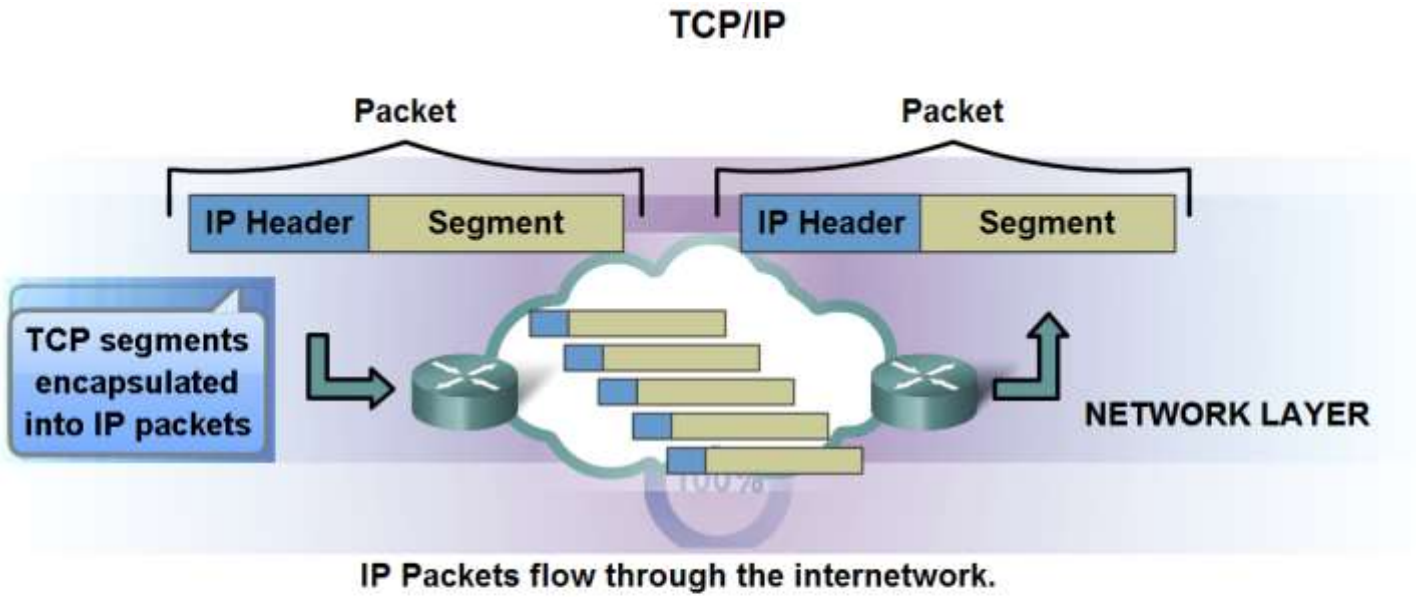
Network Layer Protocols and Internet Protocol (IP)

- Identify the basic characteristics and the role of the IPv4 protocol



IP Packets flow through the internetwork.

- Connectionless - No connection is established before sending data packets.
- Best Effort (unreliable) - No overhead is used to guarantee packet delivery.
- Media Independent - Operates independently of the medium carrying the data.

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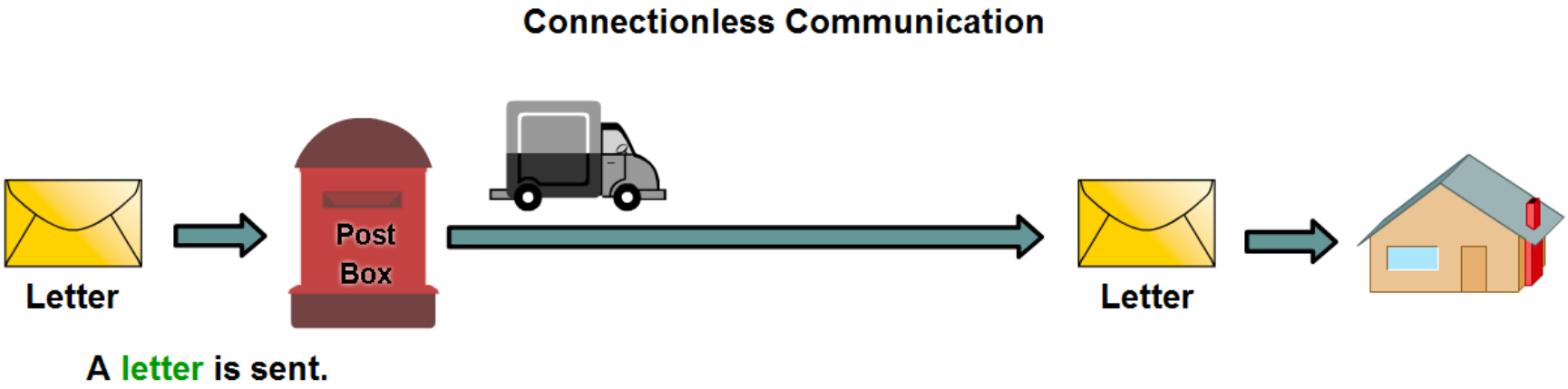
Network Layer Protocols and Internet Protocol (IP)

- Describe the implications for the use of the IP protocol as it is connectionless



The sender doesn't know:

- if the receiver is present
- if the letter arrived
- if the receiver can read the letter

The receiver doesn't know:

- when it is coming

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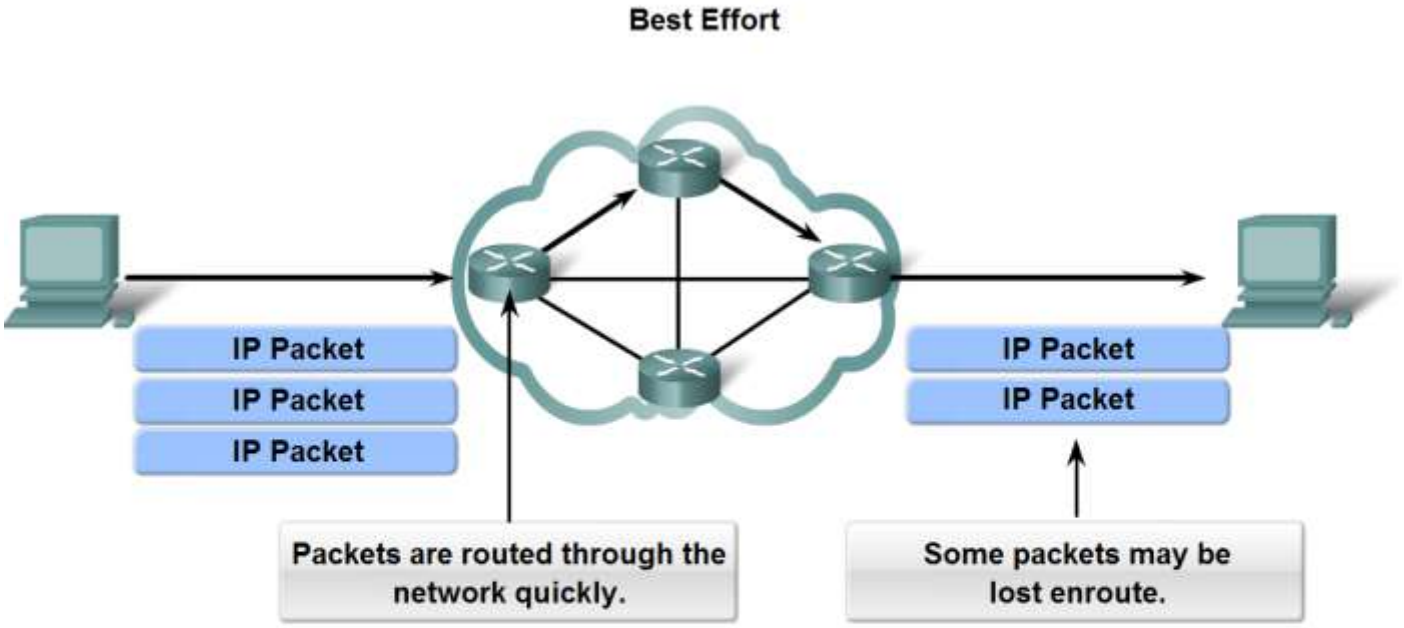
Network Layer Protocols and Internet Protocol (IP)

- Describe the implications for the use of the IP protocol as it is considered an unreliable protocol



As an unreliable Network layer protocol, IP does not guarantee that all sent packets will be received.

Other protocols manage the process of tracking packets and ensuring their delivery.

