

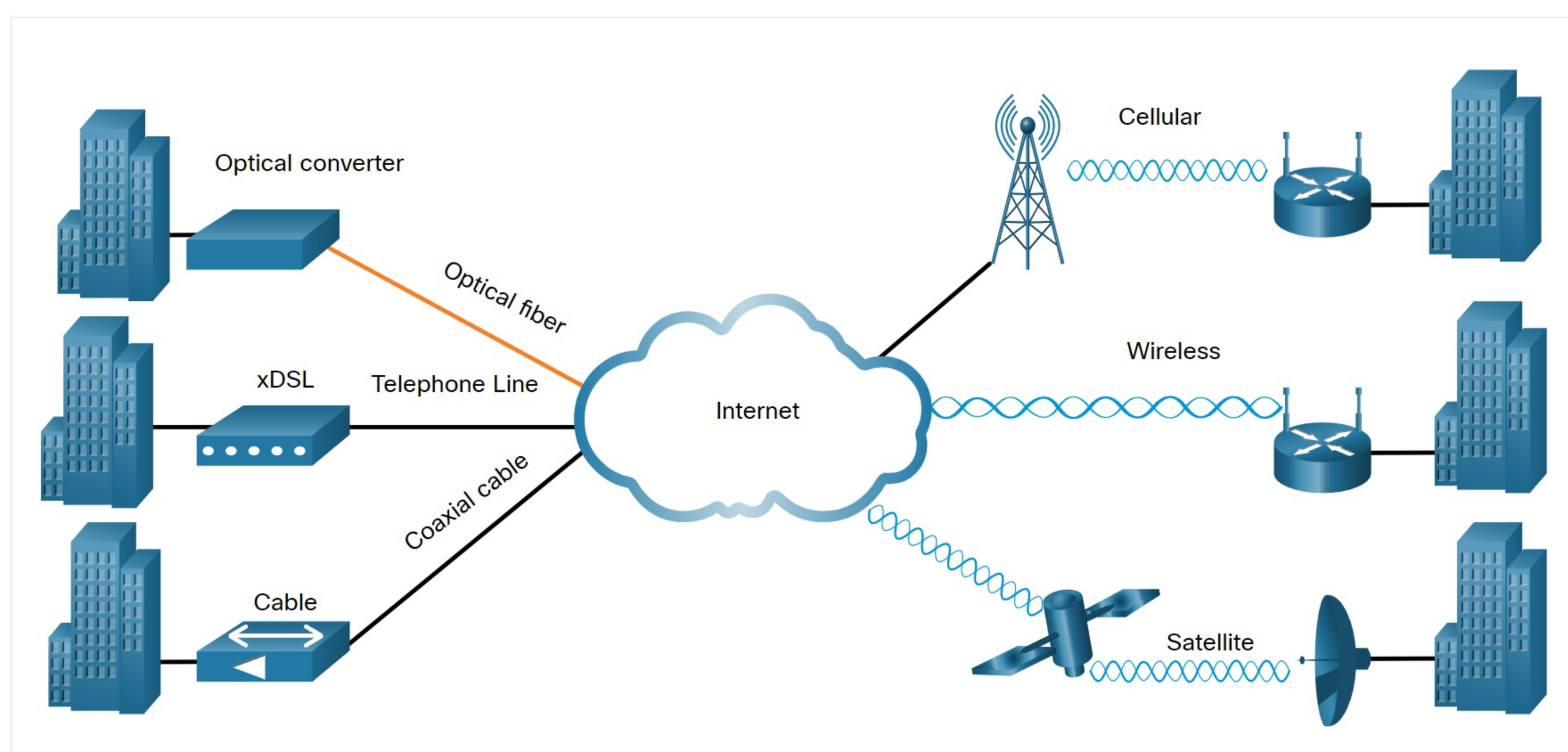
## Modern WAN Connectivity

### 7.4.1

## Modern WANs

Modern WANs have more connectivity options than traditional WANs. Enterprises now require faster and more flexible WAN connectivity options. Traditional WAN connectivity options have rapidly declined in use because they are either no longer available, too expensive, or have limited bandwidth.

