Chapter 6: Broadband Solutions

Connecting Networks

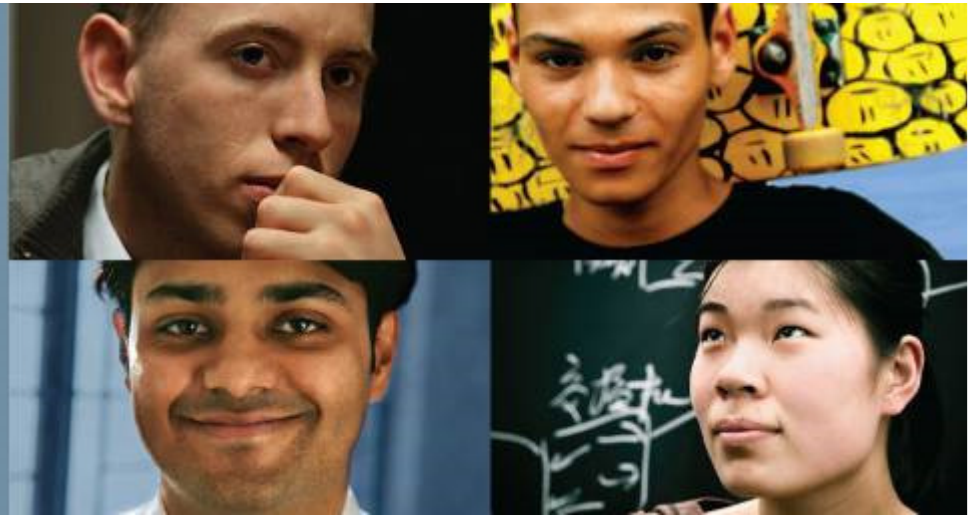
Cisco | Networking Academy®
Mind Wide Open™

Chapter 6

Chapter 6: Objectives

- Determine how to select broadband solutions to support remote connectivity in a small-to-medium-sized business network.
- Explain the benefits of teleworking solutions.
- Describe the business requirements of teleworking.
- Describe a cable system and cable broadband access.
- Describe a DSL system and DSL broadband access.
- Describe broadband wireless options.
- Compare broadband solutions.
- Configure and verify a basic Point-to-Point Protocol (PPP) over Ethernet connection on a client router.

6.1 Teleworking



Cisco | Networking Academy®
Mind Wide Open™

Introduction to Teleworking

- Teleworking is conducting work by connecting to a workplace from a remote location, using telecommunications.
- Efficient teleworking uses broadband Internet connections, a Virtual Private Network (VPN), VoIP, and videoconferencing.

Employer Benefits of Teleworking

- **Improved employee productivity** – Teleworking staff is between 8 and 40% more productive than office working staff.
- **Reduced costs and expenses** – Savings in real estate cost equaling anywhere from 10 to 80%.
- **Easier recruitment and retention** – Being able to offer flexibility can reduce staff turnover by up to 20%.
- **Reduced absenteeism**
- **Improved morale**
- **Improved corporate citizenship**
- **Improved customer service**

Benefits of Teleworking

Government Benefits of Teleworking

- Helps build a sustainable economy
- Helps reduce contemporary problems, such as traffic
- Increases productivity
- Alleviates symptoms of the digital divide
- Reduces costs and expenses
- Improves flexibility
- Attracts growth and development

Individual Benefits of Teleworking

- **Productivity** – Over 70% of teleworkers claim they are significantly more productive.
- **Time savings** – Less time commuting.
- **Cost savings** – Saving money on lunch, clothing, commuting.
- **Better health** – Less exposure to ‘sick' buildings, traffic accidents, stress.
- **Home and family** – Able to spend more time with the family.
- **Taking control** – The teleworker can take control over when and where work is performed, and also over the myriad of other details of modern life.
- **Flexibility** – Telework can make it easier to have a more flexible schedule.

Community Benefits of Teleworking

- **Helps build a sustainable economy** – Telework is a critical component to building a truly sustainable local economy.
- **Increases value of real estate** – Less traffic, less smog, and lower demands for urban office space means existing green spaces and heritage buildings can be preserved.
- **Helps reduce contemporary problems, such as traffic, infrastructure needs, urban drift.**
- **Increases productivity.**
- **Alleviates symptoms of the digital divide.**
- **Reduces costs and expenses.**
- **Attracts growth and development.**

Benefits of Teleworking

Detriments to Telework

For the organization:

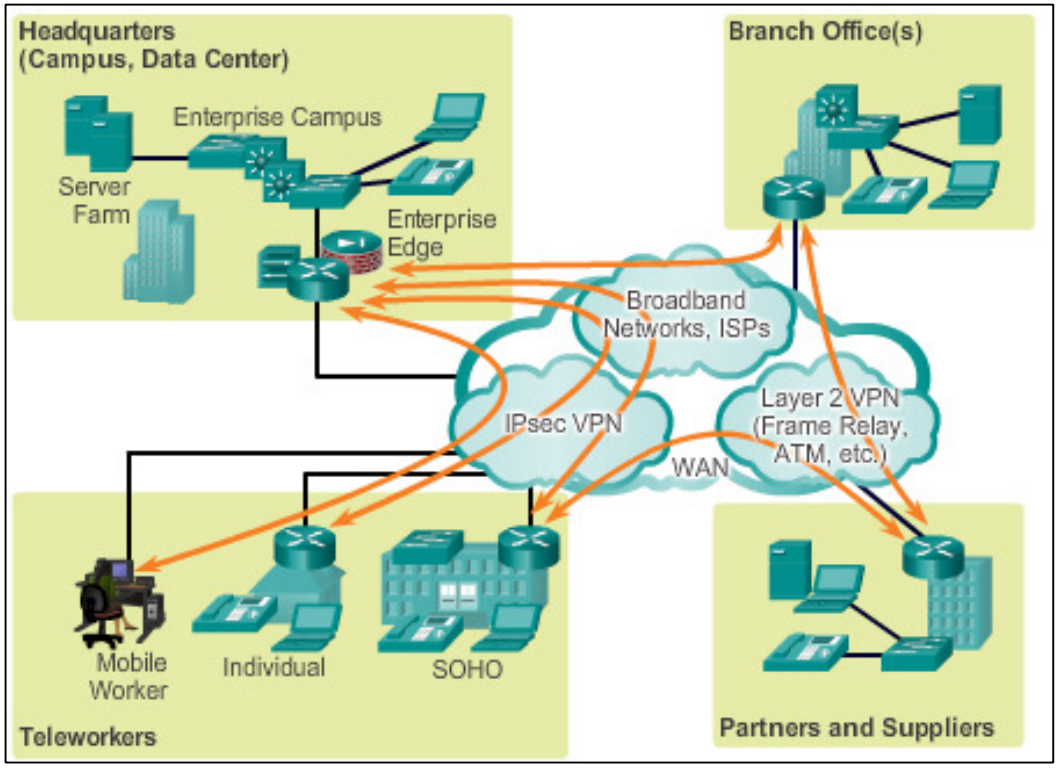
- More difficult to track employee progress
- Necessary to implement a new management style