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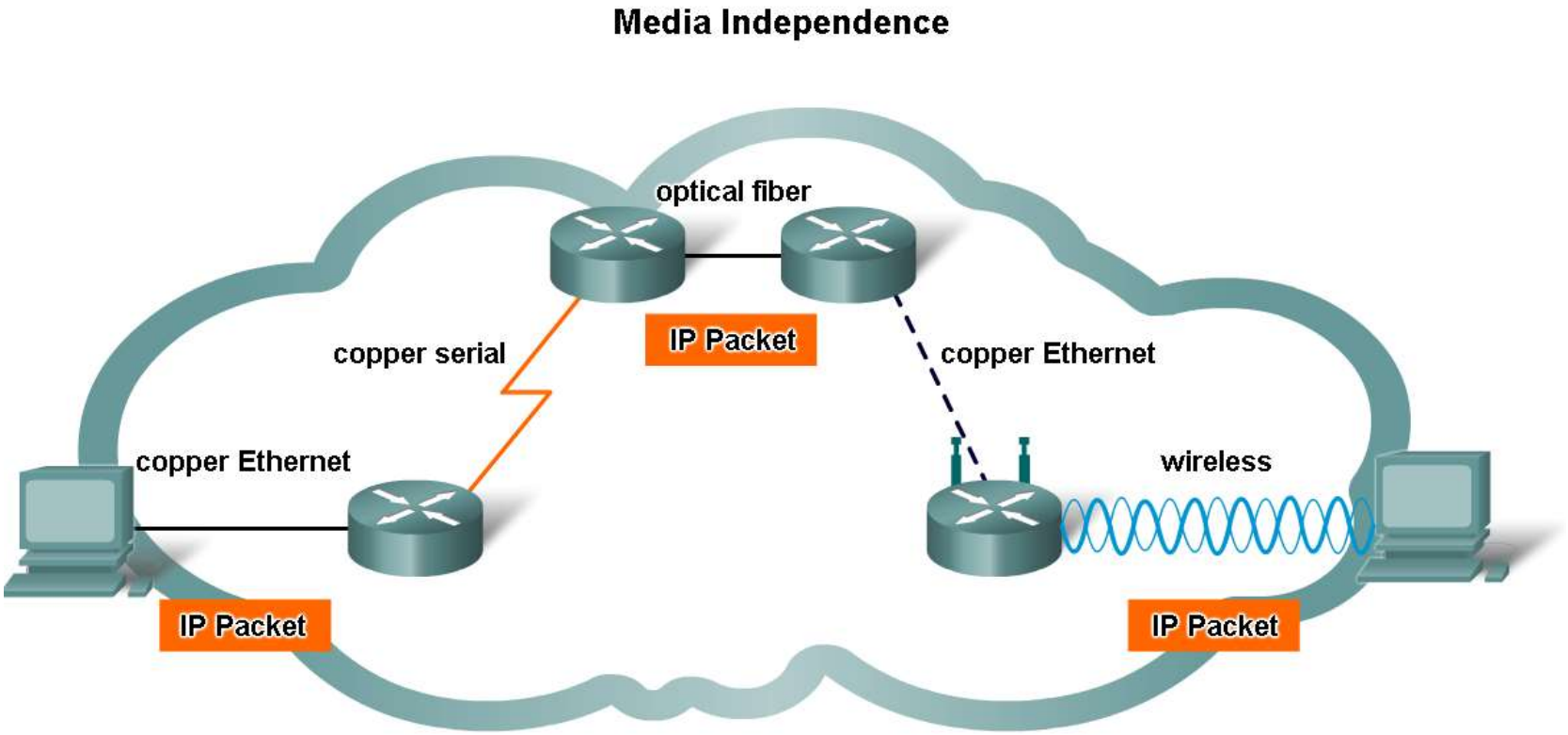
Network Layer Protocols and Internet Protocol (IP)

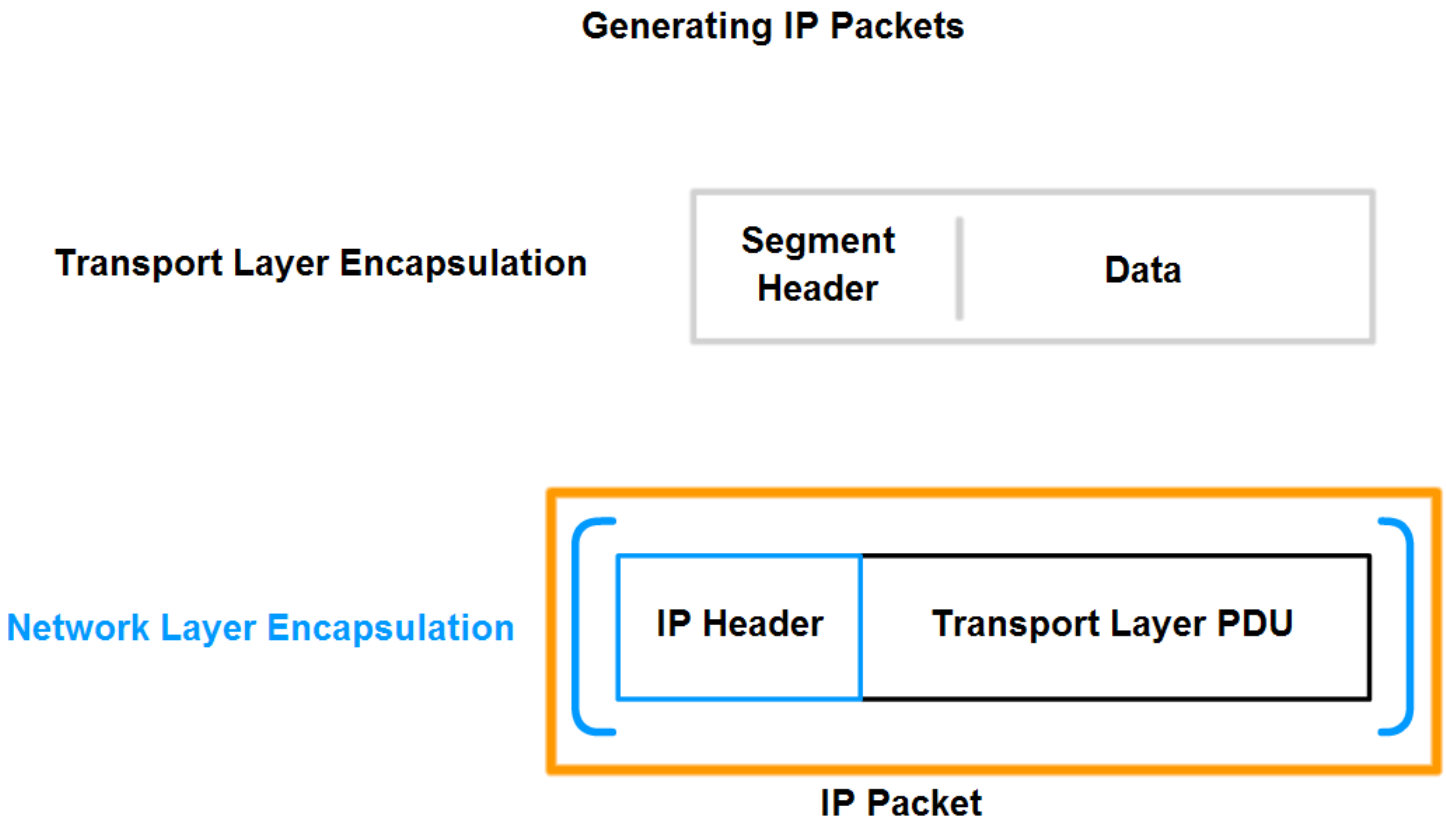
- Describe the implications for the use of the IP as it is media independent



IP packets can travel over different media.