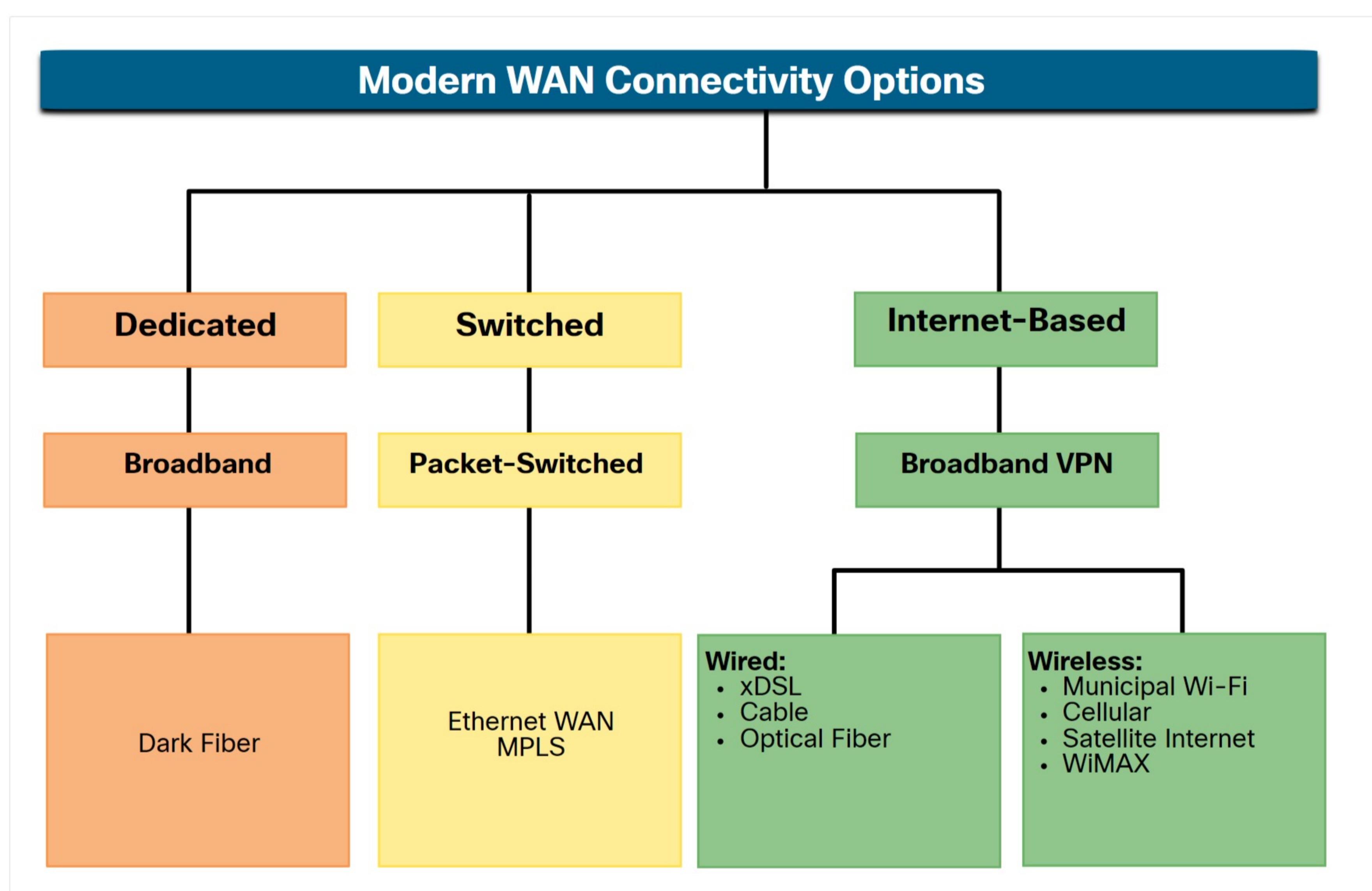
The figure displays the local loop connections most likely encountered today.