For the individual:

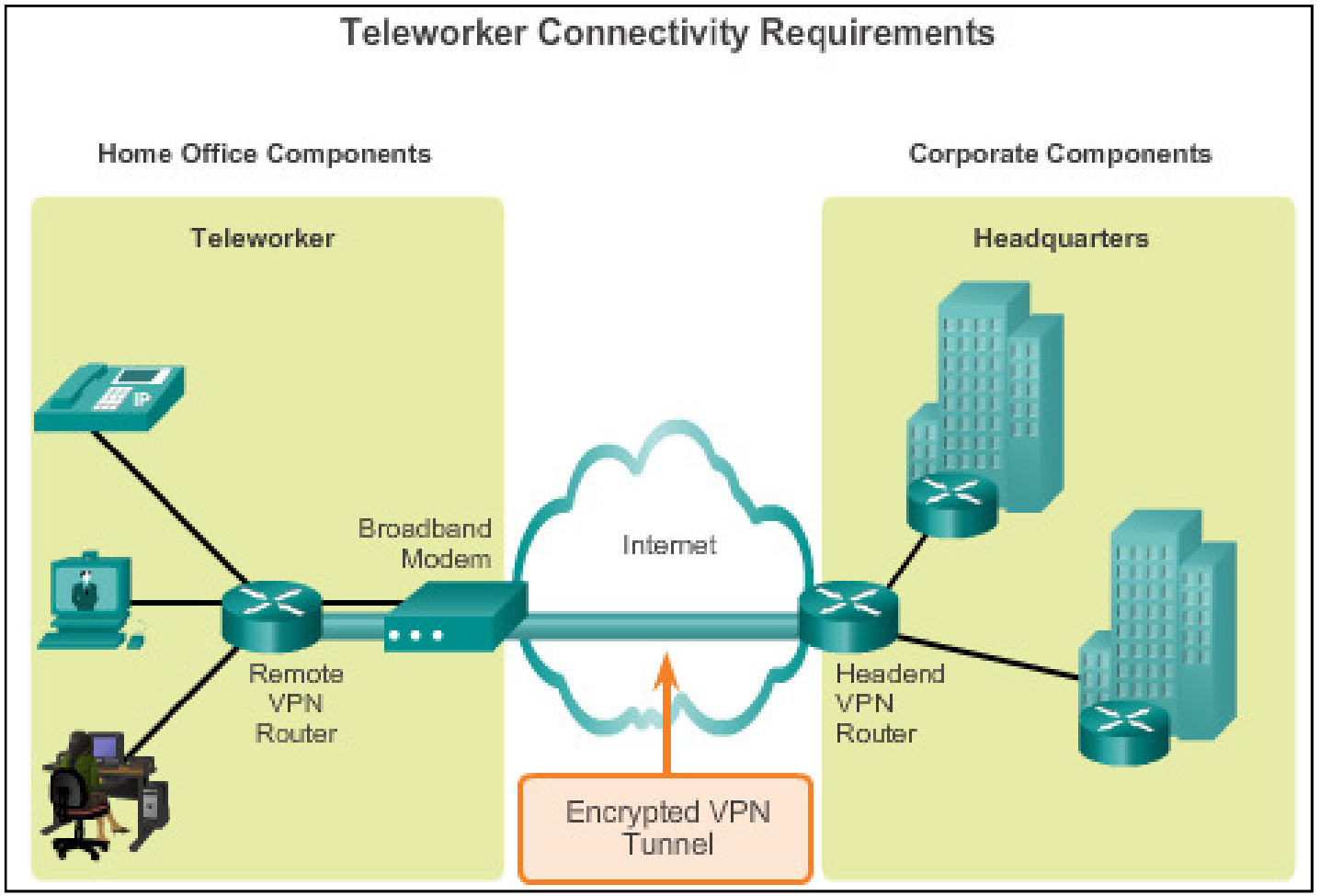
- Feeling of isolation
- Slower connections
- Distractions