Network Layer Protocols and Internet Protocol (IP)

- Describe the role of framing in the Transport Layer and explain that segments are encapsulated as packets



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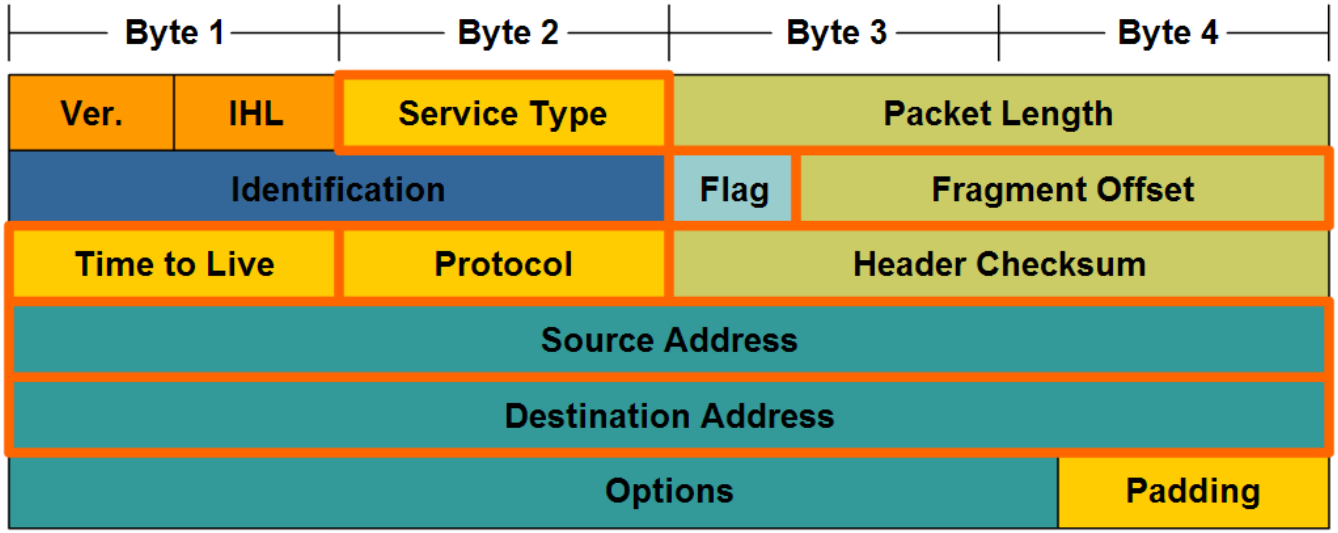
Network Layer Protocols and Internet Protocol (IP)

- Identify the major header fields in the IPv4 protocol and describe each field's role in transporting packets

IPv4 Packet Header Fields



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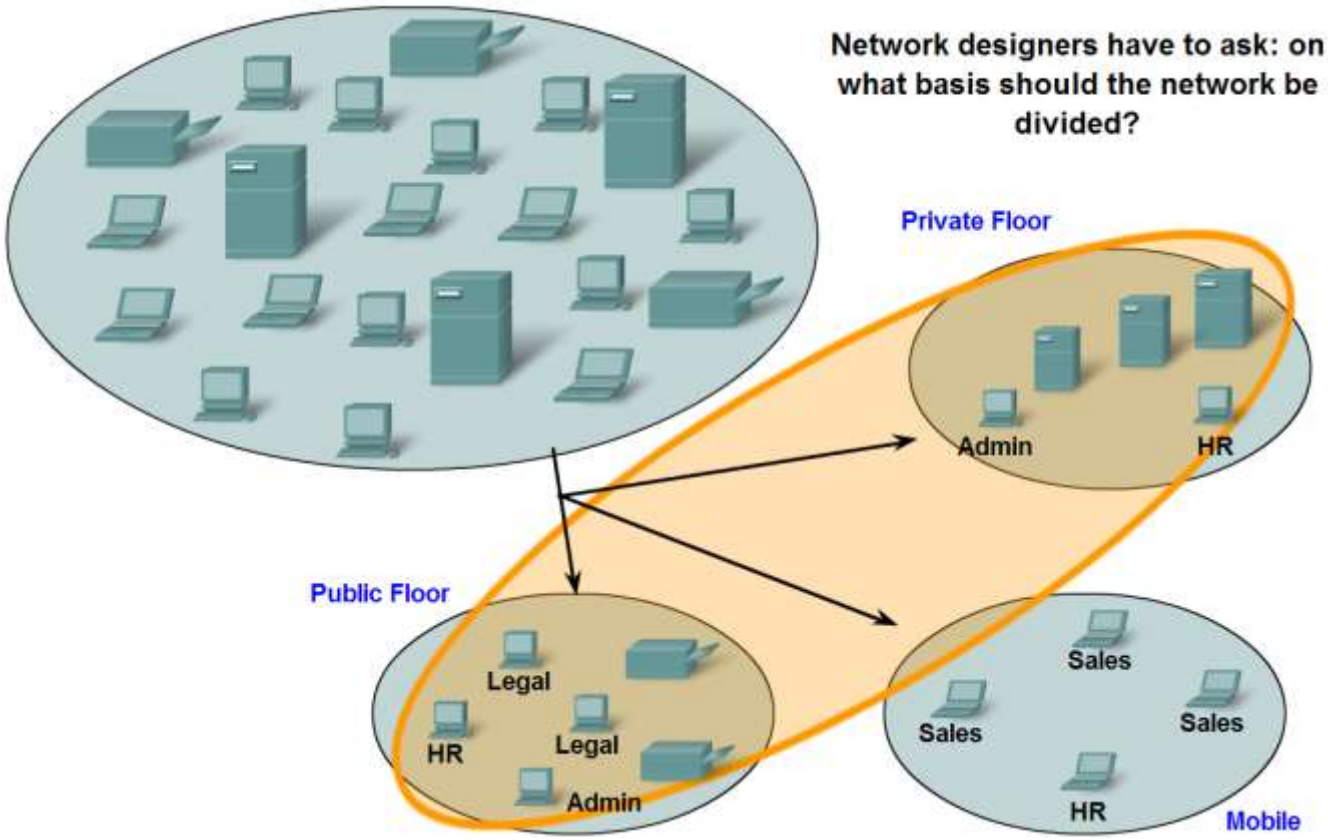
Grouping Devices into Networks and Hierarchical Addressing

- List several different reasons for grouping devices into sub-networks and define several terms used to identify the sub-networks



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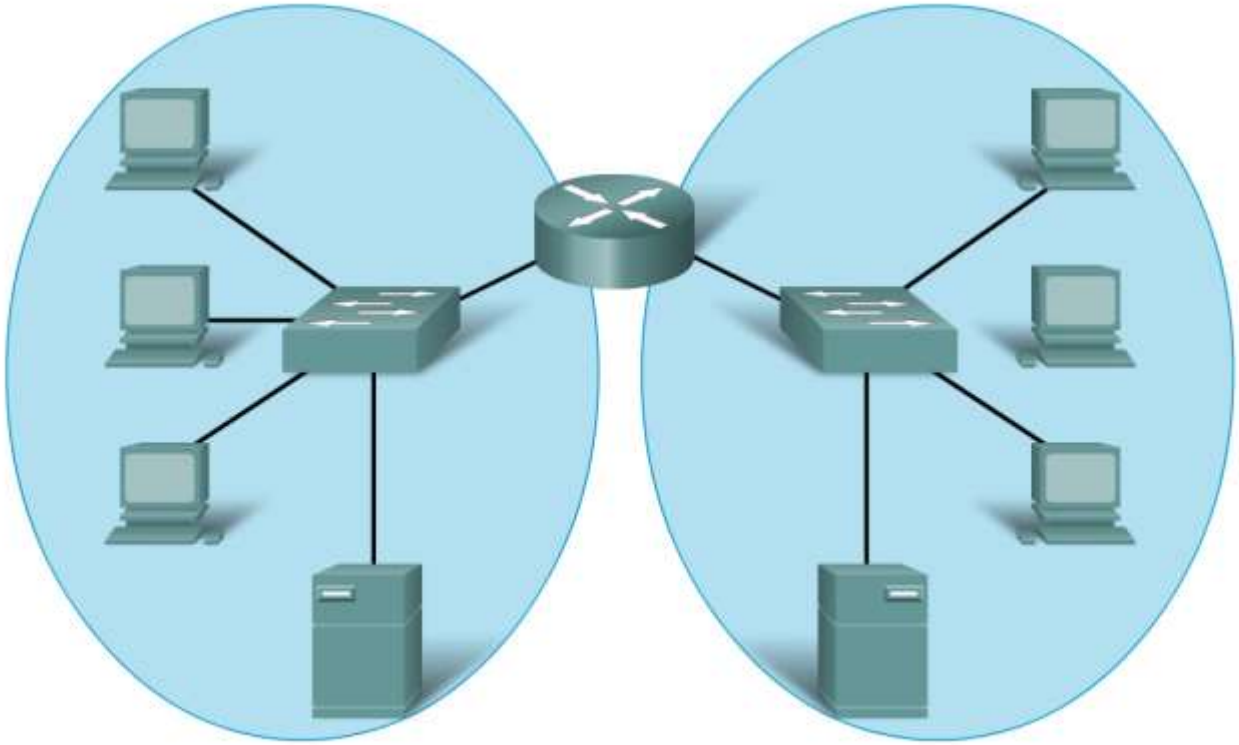
Grouping Devices into Networks and Hierarchical Addressing

- List several ways in which dividing a large network can increase network performance



Replacing the middle switch with a router creates 2 IP subnets, hence, 2 distinct broadcast domains. All devices are connected but local broadcasts are contained.