### 7.4.2

## Modern WAN Connectivity Options

New technologies are continually emerging. The figure summarizes the modern WAN connectivity options.



Click each button for a detailed description of the three major types of modern WAN connectivity options.

The diagram illustrates the concept of Dedicated Broadband. It features a central blue box labeled "Dedicated Broadband" at the top. Below this box, there are three smaller blue boxes arranged vertically, each containing a different type of broadband service: "Packet-Switched", "Internet-based Broadband", and "Fiber-optic". To the right of these boxes, a large blue box contains the text: "In the late 1990s, many telecommunication companies built optical fiber networks with enough fiber to satisfy projected next generation needs. However, optical technologies such as wavelength division multiplexing (WDM) were developed and dramatically increased the transmitting ability of a single strand of optical fiber. Consequently, many fiber-optic cable runs are not in use. Fiber-optic cable that is not in use, and therefore, 'un-lit' (i.e. dark) is referred to as dark fiber." Below this text, another large blue box contains the text: "Fiber can be installed independently by an organization to connect remote locations directly together. However, dark fiber could also be leased or purchased from a supplier. Leasing dark fiber is typically more expensive than any other WAN option available today. However, it provides the greatest flexibility, control, speed, and security."

**Note:** There are several WAN access connection options that the enterprise edge can use to connect over the local loop to the provider. These WAN access options differ in technology, bandwidth, and cost. Each has distinct advantages and disadvantages. Familiarity with these technologies is an important part of network design.

### 7.4.3

## Ethernet WAN

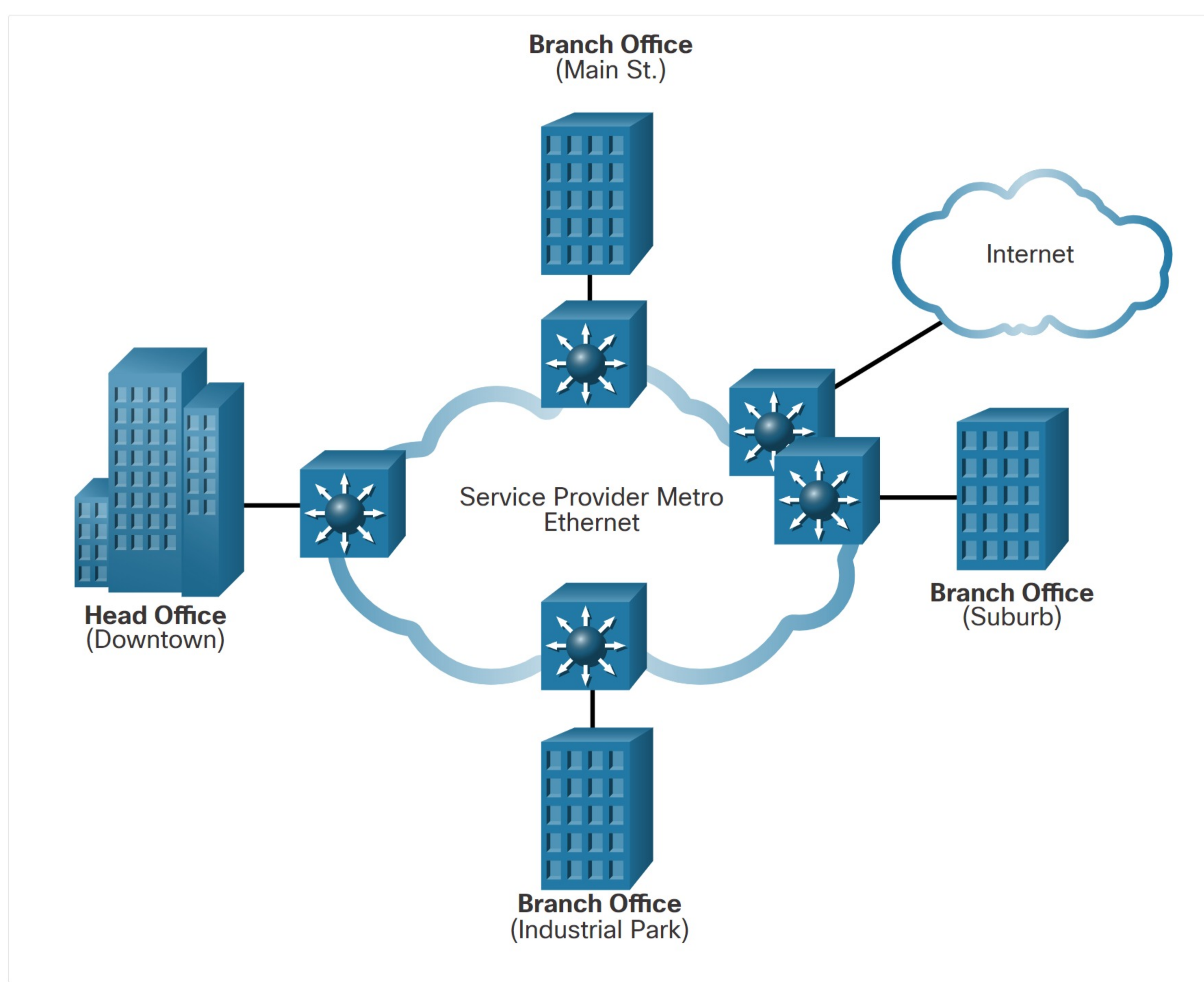
Ethernet was originally developed as a LAN access technology and was not suitable as a WAN access technology due primarily to the limited distance provided by copper media.