Teleworker Solution

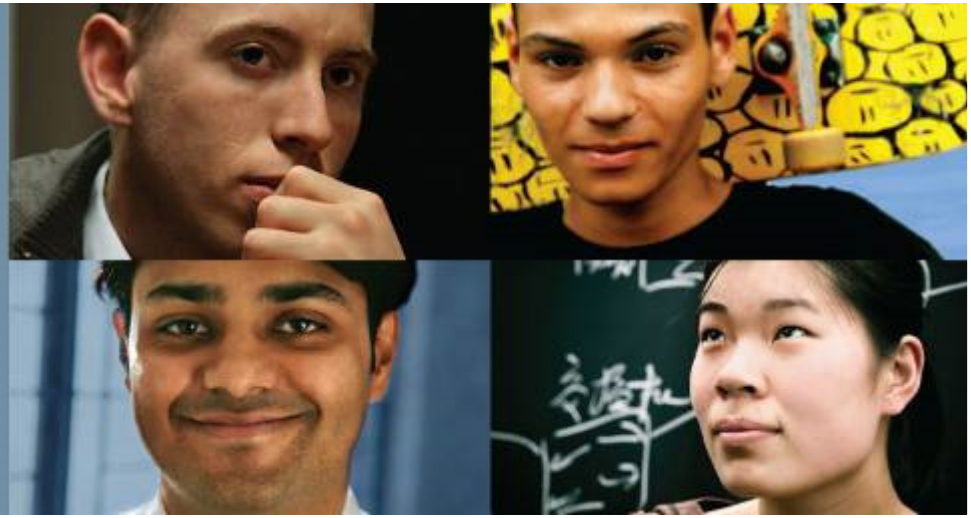
- Broadband connections
- IPsec VPNs
- Traditional private WAN Layer 2 technologies