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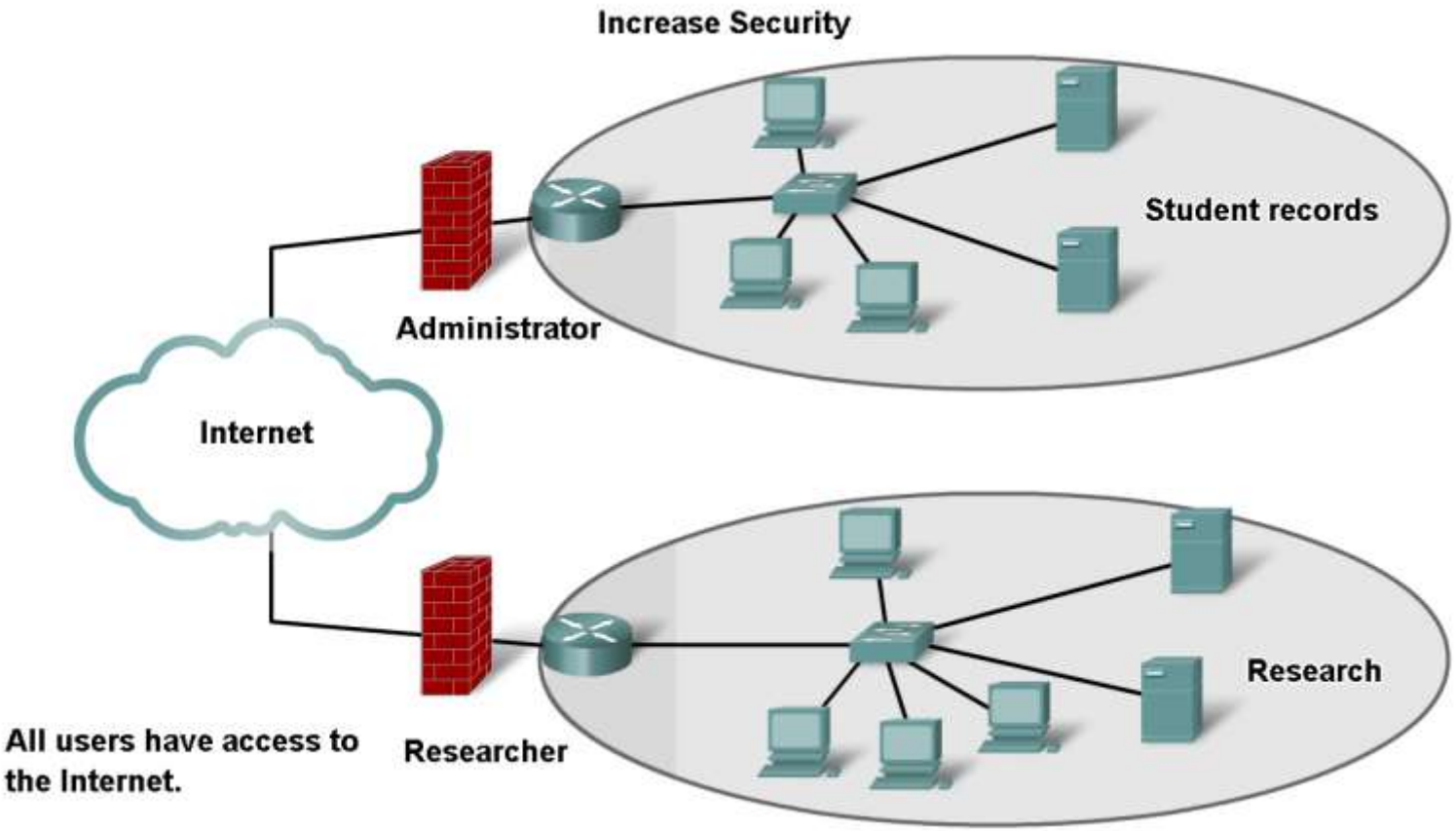
Grouping Devices into Networks and Hierarchical Addressing

- List several ways in which dividing a large network can increase network security



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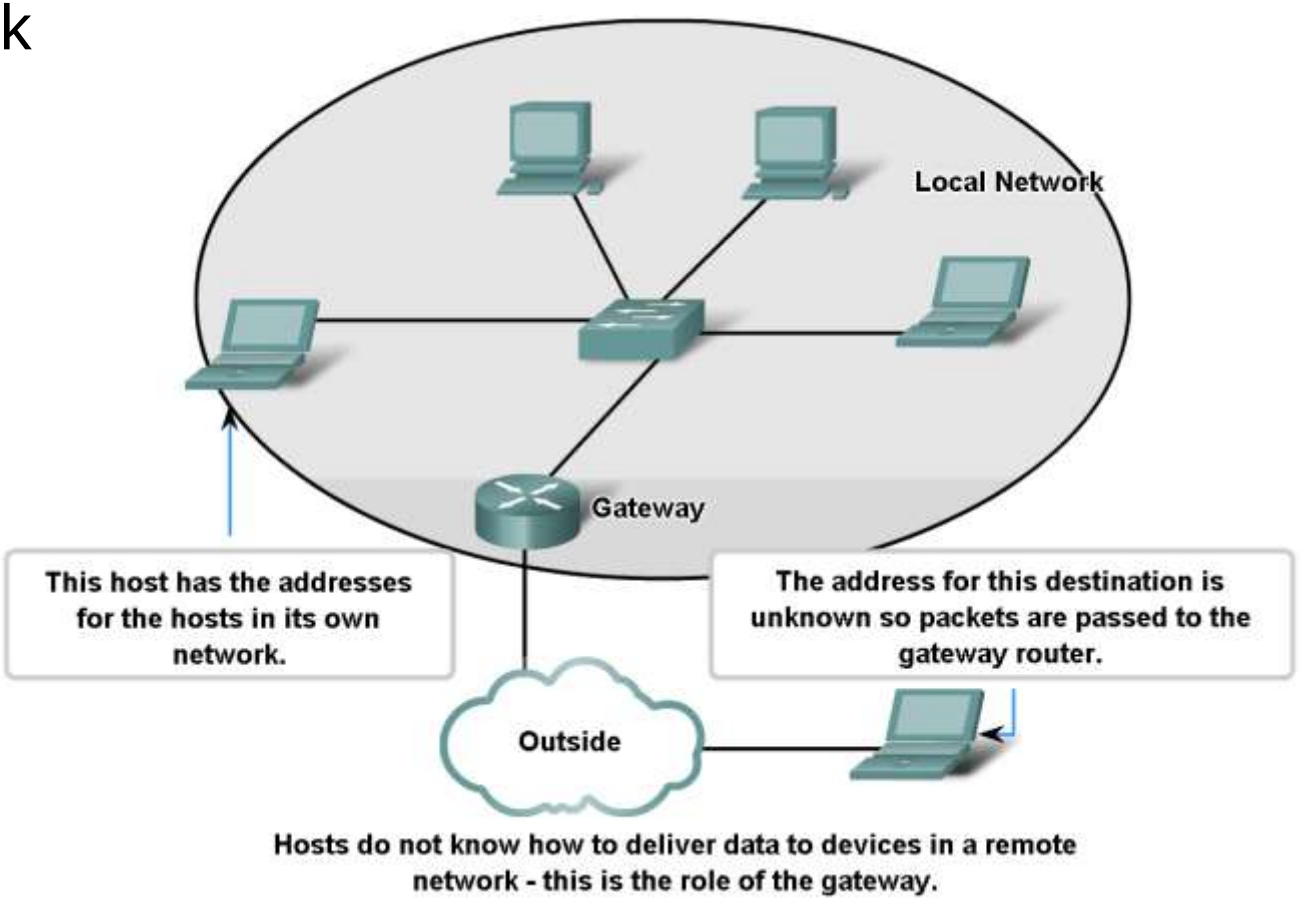
Grouping Devices into Networks and Hierarchical Addressing

- Explain the communication problems that emerge when very large numbers of devices are included in one large network