However, newer Ethernet standards using fiber-optic cables have made Ethernet a reasonable WAN access option. For instance, the IEEE 1000BASE-LX standard supports fiber-optic cable lengths of 5 km, while the IEEE 1000BASE-ZX standard supports cable lengths up to 70 km.

Service providers now offer Ethernet WAN service using fiber-optic cabling. The Ethernet WAN service can go by many names, including the following:

- Metropolitan Ethernet (Metro E)
- Ethernet over MPLS (EoMPLS)
- Virtual Private LAN Service (VPLS)

The figure displays a simple Metro Ethernet topology example.



The following are several benefits to an Ethernet WAN:

- **Reduced expenses and administration** – Ethernet WAN provides a switched, high-bandwidth Layer 2 network capable of managing data, voice, and video all on the same infrastructure. This increases bandwidth and eliminates expensive conversions to other WAN technologies. The technology enables businesses to inexpensively connect numerous sites in a metropolitan area, to each other, and to the Internet.
- **Easy integration with existing networks** – Ethernet WAN connects easily to existing Ethernet LANs, reducing installation costs and time.
- **Enhanced business productivity** – Ethernet WAN enables businesses to take advantage of productivity-enhancing IP applications that are difficult to implement on TDM or Frame Relay networks, such as hosted IP communications, VoIP and streaming and broadcast video.