Teleworker Connectivity Requirements

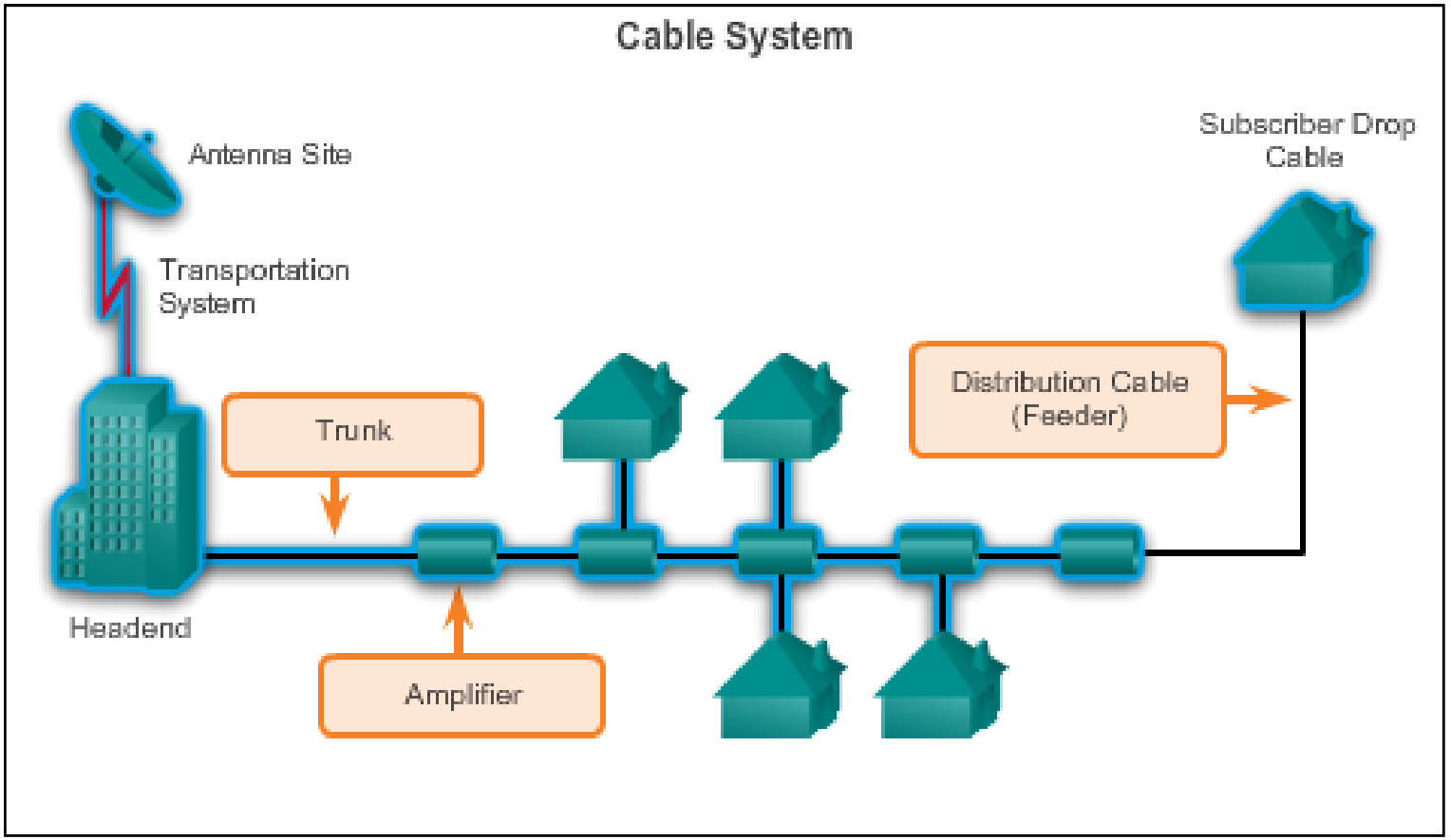


6.2 Comparing Broadband Solutions

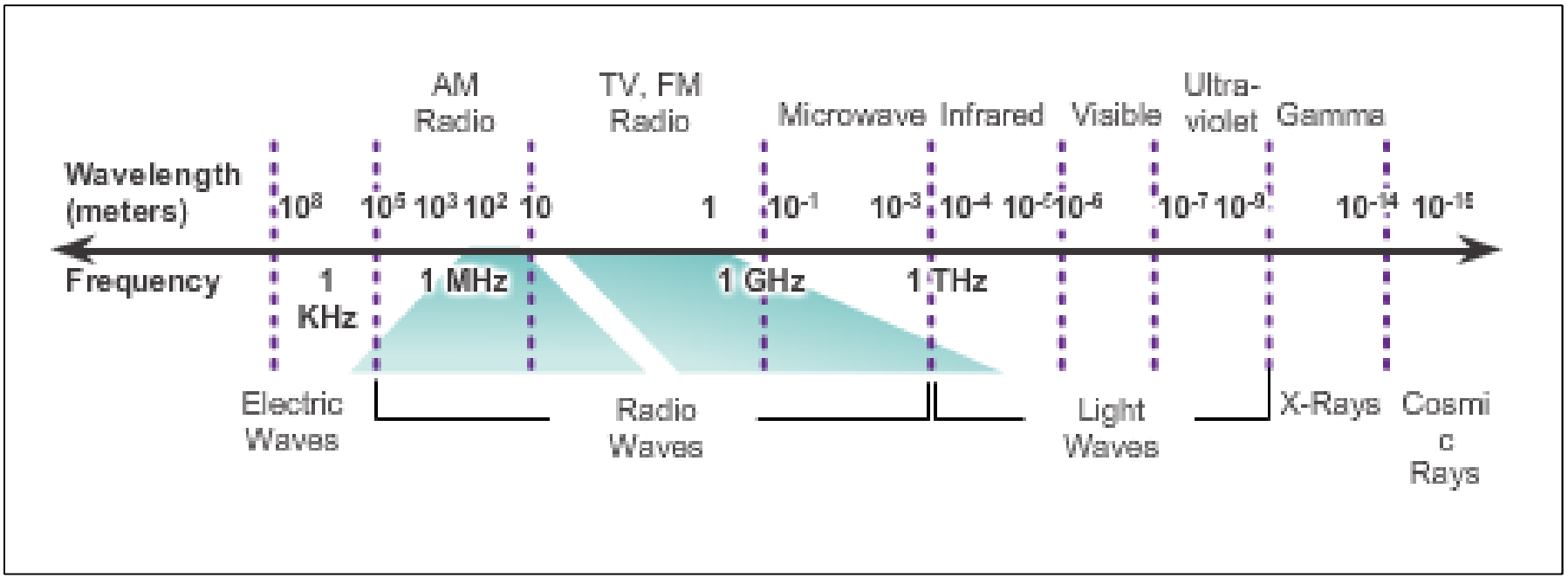


Cisco Networking Academy®
Mind Wide Open™

What is a Cable System?



Cable and the Electromagnetic Spectrum



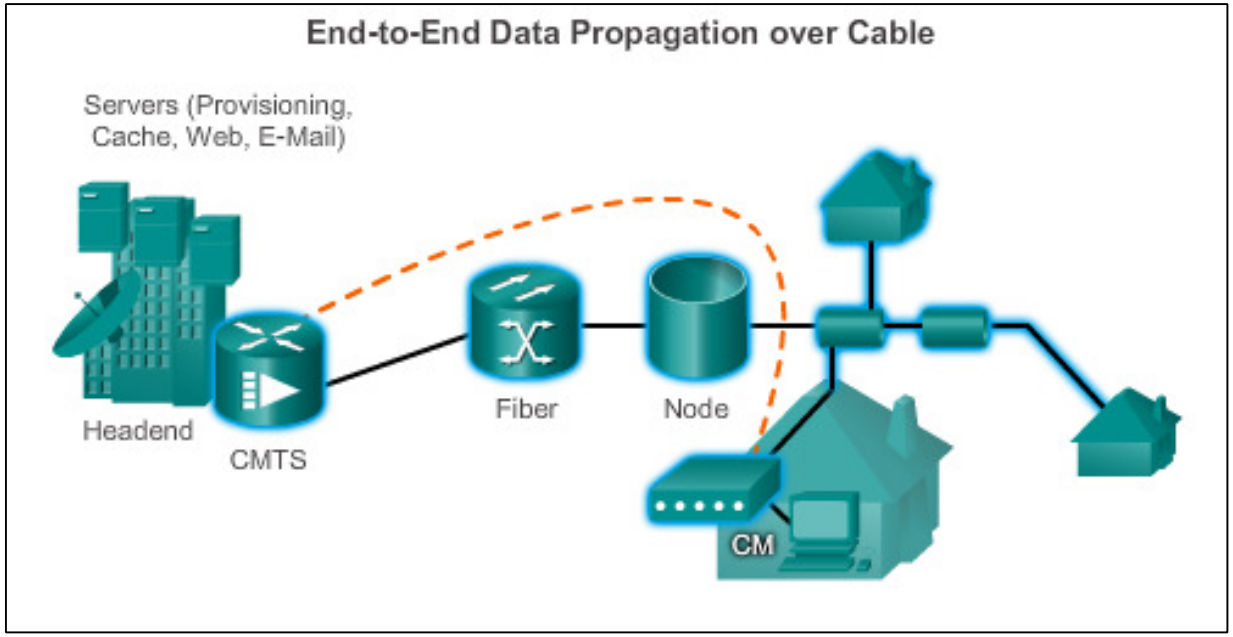
Cable
DOCSIS

- Data-over-Cable Service Interface Specification (DOCSIS) is an international standard developed by CableLabs.
- Tests and certifies cable equipment vendor devices.
- Defines the communications and operation support interface requirements for a data-over-cable system.
- Specifies the OSI Layer 1 and Layer 2 requirements.

Cable Components

Two types of equipment required to send digital modem signals upstream and downstream on a cable system:

- Cable Modem Termination System (CMTS) at the headend of the cable operator.
- Cable modem (CM) on the subscriber end.