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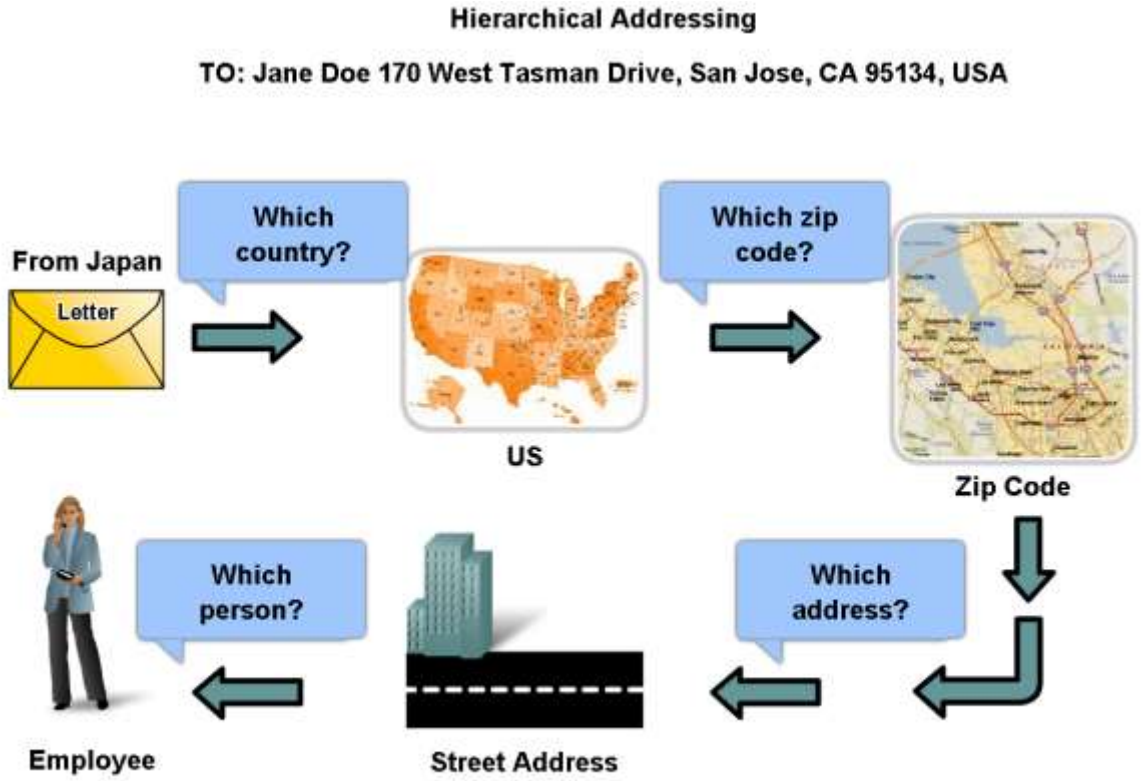
Grouping Devices into Networks and Hierarchical Addressing

- Describe how hierarchical addressing solves the problem of devices communicating across networks of networks



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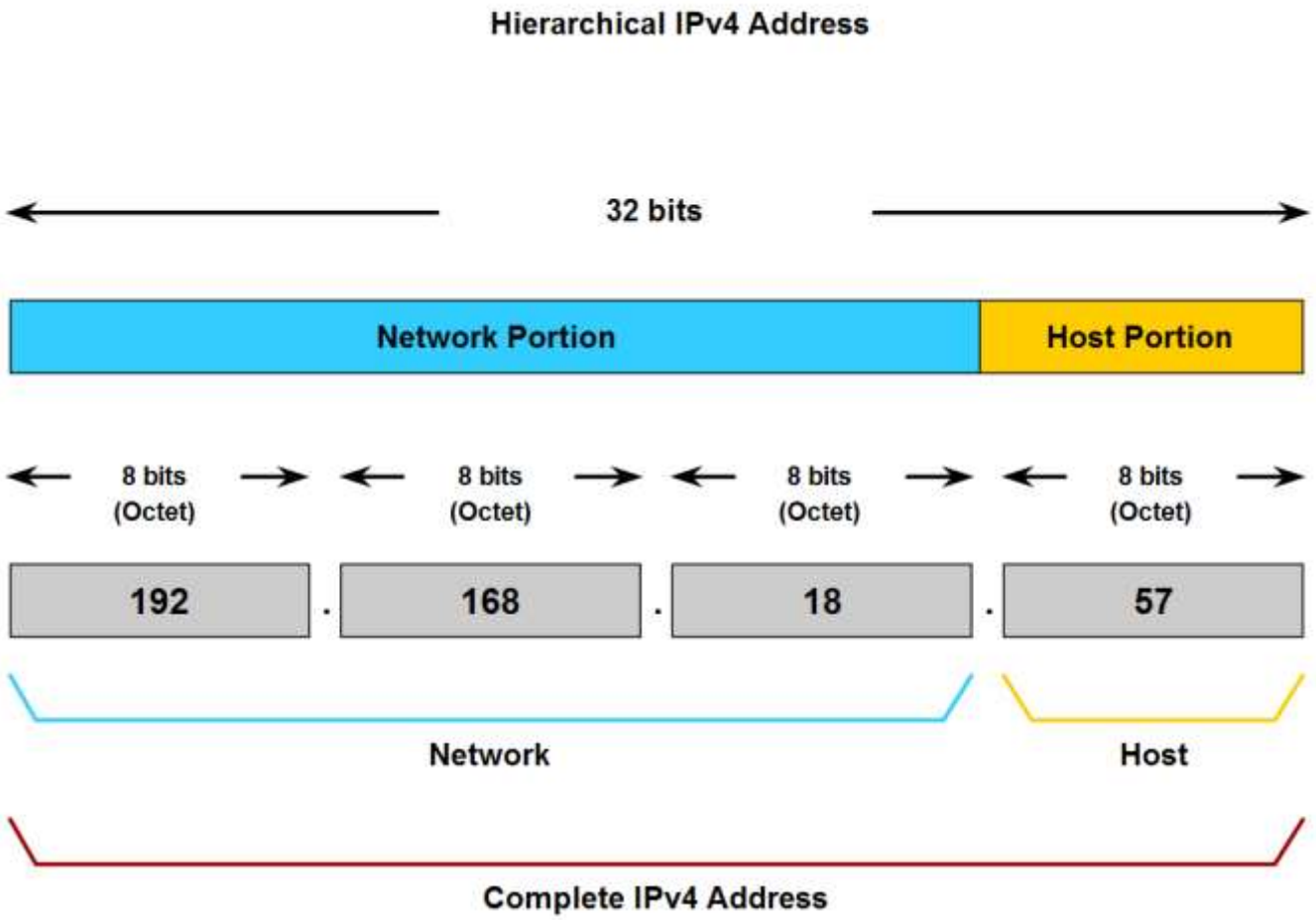
Grouping Devices into Networks and Hierarchical Addressing

- Describe the purpose of further subdividing networks into smaller networks



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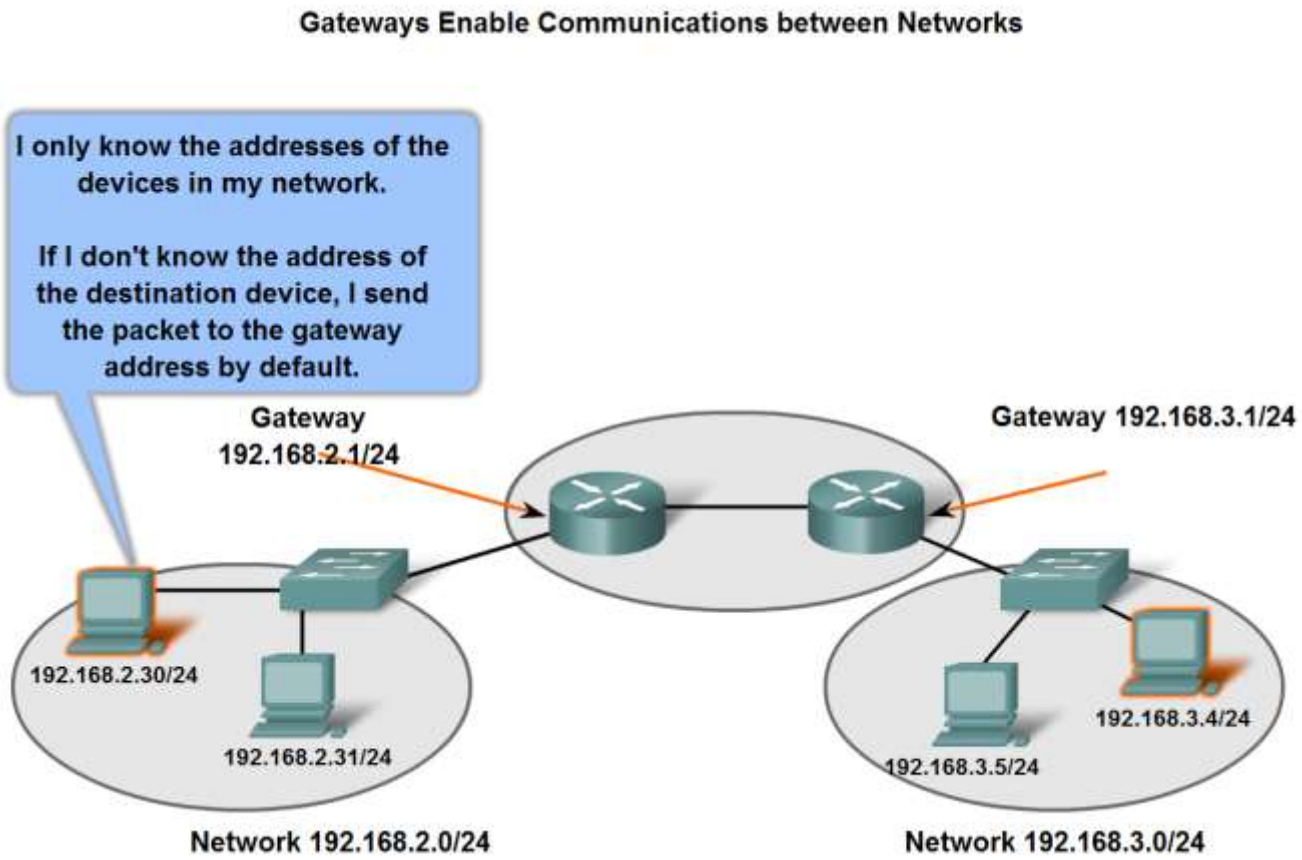
Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Describe the role of an intermediary gateway device in allowing devices to communicate across sub-divided networks