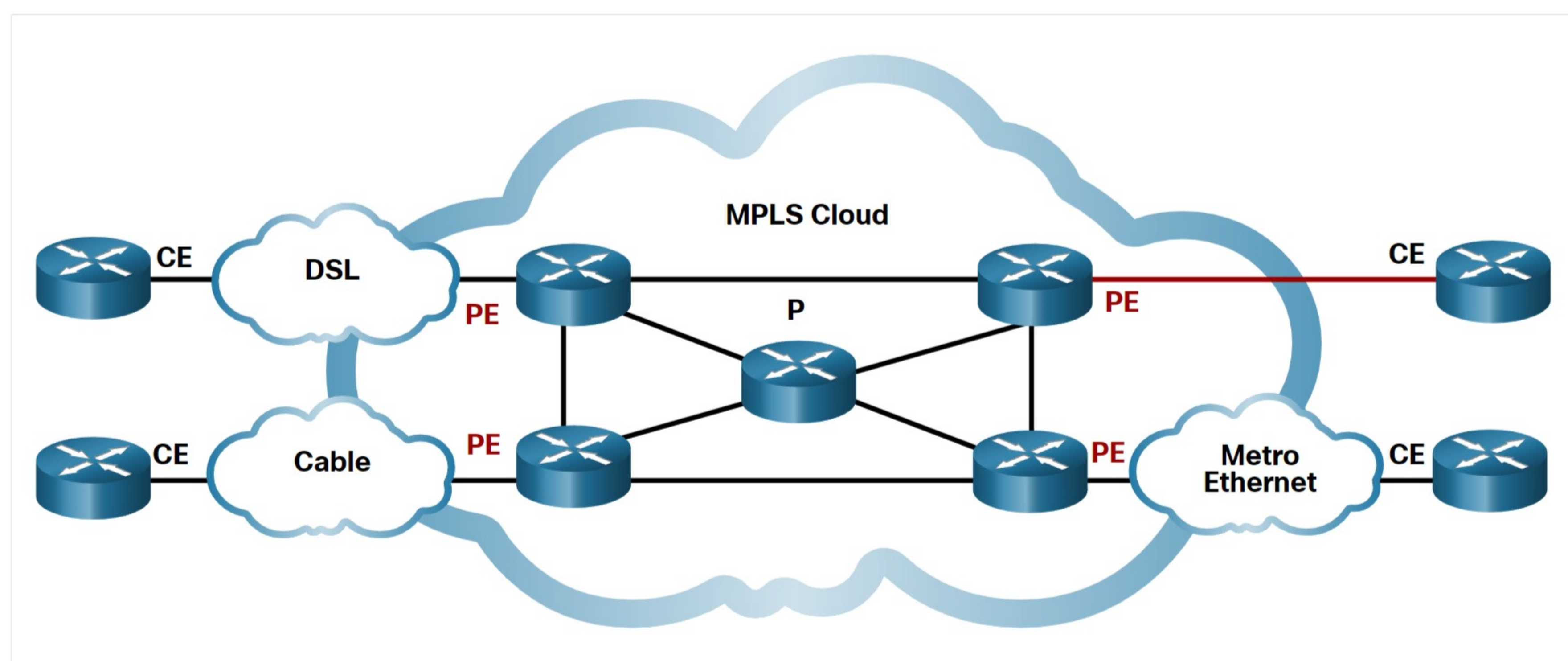
**Note:** Ethernet WANs have gained in popularity and are now commonly being used to replace the traditional serial point-to-point, Frame Relay and ATM WAN links.

#### 7.4.4

## MPLS

Multiprotocol Label Switching (MPLS) is a high-performance service provider WAN routing technology to interconnect clients without regard to access method or payload. MPLS supports a variety of client access methods (e.g., Ethernet, DSL, Cable, Frame Relay). MPLS can encapsulate all types of protocols including IPv4 and IPv6 traffic.

Refer to the sample topology of a simple MPLS enabled network.



An MPLS router can be a customer edge (CE) router, a provider edge (PE) router, or an internal provider (P) router. Notice that MPLS supports a variety of client access connections.

MPLS routers are label switched routers (LSRs). This means that they attach labels to packets that are then used by other MPLS routers to forward traffic. When traffic is leaving the CE, the MPLS PE router adds a short fixed-length label between the frame header and packet header. MPLS P routers use the label to determine the next hop of the packet. The label is removed by the egress PE router when the packet leaves the MPLS network.

MPLS also provides services for QoS support, traffic engineering, redundancy, and VPNs.

### 7.4.5

## Check Your Understanding - Modern WAN Connectivity

 Check your understanding of modern WAN connectivity options by choosing the BEST answer to the following questions.

1. Which WAN connectivity option is based on Ethernet LAN technology?
- ☐ ATM
- ☐ Cable
- ☐ DSL
- ☒ Metro Ethernet
- ☐ MPLS
2. Which is a service provider WAN solution that uses labels to direct the flow of packets through the provider network?
- ☐ ATM
- ☐ Cable
- ☐ DSL
- ☐ Metro Ethernet
- ☒ MPLS

Check

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Reset