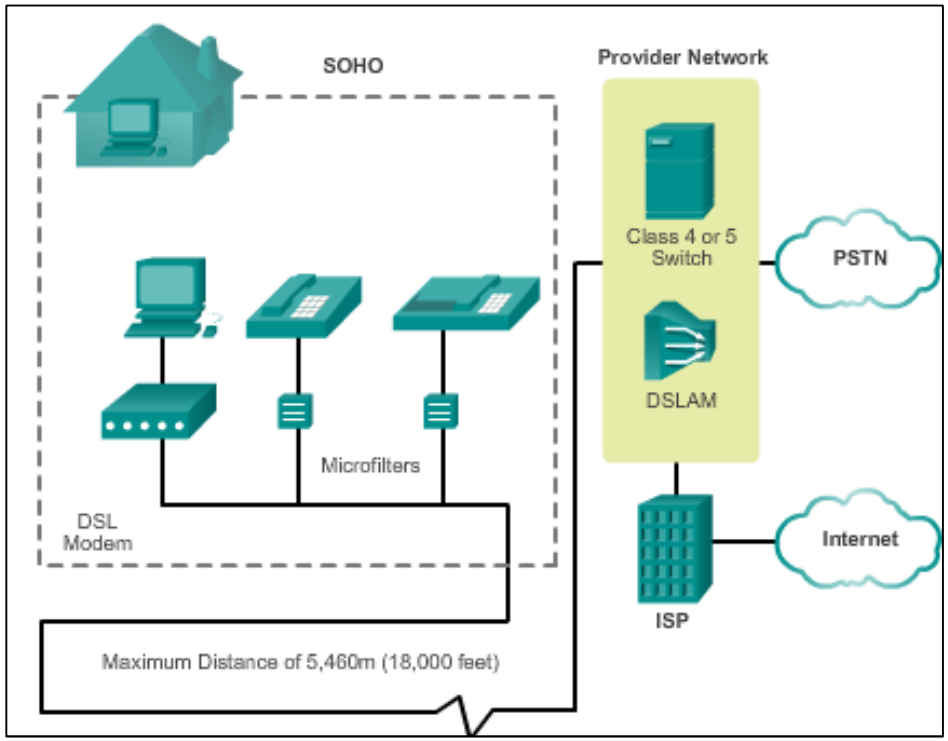
DSL

- DSL provides high-speed connections over installed copper wire system.
- Two basic types of DSL technologies are asymmetric (ADSL) and symmetric (SDSL).
- ADSL uses a frequency range from approximately 20 kHz to 1 MHz.
- ADSL provides higher downstream bandwidth to the user than upload bandwidth.
- SDSL provides the same capacity in both directions.
- Local loop must be less than approximately 3.39 mi. (5.46 km) for ADSL.

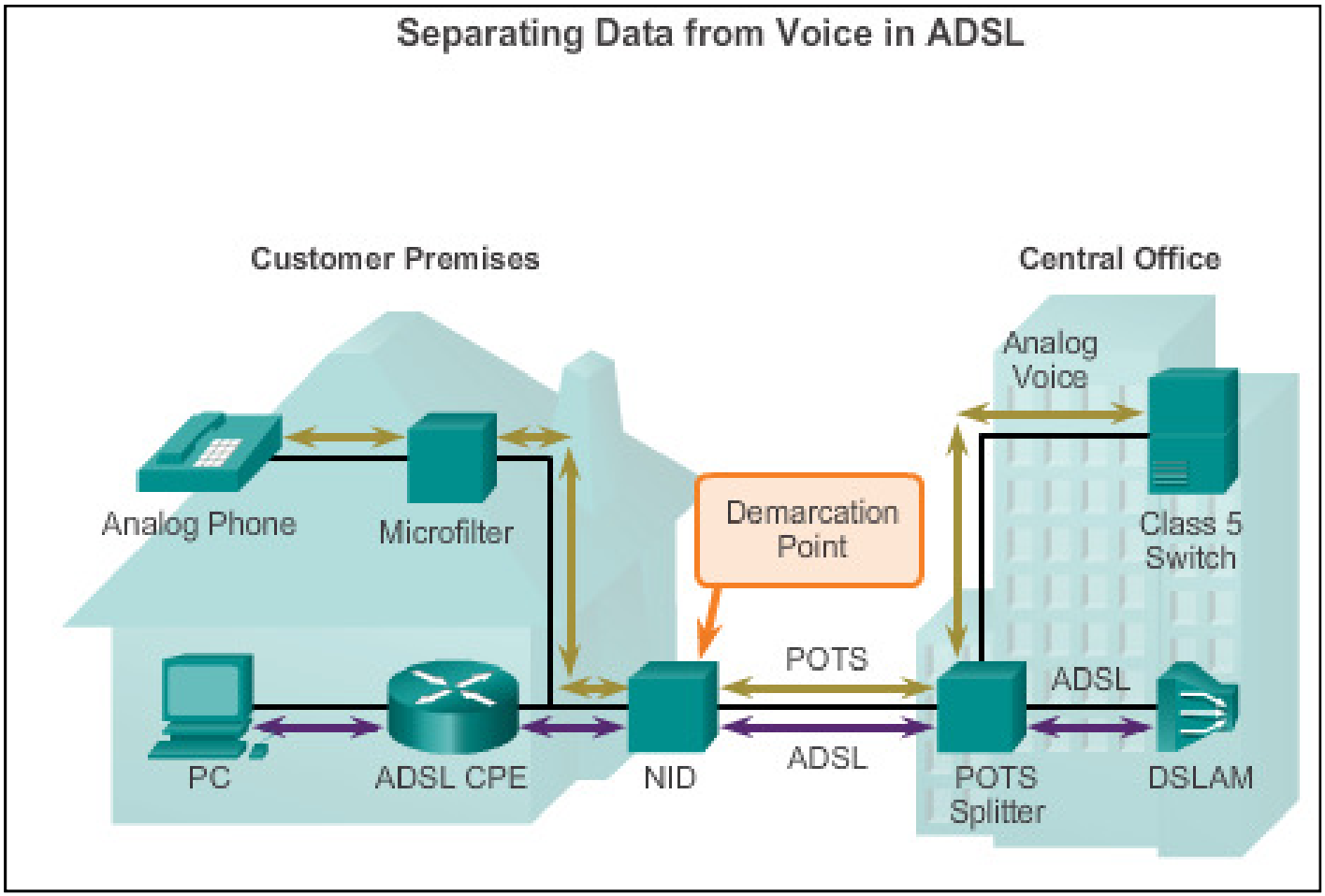
DSL Connections

Two key components required to provide a DSL connection:

- **Transceiver** – Connects the computer of the teleworker to the DSL.
- **DSL access multiplexer** (DSLAM) – Located at the carrier's central office, it combines individual DSL connections from users into one high-capacity link to an ISP.



Separating Voice and Data in ADSL



Broadband Wireless Technology Types

- Municipal Wi-Fi (Mesh)
- Worldwide Interoperability for Microwave Access (WiMAX)
  - A single WiMAX tower can provide coverage to an area as large as 3,000 square miles.
  - A WiMAX receiver similar in size and shape to a PCMCIA card, or built into a laptop or other wireless device.

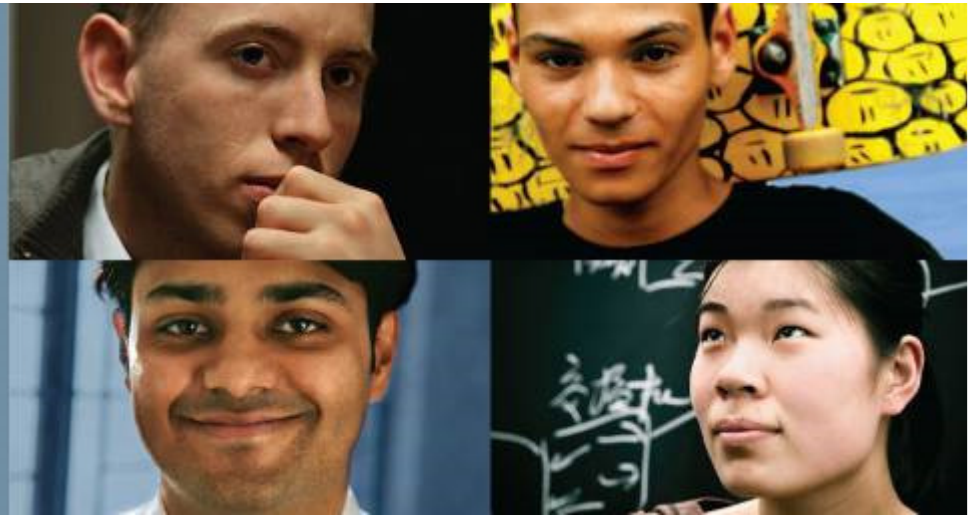
Broadband Wireless Technology Types

- Cellular/mobile implementations wireless Internet:
  - 3G/4G Wireless: Third generation and fourth generation wireless.
  - Long-Term Evolution (LTE): A newer and faster technology considered to be part of the 4G technology.
- Satellite Implementations
  - one-way multicast
  - one-way terrestrial return
  - two-way satellite Internet

Comparing Broadband Solutions

- **Cable** – Bandwidth is shared by many users.
- **DSL** – Limited bandwidth that is distance-sensitive.
- **Fiber-to-the-Home** – Requires fiber-access network overlay.
- **Cellular/Mobile** – Coverage is often an issue, bandwidth relatively limited.
- **Wi-Fi Mesh** – Many municipalities do not have a mesh network deployed.
- **WiMAX** – Bit rate is limited to 2 Mb/s per subscriber; cell size is 1.25 miles (1 to 2 km.)
- **Satellite** – Expensive; limited capacity per subscriber.