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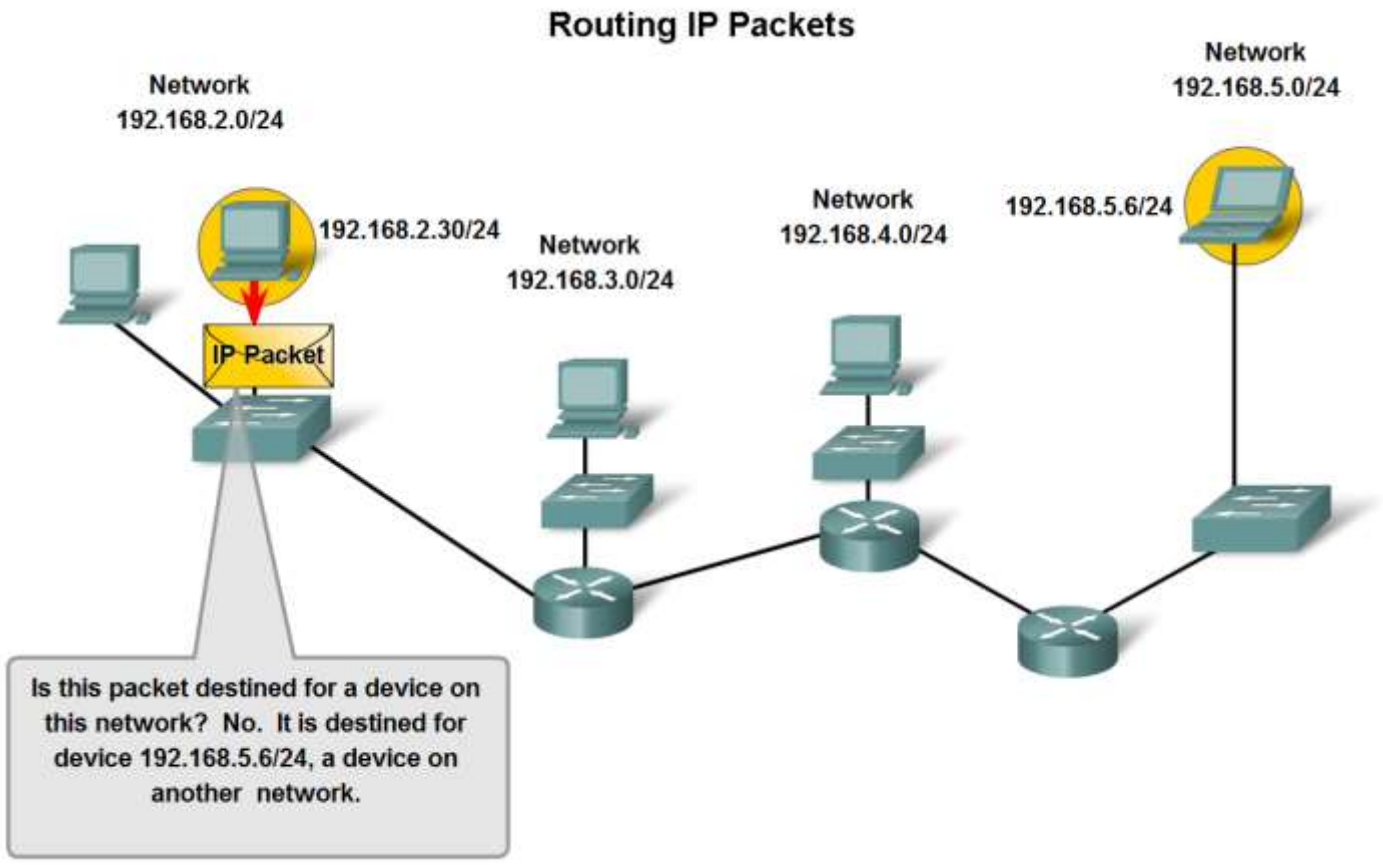
Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Trace the steps of an IP packet as it traverses unchanged via routers from sub network to sub-network



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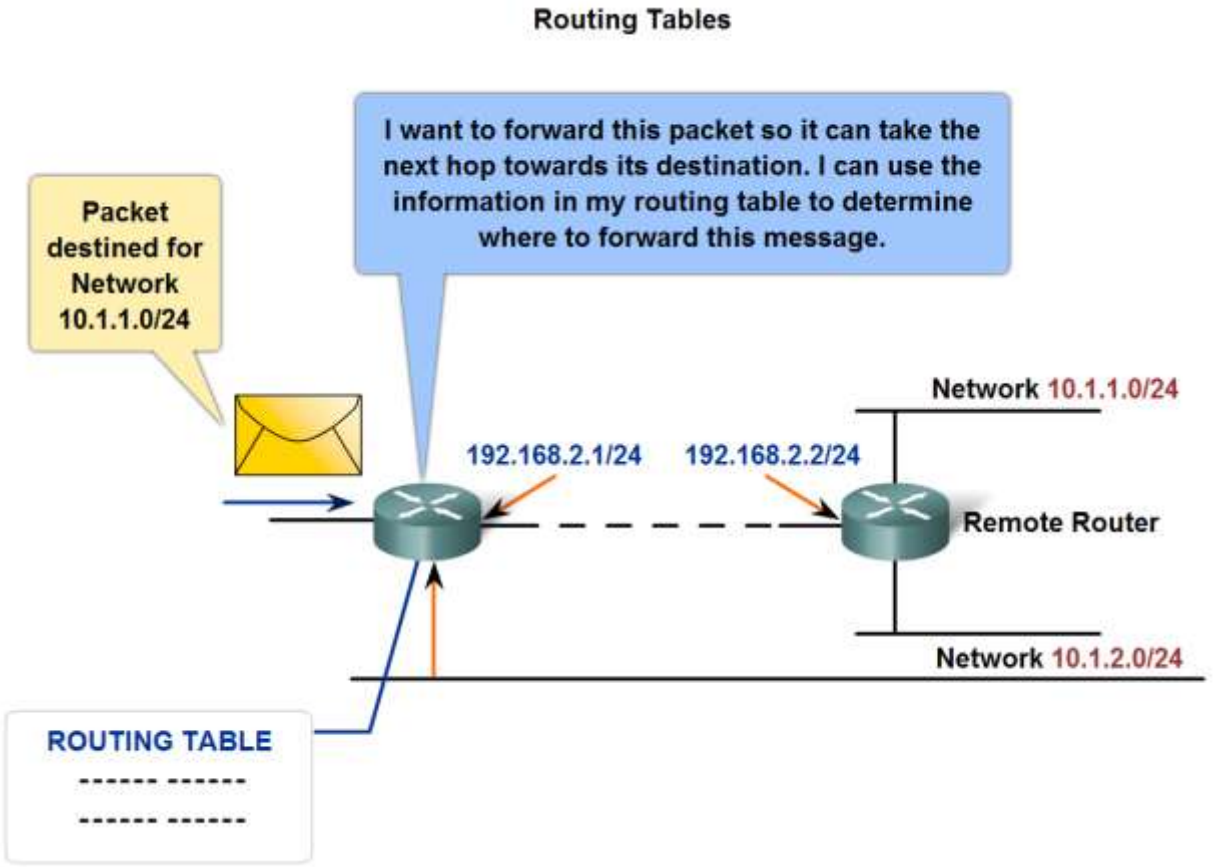
Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Describe the role of a gateway and the use of a simple route table in directing packets toward their ultimate destinations