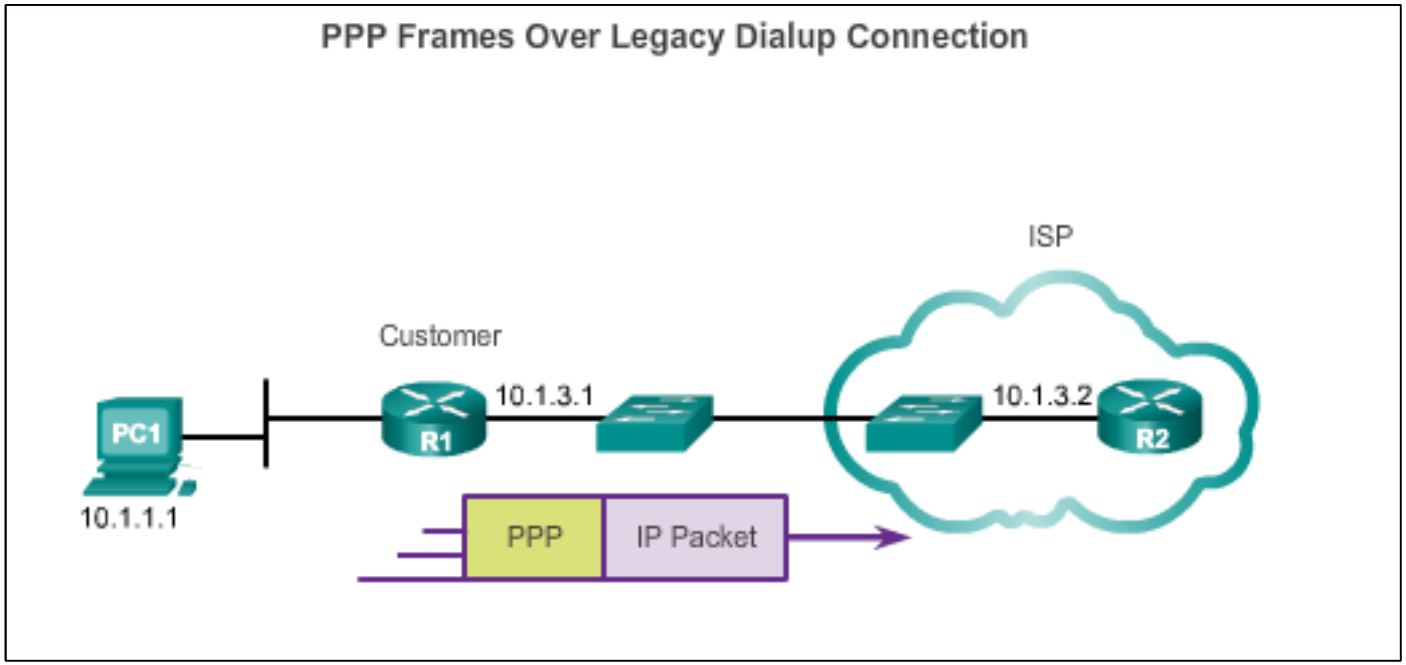
6.3 Configuring xDSL



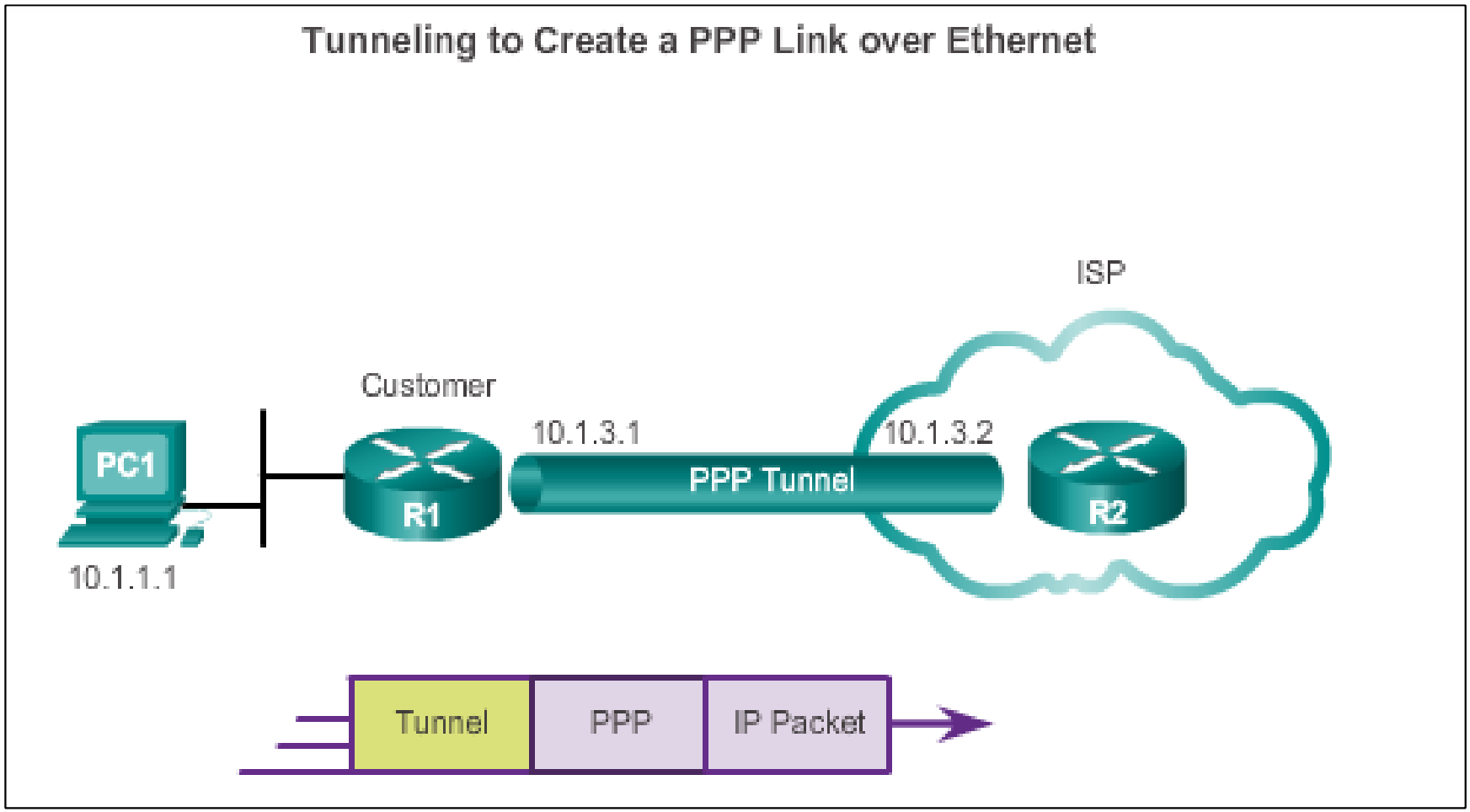
Cisco | Networking Academy®
Mind Wide Open™

PPPoE Motivation

- Most commonly used data link layer protocol by ISPs is PPP.
- The PPP over Ethernet (PPPoE) protocol allows the transmission of PPP frames encapsulated inside Ethernet frames.

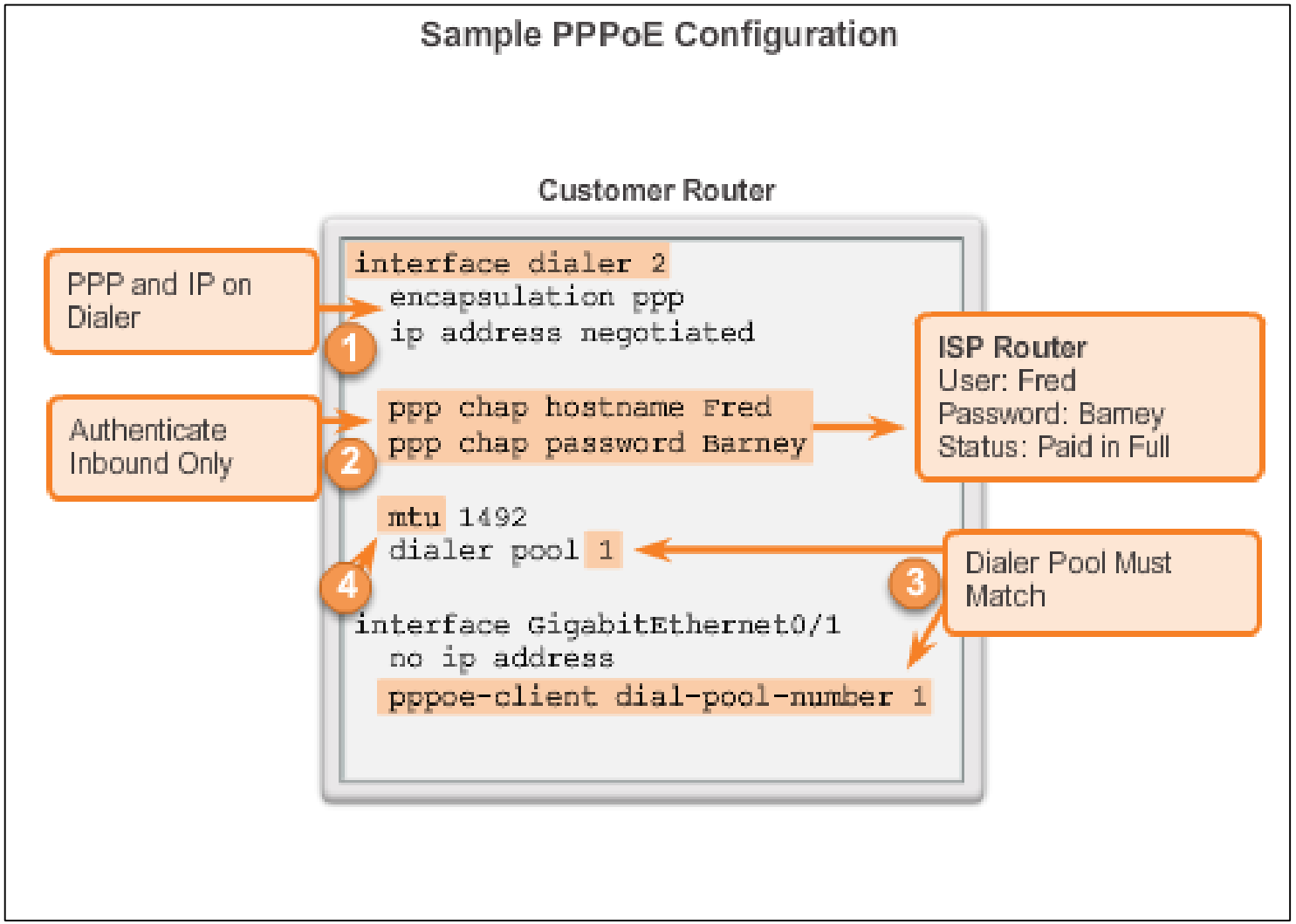


PPPoE Concepts

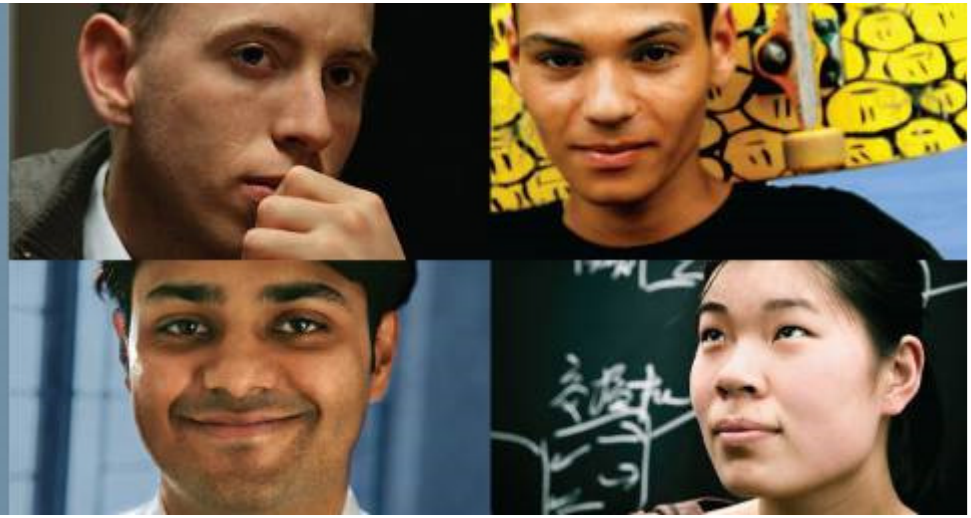


Configuring PPP0E

PPPoE Configuration



6.4 Summary



Cisco | Networking Academy®
Mind Wide Open™

Chapter 6: Summary

This chapter:

- Explored the various broadband solutions used by telecommuters and branch office workers.
- Outlined the features and basic infrastructure behind each broadband technology, which enables a network manager to make an informed selection.
- Identified DSL, cable, and broadband wireless options as the various broadband solutions.
- Described basic DSL configuration.