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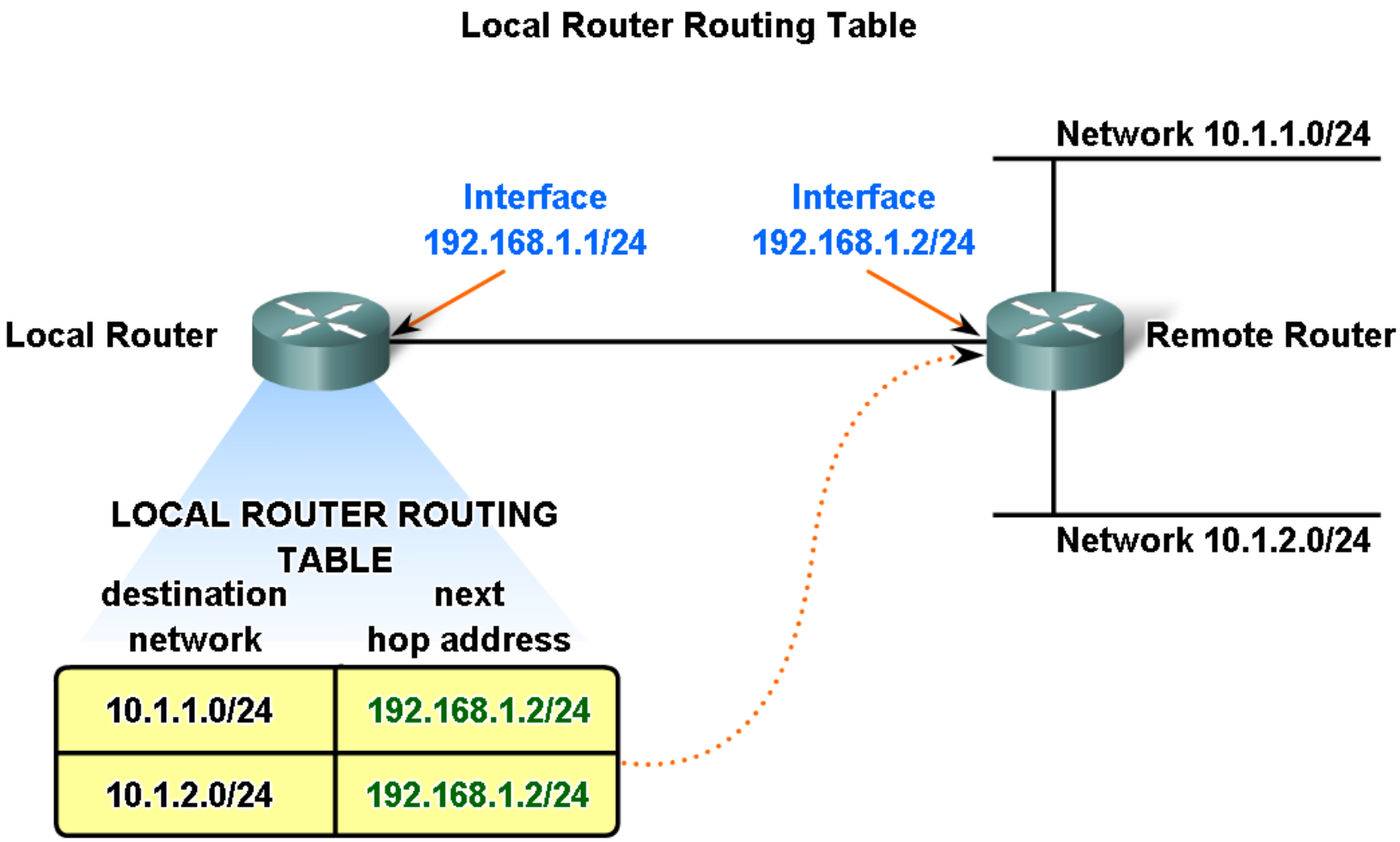
Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Define a route and its three key parts



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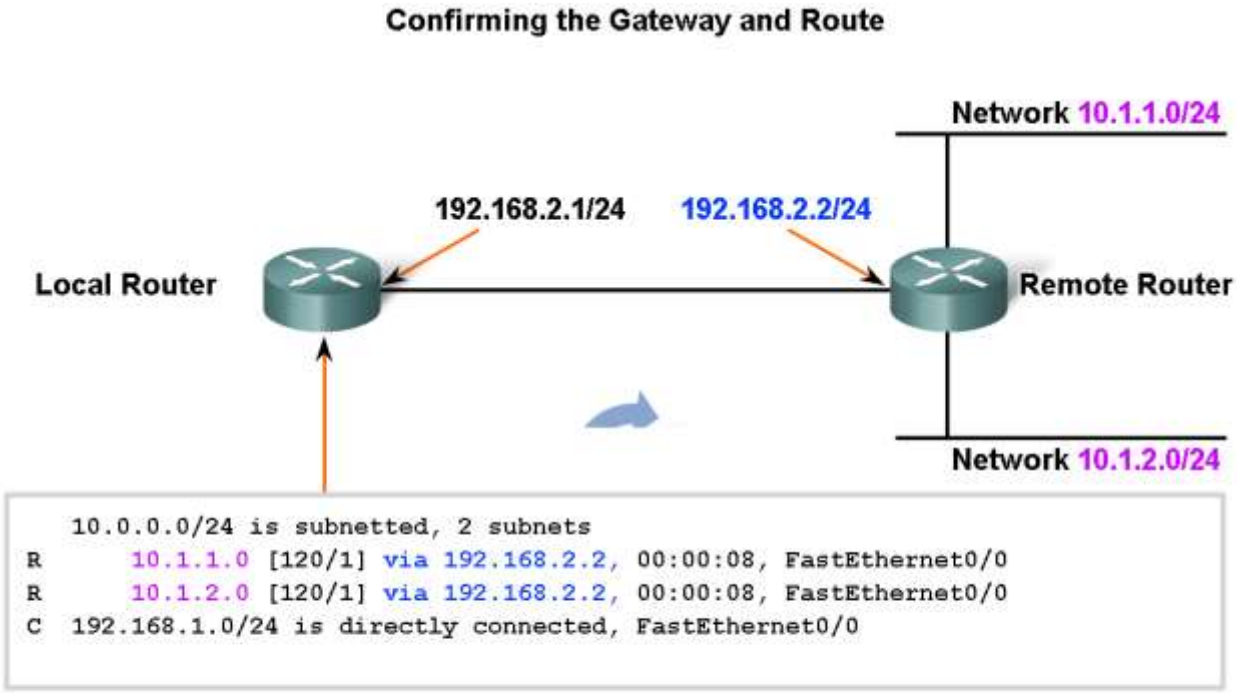
Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Describe the purpose and use of the destination network in a route



This is the routing table output of Local Router when the "show ip route" is issued.

The next hop for networks 10.1.1.0/24 and 10.1.2.0/24 from Local Router is 192.168.2.2.

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Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Describe the purpose and use of the next hop in a route

Routing Table Output with Next Hops

```
  10.0.0.0/24 is subnetted, 2 subnets
R    10.1.1.0 [120/1] via 192.168.2.2, 00:00:08, FastEthernet0/0
R    10.1.2.0 [120/1] via 192.168.2.2, 00:00:08, FastEthernet0/0
C 192.168.1.0/24 is directly connected, FastEthernet0/0
```

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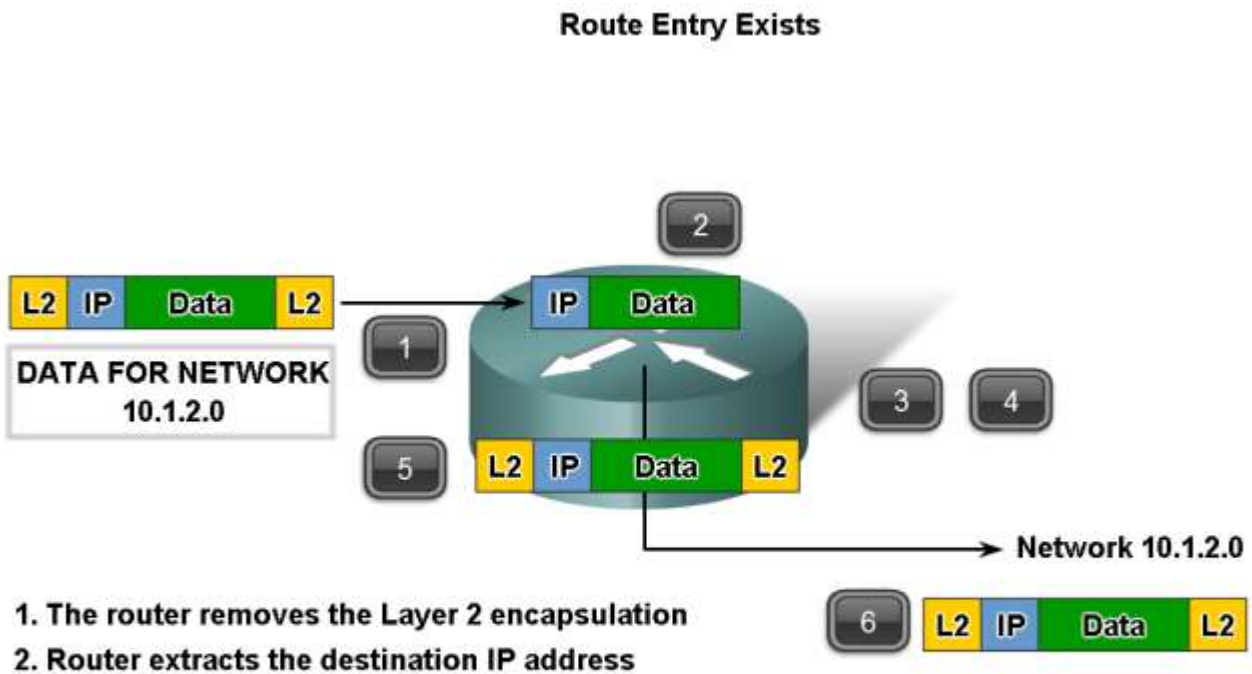
Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Trace the steps of several IP packets as they are routed through several gateways from devices on one sub network to devices on other sub networks



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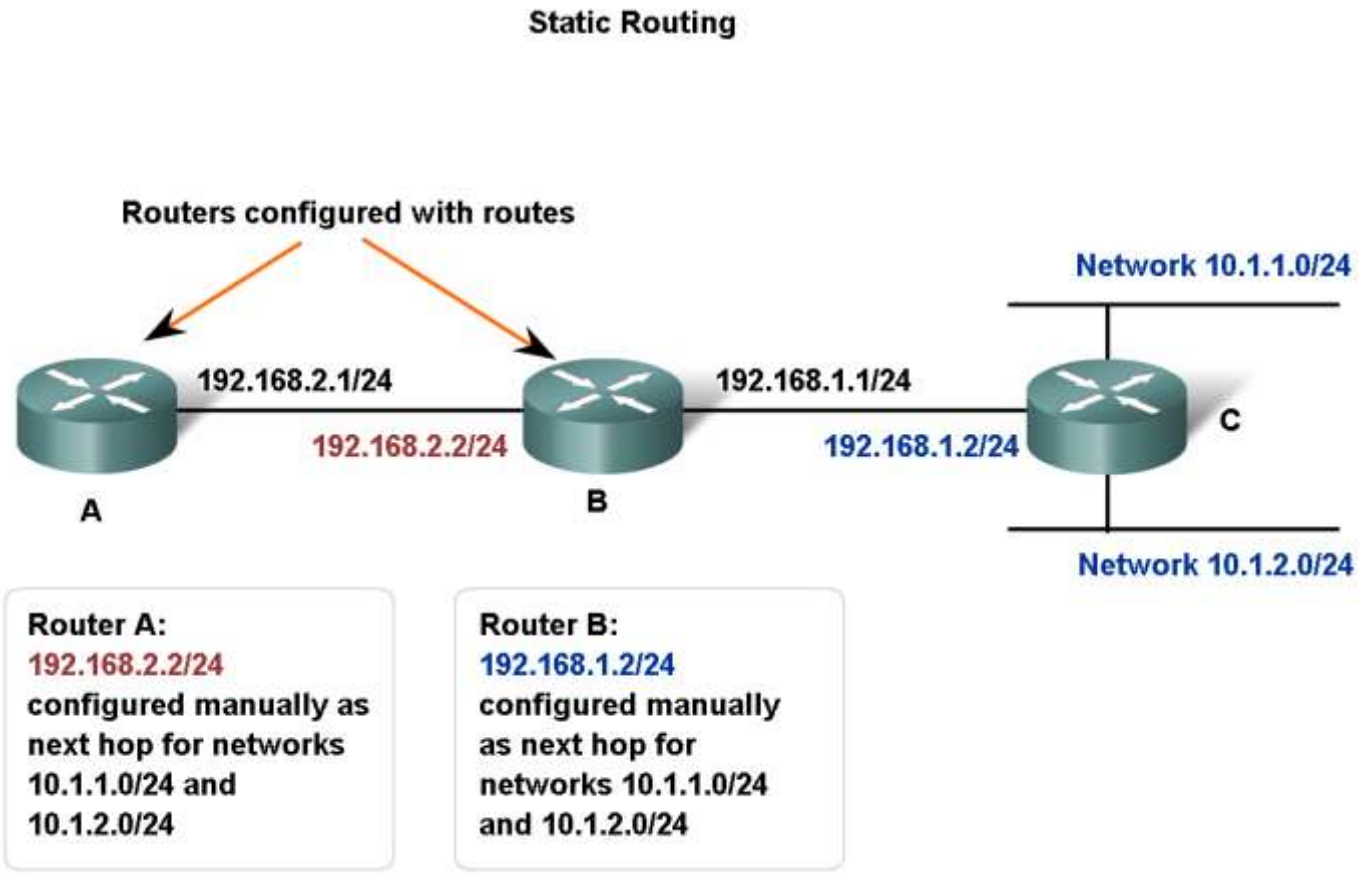
Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Describe the purpose of routing protocols and the need for both static and dynamic routes



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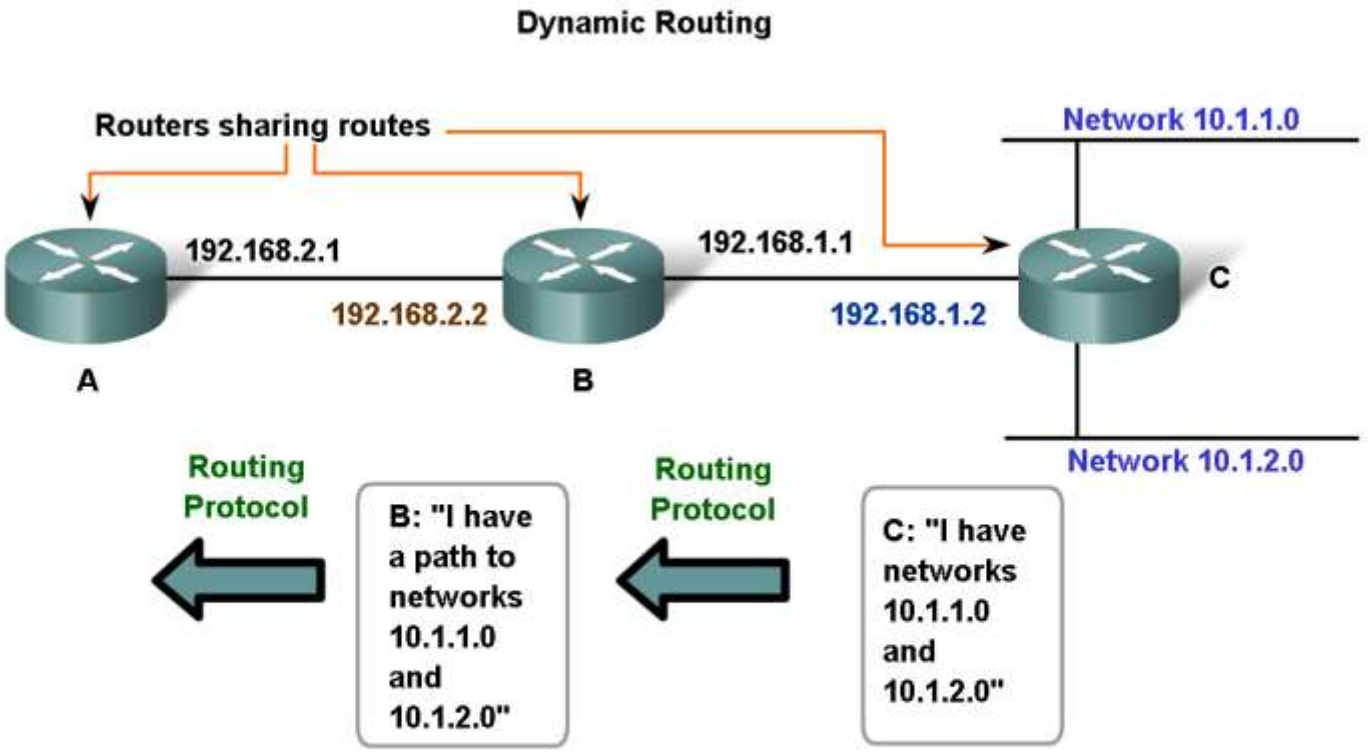
Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Explain how routes are manually configured to build routing table



Router B learns about Router C's networks dynamically.
Router B's next hop to 10.1.1.0 and 10.1.2.0 is 192.168.1.2 (Router C).
Router A learns about Router C's networks dynamically from Router B.
Router A's next hop to 10.1.1.0 and 10.1.2.0 is 192.168.2.2 (Router B).

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Fundamentals of Routes, Next Hop Addresses and Packet Forwarding

- Explain the role of routing protocols in building the routing table

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Summary

In this chapter, you learned to:

- Identify the role of the Network layer as it describes communication from one end device to another end device.
- Examine the most common Network layer protocol, Internet Protocol (IP), and its features for providing connectionless and best-effort service.
- Describe the principles used to guide the division, or grouping, of devices into networks.
- Explain the purpose of the hierarchical addressing of devices and how this allows communication between networks.
- Describe the fundamentals of routes, next-hop addresses, and packet forwarding to a destination network.

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